**Tennessee Vision for STEM Education**

- **Science** seeks to explain the complexity of the natural world and uses this understanding to make valid and useful predictions.

- **Technology** utilizes innovative tools, materials, and processes to solve problems or satisfy the needs of individuals, society, and the environment.

- **Engineering** creatively applies scientific principles to analyze events, design processes, develop materials, and construct objects that benefit society.

- **Science, Engineering** and **Technology** use **Mathematics** to explore questions about the natural and human-made worlds.

Adapted with permission from the Massachusetts Science and Technology / Engineering Curriculum Frameworks.

**Revised Standards Approval Dates:** K-8 & 9-12 Jan. 25, 2008

**Implementation:** School Year 2009-2010

NOTE: This document is a “work in progress” and will undergo subsequent revisions as needed.
# User’s Guide to the Tennessee Mathematics Curriculum Framework Index

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Introduction

Welcome to the User’s Guide designed to assist in the implementation of the 2007 version of the Tennessee Mathematics Curriculum Framework. Approximately every six years the Department of Education is mandated by the Tennessee State Board of Education's Rules, Regulations, and Minimum Standards to reassess the state’s curriculum standards. The 2008 revised mathematics standards resulted from the efforts of committees comprising mathematics educators from across the state. The new standards are:

- Focused on major mathematics themes and their contextual applications
- Organized and consistent across the grade bands
- Stated clearly and concisely
- Increasingly complex across grade bands K-12
- Aligned with both the National Council of Teachers of Mathematics Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics and the Principals and Standards for School Mathematics, American Diploma Project Benchmarks, National Association for Educational Progress standards, and ACT Standards.
- Easier to implement than previous versions

Overview of the Mathematics Curriculum

Framework Revision Process

Approved Mathematics Framework K - 12

High School Mathematics Redesign

Changes

1. Effective with the ninth grade class entering high school during school year 2009-2010, all students will pursue a focused program of study that includes four credits in mathematics. The four credits are to include Algebra I and II, Geometry or its equivalent, and another mathematics course beyond Algebra I. Students must be enrolled in a mathematics course each school year. A Bridge Mathematics course is designed for students who have not scored a 19 or higher on the ACT by the beginning of the senior year.

2. Students with qualifying disabilities in math, as documented in the individualized education program, shall be required to complete a minimal sequence of Algebra I and Geometry (or its equivalent). The required number of credits in mathematics may be earned with modifications such as, but not limited to, increased time, appropriate methodologies, and accommodations as determined by the IEP team.

Rationale for High School Mathematics Redesign

Research points out that unlike their counterparts in other countries, a significant number of American children display little or no mastery of mathematics applications. National tests including PISA and NAEP, international assessments (TIMSS, http://nces.ed.gov/timss/), and reports such as the Glenn Commission, urge that the United States carefully redesign high school science and mathematics programs. Reform efforts are necessary to ensure that our educational system prepares adequate numbers of scientists, engineers, and mathematicians to sustain the growth of our economy.
Implications for Mathematics Teaching

The teacher is the most important link in connecting our students to higher levels of accomplishment and learning. If Dr. William Sanders, developer of TVAAS (Tennessee Value Added Assessment System), tells us anything, it is the inexorableness of teacher-effect. He lists it as the single-most important factor in student achievement: more than socio-economics, budgets, parents, and facilities. The teacher is the most important asset that any school system has to offer.

The new Tennessee Mathematics Standards will require more coverage and depth than the previous standards, and will therefore require more teacher-knowledge and a change in facilitation and pedagogy to achieve these goals. In order to attain greater student achievement, instructors will need to use more efficient methodologies, which are undergirded by a paradigm shift in how students learn.

One such paradigm shift is a move away from the stereotypical textbook-driven plan, which is linear in nature, and thus limited in efficiency, toward a plan which is spiraled and more inline with how human beings actually are wired to learn. Below is a concise compare-contrast of the old and new paradigms.

### Contrasting Spiraled vs. Linear Methods

<table>
<thead>
<tr>
<th>Spiraled Paradigm (Human-Friendly)</th>
<th>Linear Paradigm (Not Ideal for Humans)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time is the variable; performance is constant</td>
<td>Time is constant; performance is the variable</td>
</tr>
<tr>
<td>Goal: expect performance standards to be obtained by all students</td>
<td>Goal: Expect normally distributed performance</td>
</tr>
<tr>
<td>Based on spiral learning curve</td>
<td>Based on linear learning curve</td>
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<tr>
<td>Less “coverage” yields more “higher order” cognition</td>
<td>More “coverage” yields less “higher order” cognition</td>
</tr>
<tr>
<td>Domains-driven curriculum</td>
<td>Textbook-driven curriculum</td>
</tr>
<tr>
<td>Long-term retention</td>
<td>Short-term memorization</td>
</tr>
<tr>
<td>Concrete-to-abstract</td>
<td>Abstract; no concrete basis</td>
</tr>
<tr>
<td>Constructivist mathematics</td>
<td>Traditionalist mathematics</td>
</tr>
<tr>
<td>Gifted students allowed time to linger on various topics</td>
<td>Gifted students must keep up pace, potential for burnout</td>
</tr>
<tr>
<td>Emphasis placed on raising underachievers’ performance levels</td>
<td>Emphasis on maintaining timeline, underachievers separated</td>
</tr>
<tr>
<td>Socratic, discovery methods</td>
<td>Lecture, dissemination</td>
</tr>
<tr>
<td>Begins with end in mind</td>
<td>Rarely reaches the end</td>
</tr>
<tr>
<td>Time frames collapsed</td>
<td>High emphasis on time</td>
</tr>
<tr>
<td>Teach inquiry mathematics</td>
<td>Teach math history</td>
</tr>
<tr>
<td>Integrated curriculum</td>
<td>Segmented curriculum</td>
</tr>
</tbody>
</table>

It goes beyond the scope of this document to elaborate on each facet of the new paradigm, but here are a few points worth mentioning:

- All people do not learn in the way a textbook presents a topic anymore than they learn to speak a language by reading a dictionary. In learning to speak, humans proceed in a need-to-know basis, and the formal structures are added later. When a child learns a language, it is more caught than taught, and teachers who design lesson plans and activities based on this idiosyncrasy of human behavior are able to train students more effectively with less stress on the part of both instructor and student.
The introduction of rich tasks into the curriculum early in the school year enables the teacher to collapse time frames and cover more topics in a deeper vein than textbook-lecture formats.

There is a myth of coverage among teachers of mathematics that assumes that if a topic is covered then it is mastered. Teaching is more than telling, and just because a topic is covered doesn’t mean that it is mastered.

When possible, topics should be introduced in a concrete fashion, and abstraction should be added gradually throughout the year until the concrete example is no longer needed. Abstraction is difficult for many students, especially early in their educational tenure, and should be preceded by concrete activities to allow students to attach meaning to the abstraction.

Most ideas can be introduced early in the school year, even in the first six weeks, and then gradually covered again and again in depth so that all students have an opportunity to master the topics from a concrete, discovery approach to the more abstract, symbolic approach.

We must assume that all students can learn at higher levels.

In the typical coverage model, time is constant; i.e. the teacher sets aside a week or two to cover a topic. Assessment is done at the end of that time period. Results are generally normally distributed. But if knowledge is the constant, then it is assumed that all students can and will learn the topic, but time and pedagogy will vary greatly for each student to uniformly achieve high standards.

If learning/achievement, not time, is held constant, then that means students will learn at different rates. This allows students who learn more quickly to serve as tutors, use free-time to explore topics in more depth, and/or allow them more time to work on other subjects and projects that interest them. It is a myth that all students should be working on the same topic at the same pace all of the time for optimal learning.

With increased emphasis on high-stakes testing, often the joy of teaching and learning can wane. Keep teaching and learning fun.

There are master teachers in every system in the state. It is imperative that teachers utilize these experts, along with the many other resources available, to achieve the new, high expectations. Teachers need not feel overwhelmed or as if they have to re-invent the wheel.

Major Features of the Mathematics Curriculum Framework

The new Mathematics Standards for Tennessee exhibit more rigor. In constructing the new standards, teams of math teachers and professors from across the state synthesized national standards from several resources: the American Diploma Project Standards, National Council of Teachers of Mathematics Focal Points (NCTM), National Assessment of Educational Progress (NAEP), ACT Standards, and Mid-Continent Research for Education and Learning Standards (MCREL). The development of these new Standards involved three stages: teams of teachers composed necessary content, the standards were reviewed and held up to the national standards by a different team of reviewers, and finally, they were proofed and organized into the form found on the Tennessee Department of Education website.

Governor Bredesen commissioned the Standards Committees to develop a curriculum that will “ramp up” the mathematical education of all Tennessee students. There were several guiding premises. Among these are the following.

1. There is no redundancy in the content standards. If a concept is addressed at a grade level subsequent to its introduction, it must include deeper understanding, more complexity, wider application, or more rigor.
2. Every Tennessee student can learn more than he/she is currently learning and expectations are higher.
3. The Mathematical Processes must be addressed at every grade level and in every one of the Content Strands.
4. Appropriate use of technology (not to replace understanding and individual performance) will be addressed at each grade level.
5. All concepts in the standards of every grade level will be addressed in the classroom. The standards are streamlined to allow for greater depth of understanding and more facilitation with problem-solving and application.

When the P-16 Council developed recommendations for future graduates, it was with the understanding that existing teachers would receive the professional development necessary to allow them to be qualified to teach the mathematics of the new standards. We must be proactive in preparing our teachers for this eventuality while exposing them to the changes in the new standards. In the tables in this document, it can be seen how the WCS Curriculum Department and the FSSD Curriculum Department are informing teachers of the changes that will be meet in the transition year 2008-2009. It is hoped that teachers will be fully prepared to address the new standards while being cognizant that the TCAP of 2009 will address the former standards.

**Organization of the New Standards**

There are still five strands; two former ones have been combined and one new one has been added:
- **Mathematical Processes – New Strand***
- Number and Operation – **Content Strand**
- Algebra– **Content Strand**
- Geometry and Measurement– **Content Strand**
- Data Analysis, Probability, Statistics– **Content Strand**

Each Strand is composed of three major parts:
- Grade Level Expectations or Course Level Expectations
- Checks for Understanding
- State Performance Indicators

*New Strand*: The Grade Level Expectations for the Mathematical Processes Strand are the same for grade bands K-8 and for 9-12. The Checks for Understanding and the SPIs differ at each grade/course level.

**Elementary/Middle  Grades K-8 Mathematical Processes Grade Level Expectations**

GLE 00-08 06.1.1  Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 00-08 06.1.2  Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 00-08 06.1.3  Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 00-08 06.1.4  Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 00-08 06.1.5  Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 00-08 06.1.6  Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 00-08 06.1.7  Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 00-08 06.1.8  Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.
High School Grades 9-12 Mathematical Processes Course Level Expectations

CLE 1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

CLE 1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.

CLE 1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.

CLE 1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.

CLE 1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.

CLE 1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.

CLE 1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Notes on the Features of the New Tennessee Mathematics Standards

The Mathematical Process Standards should be embedded in the content standards to reap the learning benefits gained from attention to them. These standards exemplify best teaching practices in mathematical instruction and mirror the NCTM Process Standards:

Represenation: Students learn in different manners. Addressing content in multiple representations can incorporate differentiation as well as encourage engagement.

Communication: Students' ability to elucidate their thinking both verbally and in writing informs instruction. Classroom discussions and writing activities focus attention to development of meaning for and appropriate use of mathematical language and mathematical notation.

Connections: Making connections within the discipline, to other disciplines (especially, history of development of mathematics), to careers, and to the real world highlight relevance.

Problem-Solving with Reasoning and Justification: These two almost inextricably intertwined. Students should have opportunity to practice both of these standards in theory as well as in application through rich tasks. Students’ lack of ability in these areas (as bemoaned by employers and higher education) is the primary catalyst for the rewriting of the standards.

Implementation of Technology and Modeling: Students need opportunities to make appropriate use of tools that foster discovery and facilitate the construction of mathematical concepts. Appropriate use of technology occurring at all grade levels involves more than using technology as computing tool.

State Performance Indicators (SPI) are broader than those associated with the former framework; therefore there are many ways to assess the learning expectations. Tasks that require a skill or an algorithm are important in the classroom but are not sufficient for developing mathematical thinking. Student success on assessments depends on their meeting challenging problems daily. Higher expectations will be actualized in the new assessments. Pay attention to the Checks for learning as they could indicate a format for an SPI question.
"No Redundancy" in the new TN DOE Math Standards has implications for curriculum planning:

1. Familiarity with concepts learned in previous grades is imperative so that students have the opportunity to
   (a) hone arithmetic skills, undergird algorithms with conceptual understanding, and apply those skills
       more inclusively in the system of real numbers;
   (b) revisit processes at a more sophisticated level and/or with more complexity;
   (c) apply previously learned concepts in grade level appropriate settings; and
   (d) revisit concepts while developing a greater depth of understanding.

2. Identification of concepts that will be addressed for mastery in the following grade/course in order to take
   the opportunity to introduce any of those concepts that naturally succeed concepts for the current grade level.

**Responsibility for content knowledge:** In order to prepare to ramp up the mathematical standards in the
mathematics classroom, school instructional leaders will want to be proactive:
1. Request assistance from district math personnel to provide content background at site-based professional
   development;
2. Work with the professional development coordinator to address teacher content needs prior to the school year
   2009-2010 in all aspects of content: vocabulary, notation, processes, concepts, and applications.
3. Encourage math teachers to initiate vertical discussions among teachers of both lower and higher grades.
4. Streamline the curriculum to offer time for students to develop depth of understanding so that students finish
   a grade/course with conceptual foundations that lead to success in future math courses.
5. Act as a facilitator to provide effective instruction for standards-based curricula to provide discovery learning
   and student-generated construction of knowledge.
6. Allow time to plan differentiated instruction for content that is not readily addressed in the currently adopted
textbooks.
General Organizational Format of the Tennessee Mathematics Curriculum Framework

**STANDARDS**
are the major math content area topics addressed in a particular grade level or course.

**STATE PERFORMANCE INDICATORS**
are the basis for student accountability and are used by the state to prepare standardized test items aligned with corresponding Grade (GLE) or Course (CLE) Level Expectations.

### Grade 7: Standard 3 Algebra

<table>
<thead>
<tr>
<th>Grade Level Expectation</th>
<th>Check for understanding (formative/summative assessment)</th>
<th>State Performance Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLE 0706.3.2 Understand and compare various representations of relations and functions.</td>
<td>✓ 0706.3.3 Identify a function from a written description, table, graph, rule, set of ordered pair, and/or mapping.</td>
<td>SPI 0706.3.2 Determine whether a relation (represented in various ways) is a function.</td>
</tr>
</tbody>
</table>

**CHECKS FOR UNDERSTANDING**
are suggestions for assessing student learning. Formative assessments are typically embedded within a lesson. Summative assessments provide information about whether a student has met a particular Grade or Course Level Expectation.

<table>
<thead>
<tr>
<th>GLE 0706.3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Level Expectation</td>
</tr>
<tr>
<td>Grade 7 Mathematics Standard 3 (Algebra) Second GLE for that standard</td>
</tr>
</tbody>
</table>

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9
Figure 2. Formative and Summative Assessment

Formative Assessment

- generates
- Timely student achievement information
  - to monitor
  - to evaluate

  Individual student progress
  - in terms of
  - What student did or did not learn

  Instructional effectiveness
  - requires
  - warrants
  - Modifying Instruction
  - Reteaching

Summative Assessment

- determined through
  - Standards: What Student Know or Are Able to Do

  provides evidence of
  - Student mastery of standards

  indicates
  - Specific knowledge gaps
    - addressed by
    - Targeted content-based instruction
**Tennessee Standards Analysis**

### Grade Level Totals

<table>
<thead>
<tr>
<th>Grade Level Totals</th>
<th>K</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>All</th>
</tr>
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<tr>
<td>Grade Level Expectations</td>
<td>21</td>
<td>19</td>
<td>22</td>
<td>25</td>
<td>23</td>
<td>23</td>
<td>25</td>
<td>32</td>
<td>26</td>
<td>216</td>
</tr>
<tr>
<td>Checks For Understanding</td>
<td>41</td>
<td>47</td>
<td>49</td>
<td>52</td>
<td>56</td>
<td>44</td>
<td>62</td>
<td>52</td>
<td>44</td>
<td>447</td>
</tr>
<tr>
<td>State Performance Indicators</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>36</td>
<td>33</td>
<td>26</td>
<td>31</td>
<td>27</td>
<td>23</td>
<td>176</td>
</tr>
</tbody>
</table>

### K-8 TOTALS BY MATHEMATICS CONTENT AREA

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Numbers &amp; Operations</th>
<th>Algebra</th>
<th>Geometry &amp; Measurement</th>
<th>Data Analysis, Probability and Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLEs</td>
<td>8</td>
<td>47</td>
<td>41</td>
<td>36</td>
<td>20</td>
</tr>
<tr>
<td>✓s</td>
<td>98</td>
<td>115</td>
<td>78</td>
<td>101</td>
<td>54</td>
</tr>
<tr>
<td>SPIs</td>
<td>28</td>
<td>54</td>
<td>36</td>
<td>37</td>
<td>21</td>
</tr>
</tbody>
</table>

### Tennessee Standards Analysis

#### 9-12 Course Totals

<table>
<thead>
<tr>
<th></th>
<th>Algebra</th>
<th>Geometry</th>
<th>Algebra</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Level Expectations</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>72</td>
</tr>
<tr>
<td>Checks For Understanding</td>
<td>86</td>
<td>78</td>
<td>65</td>
<td>229</td>
</tr>
<tr>
<td>State Performance Indicators</td>
<td>29</td>
<td>25</td>
<td>32</td>
<td>86</td>
</tr>
</tbody>
</table>

### 9-12 COURSE TOTALS BY MATHEMATICS CONTENT AREA

<table>
<thead>
<tr>
<th>Process</th>
<th>Numbers &amp; Operations</th>
<th>Algebra</th>
<th>Geometry &amp; Measurement</th>
<th>Data Analysis, Probability and Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEs</td>
<td>7</td>
<td>9</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>✓s</td>
<td>44</td>
<td>27</td>
<td>64</td>
<td>60</td>
</tr>
<tr>
<td>SPIs</td>
<td>14</td>
<td>8</td>
<td>28</td>
<td>22</td>
</tr>
</tbody>
</table>
Webb levels and the Tennessee Curriculum

In 2006, the TN Department of Education conducted an external review of the TN Mathematics Standards that evaluated the standards through the lens of Webb’s Depth of Knowledge scale. Similar to Bloom’s Taxonomy, Webb’s scale categorizes a learning expectation in terms of the requisite knowledge or skill needed for a student to successfully meet this goal. Webb’s four Levels are: Recall, Skill/Concept, Strategic Thinking, and Extended Thinking. The principal criterion for assigning a CLE or GLE to a knowledge level is the verb used in the learning expectation statement and the level of student engagement required to achieve the desired outcome.

The rigor and relevance of earlier versions of the TN Mathematics Framework was identified by these external reviewers as a target for improvement. The addition of the Process Standard strand is a direct response to the panel’s recommendations and illustrates that expectations have been raised for all K-12 mathematics students Appendix D shows in tabular form Webb’s Level of Knowledge data from the 2007 Mathematics Curriculum Frameworks.

Four levels were used to rate depth of knowledge:
- Level 1 (recall) requires simple recall of such information as a fact, definition, term, or simple procedure.
- Level 2 (skill/concept) involves some mental skills, concepts, or processing beyond a habitual response; students must make some decisions about how to approach a problem or activity. Keywords distinguishing a Level 2 item include classify, organize, estimate, collect data, and compare data.
- Level 3 (strategic thinking) requires reasoning, planning, using evidence, and thinking at a higher level.
- Level 4 (extended thinking) requires complex reasoning, planning, developing, and thinking, most likely over an extended time. Cognitive demands are high, and students are required to make connections both within and among subject domains.

The new curriculum has been designed to positively impact the focus and cognitive level of the educational experience for students across all grades and courses. To determine if the design has undergone the desired changes, we can look at the Webb levels of cognitive development for both the former curriculum and the new curriculum. There are four Webb levels, with level 1 requiring the least cognitive development and level requiring the most. The following information compares the Webb depth-of-knowledge analysis for the GLEs of the new curriculum with the Learning Expectations of the former curriculum as informed by examination of the Accomplishments, the State Performance Indicators and the Teacher Performance Indicators. In other words, the different expectations were evaluated to determine the Webb depth-of-knowledge levels through examining the descriptions of student outcomes.

Focus of Curriculum: One of the major changes to the curriculum was intended to be an increase in the focus of the curriculum at each grade level – in other words, to narrow the number of topics developed. In addition to directing the goals of the grade to parallel NCTM Focal Points, the need to narrow the curriculum to allow the teacher to spend more time on the grade specific content was critical. This should mean a decrease in the total number of concepts. Additionally, the number of concepts in each Webb level was of concern. The new curriculum can be compared to the former curriculum through the following data analysis:
Table 1: Former Curriculum Learning Expectations Count by Webb Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Kindergarten</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Fifth</th>
<th>Sixth</th>
<th>Seventh</th>
<th>Eighth</th>
<th>Algebra I</th>
<th>Geometry</th>
<th>Algebra II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>14</td>
<td>12</td>
<td>14</td>
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<tr>
<td>Level 2</td>
<td>6</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>4</td>
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<td>10</td>
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<tr>
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<td>2</td>
<td>5</td>
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<td>0</td>
<td>7</td>
<td>7</td>
<td>18</td>
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<td>13</td>
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<tr>
<td>Level 4</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>15</td>
<td>17</td>
<td>15</td>
<td>15</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>43</td>
<td>25</td>
<td>39</td>
</tr>
</tbody>
</table>

The number of Learning Expectations per grade level in the former curriculum includes only the Learning Expectations; in other words the SPI and TPI count is not included. If you included the count for the SPIs and/or the TPIs, the difference between the curricula would be even greater. By comparing the chart above and the chart below, you can see that the grade level concepts are more evenly distributed across the grades. Additionally, there are no extra SPI and TPI goals to be added as necessary learning goals. Comparing this to the chart below, this conclusion is that the number of learning topics is reduced by approximately $\frac{1}{3}$ to $\frac{1}{2}$ per grade.

Table 2: New Curriculum GLE/CLE - Count by Webb Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Kindergarten</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Fifth</th>
<th>Sixth</th>
<th>Seventh</th>
<th>Eighth</th>
<th>Algebra I</th>
<th>Geometry</th>
<th>Algebra II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Level 2</td>
<td>13</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Level 3</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>11</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Level 4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>19</td>
<td>22</td>
<td>25</td>
<td>23</td>
<td>23</td>
<td>25</td>
<td>32</td>
<td>26</td>
<td>23</td>
<td>24</td>
<td>26</td>
</tr>
</tbody>
</table>
Webb Level: To examine the impact of the new curriculum design on the Webb Levels of the content, examination of the previous tables show that in the former curriculum the level 4 concepts were minimal at all grade levels. Additionally, the majority of the curriculum goals are level 1 or level 2. On the other hand, the new curriculum has increased the number of level 4 requirements at all grade levels; there is an expanding expectation for level 4 concepts as the student progresses through the different grades. This progression clearly expects more as students have developed stronger academic skills. The comparison between the curricula based on Webb level can also be viewed through examining the distribution by percentages.

<table>
<thead>
<tr>
<th>Table 3: Former Curriculum GLE/CLE - % by Webb Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Kindergarten</td>
</tr>
<tr>
<td>First</td>
</tr>
<tr>
<td>Second</td>
</tr>
<tr>
<td>Third</td>
</tr>
<tr>
<td>Fourth</td>
</tr>
<tr>
<td>Fifth</td>
</tr>
<tr>
<td>Sixth</td>
</tr>
<tr>
<td>Seventh</td>
</tr>
<tr>
<td>Eighth</td>
</tr>
<tr>
<td>Algebra I</td>
</tr>
<tr>
<td>Geometry</td>
</tr>
<tr>
<td>Algebra II</td>
</tr>
</tbody>
</table>

Note that the only grades including level 4 concepts are grades 2, 4, and Algebra II. In general, 60% of all learning expectations in all grades are level 1 or level 2. Within each grade level, the distribution between Webb levels is fairly even. In fact, summarized across all grades, the average number of GLE/CLE per Webb level for the former curriculum are provided in the next table.

<table>
<thead>
<tr>
<th>Table 4: Average % of concepts by Webb Level in Former Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Average</td>
</tr>
</tbody>
</table>

With regard to the new curriculum, the expectations increase for the Webb levels as the grade level increases. The increase in expectation for the Webb levels increases each year, with substantial increases beginning in eighth grade and extending into the high school courses. Even more dramatically, by high school there are no concepts developed/tested at Webb level 1. Although level 1 instruction and learning are occurring at all grades, the higher grades are no longer evaluating the introductory learning levels.
Table 5: New Curriculum GLE/CLE - % by Webb Level

<table>
<thead>
<tr>
<th></th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>19.05%</td>
<td>61.90%</td>
<td>14.29%</td>
<td>4.76%</td>
</tr>
<tr>
<td>First</td>
<td>26.32%</td>
<td>36.84%</td>
<td>31.58%</td>
<td>5.26%</td>
</tr>
<tr>
<td>Second</td>
<td>31.82%</td>
<td>31.82%</td>
<td>31.82%</td>
<td>4.55%</td>
</tr>
<tr>
<td>Third</td>
<td>20.00%</td>
<td>28.00%</td>
<td>40.00%</td>
<td>12.00%</td>
</tr>
<tr>
<td>Fourth</td>
<td>39.13%</td>
<td>21.74%</td>
<td>30.43%</td>
<td>8.70%</td>
</tr>
<tr>
<td>Fifth</td>
<td>34.78%</td>
<td>21.74%</td>
<td>34.78%</td>
<td>8.70%</td>
</tr>
<tr>
<td>Sixth</td>
<td>24.00%</td>
<td>20.00%</td>
<td>48.00%</td>
<td>8.00%</td>
</tr>
<tr>
<td>Seventh</td>
<td>25.00%</td>
<td>28.13%</td>
<td>37.50%</td>
<td>9.38%</td>
</tr>
<tr>
<td>Eighth</td>
<td>15.38%</td>
<td>26.92%</td>
<td>34.62%</td>
<td>23.08%</td>
</tr>
<tr>
<td>Algebra I</td>
<td>8.70%</td>
<td>13.04%</td>
<td>47.83%</td>
<td>30.43%</td>
</tr>
<tr>
<td>Geometry</td>
<td>0.00%</td>
<td>12.50%</td>
<td>45.83%</td>
<td>41.67%</td>
</tr>
<tr>
<td>Algebra II</td>
<td>0.00%</td>
<td>11.54%</td>
<td>34.62%</td>
<td>53.85%</td>
</tr>
</tbody>
</table>

Looking at the averages for the new curriculum clearly illustrates the success in increasing the level of cognitive expectation the curriculum as a whole.

Table 6: Average % of concepts by Webb Level in New Curriculum

<table>
<thead>
<tr>
<th></th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>20.35%</td>
<td>26.18%</td>
<td>35.94%</td>
<td>17.53%</td>
</tr>
</tbody>
</table>

Changing the Curriculum across the Grades: Perhaps the greatest difference in the new curriculum is that the “flow” of the curriculum across grade levels more closely matches the flow recommended by NCTM and prepares the students for the material as gauged by NAEP testing and ACT testing regimens. Looking at the following graph, you can see that the former curriculum basically maintained the curriculum distribution constant at 60% of the curriculum was level 1 or level 2 for all grade levels. The only exceptions were pretty much limited to grades 4 & 8.
On the other hand, within the new curriculum the Webb level expectations across grade levels clearly increases as the student progresses through school. The level 1 material decreases as students build more on previous work and are asked to deal with material at increasingly greater cognitive levels. In particular, you can see increases in the level 3 material between grades 4 and 8 and extensive increases in level 4 material after grade 8.
Within the new curriculum, the level 2 material, which is the level which encourages practice, paraphrasing, and comparison, is included fairly evenly at all grade levels. As students increase their abilities to communicate, problem solve, and analyze, the level 3 and level 4 material increases.
Tennessee’s Vision of Standards-Based Science, Technology, Engineering and Mathematics Education

The Tennessee Mathematics Curriculum Framework presents an educational pathway designed to prepare every student to function in a society in which mathematical, scientific and technological literacy are necessary for full participation and enjoyment. The new standards are founded on the premise that learning mathematics content is most successful when experienced through an active process that integrates inquiry, technology and engineering, and science, in what is commonly referred to as STEM Education (figure 4).

Figure 4. Tennessee Vision for STEM Education

The goal of standards revision is to develop a curriculum framework that will guide and support school systems in building a rigorous and relevant K-12 mathematics curriculum. The educational vision reflected in the Framework is that a carefully designed, coherent, and properly implemented set of K-12 mathematics learning experiences will enable all students to:

- Develop a deep understanding of the key mathematical concepts, principles, and theories drawn from contextual applications
- Apply process skills by posing questions and investigating phenomena through the language, procedures, and tools of mathematics
- Be aware of how engineering, technology, and science are integrated into the historical and cultural advancement of mathematics
- Think and act in a way that demonstrates a positive attitude toward problem-solving and personal decision-making about issues that affect society

Further, all Tennessee students should emerge from their K-12 mathematics education experiences fully prepared for transitioning to higher education, careers in the technical workforce, and service to their communities or nation.
Implementation of the new Mathematics Standards

The new standards and course and grade level expectations can and should be used by all stakeholders in the mathematics education arena to guide whatever decisions are deemed necessary to support effective K-12 mathematics programs. Because the Curriculum Framework is based on a developmental progression, teachers will introduce mathematics content and skills at a level of sophistication consistent with a student’s readiness to learn and discover. Similarly, different emphases will characterize instructional time allocations at individual grade levels.

Figure 5 illustrates a suggested percentage of emphasis for the teaching of the content and integration of the embedded strands for number, algebra, geometry, measurement, and data analysis and probability. The Standards’ orientation toward the teaching of mathematics in the lower grades and its shifting emphasis in grades 9-12 is consistent with the research on when students learn best.

![Figure 5. Suggested Emphasis by NCTM for Content Standards across the grade band.](image)
Next Generation Tools for STEM Education

A Resource for Implementing the Tennessee Science and Mathematics Curriculum Frameworks

The materials found in the Next Generation Tools for STEM Education constitute a "toolkit" that can be used to support teachers who are moving toward standards-based practices. Within the contents, the term "standards-based" describes educational contexts wherein everything that is associated with teaching and learning is referenced to the national and state standards. The tools found on the disc can assist with the implementation of the mathematics curriculum standards (SBE 2001). All of these standards-based tools have been customized to align with the Tennessee Science and Mathematics Curriculum Standards.

The Next Generation Tools for STEM Education resource was developed after recognizing that teachers need quality support materials and clear, high quality work samples for implementing the state curriculum standards. To be successful, every teacher must have appropriate instructional tools and the background preparation needed to implement curriculum standards in the classroom. Some materials, like grade and attendance managers, simplify routine classroom management tasks. However, labor-saving technologies for delivering standards-based curriculum and instruction and for preparing aligned assessments are not routinely available to teachers. Without proper tools, effective implementation of many standards-based reform practices, while possible, are not really feasible for most teachers. The compilation of standards, curriculum development and instructional tools, science and mathematics teacher resources, and work samples found in the Next Generation Tools for STEM Education can facilitate the consistent delivery of high-quality, standards based instruction.
APPENDIX A

Tennessee Mathematics Standards
2009-2010 Implementation
Tennessee Mathematics Standards
2009-2010 Implementation

Kindergarten Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:
- GLE 0006.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
- GLE 0006.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
- GLE 0006.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
- GLE 0006.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
- GLE 0006.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
- GLE 0006.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
- GLE 0006.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
- GLE 0006.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):
- 0006.1.1 Model addition and subtraction (e.g., using a number chart, number line and/or concrete objects).
- 0006.1.2 Begin to develop the concept of estimation using concrete objects.
- 0006.1.3 Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, tomorrow).
- 0006.1.4 Tell time to the hour.
- 0006.1.5 Recognize a calendar as a way of measuring time.
- 0006.1.6 Name and identify coins and their values.
- 0006.1.7 Use words to describe temperature (e.g., hot, warm, cool, cold).
- 0006.1.8 Recognize a thermometer as a way of measuring temperature.
- 0006.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

Standard 2 – Number and Operations

Grade Level Expectations:
- GLE 0006.2.1 Count objects in a set and use numbers, including written numerals to 25.
- GLE 0006.2.2 Create, represent and recognize a set with a given number of objects.
- GLE 0006.2.3 Recognize, compare and order sets of numerals by using both cardinal and ordinal meanings.
- GLE 0006.2.4 Understand addition as “putting together” and subtraction as “breaking apart.”
- GLE 0006.2.5 Model the numbers 1 through 10 as sums or differences of different sets of whole numbers (composing and decomposing numbers).
Checks for Understanding (Formative/Summative Assessment):
✓ 0006.2.1 Count objects to 25 using one-to-one correspondence and identify the quantity in the counted group.
✓ 0006.2.2 Match quantities to 25 with numerals and written words.
✓ 0006.2.3 Count backward from 10 to 1.
✓ 0006.2.4 Count to 20 by twos.
✓ 0006.2.5 Create a set with a given number of objects.
✓ 0006.2.6 Quickly recognize the number of objects in a small set.
✓ 0006.2.7 Recognize zero (0) as a set with “no objects”.
✓ 0006.2.8 Compare sets of ten or fewer objects and identify which are equal to, more than, or less than others.
✓ 0006.2.9 Order the numbers through 25 using numerals and words.
✓ 0006.2.10 Recognize 6 through 10 as “five and some ones.”
✓ 0006.2.11 Recognize and use ordinal numbers (e.g., first, fourth, last).
✓ 0006.2.12 Model simple joining and separating situations with objects.
✓ 0006.2.13 Add and subtract single-digit numbers whose total or difference is between 0 and 10.
✓ 0006.2.14 Understand add as “put together” or “count on” and solve addition problems with sums less than 20.
✓ 0006.2.15 Understand subtraction as “break apart” or “take away” and solve subtraction problems using numbers 1 through 10.
✓ 0006.2.16 Model, demonstrate, and solve story problems that illustrate addition and subtraction.
✓ 0006.2.17 Understand that numbers can be represented by different groupings.

Standard 3 – Algebra

Grade Level Expectations:
GLE 0006.3.1 Identify, duplicate, and extend simple number patterns and sequential and growing patterns.
GLE 0006.3.2 Recognize attributes (such as color, shape, size) and patterns (such as repeated pairs, bilateral symmetry).
GLE 0006.3.3 Describe qualitative change.

Checks for Understanding (Formative/Summative Assessment):
✓ 0006.3.1 Use a variety of manipulatives (such as connecting cubes, number cards, shapes) to create patterns.
✓ 0006.3.2 Name, copy, and extend patterns.
✓ 0006.3.3 Translate simple patterns into rules.
✓ 0006.3.4 Sort, order and classify objects by attribute and identify objects that do not belong in a particular group.
✓ 0006.3.5 Describe change in attributes according to qualitative criteria such as longer/shorter, colder/warmer, heavier/lighter.
Standard 4 – Geometry and Measurement

Grade Level Expectations:
- GLE 0006.4.1 Interpret and describe the physical world with geometric ideas and vocabulary.
- GLE 0006.4.2 Use positional terms to specify locations with simple relationships.
- GLE 0006.4.3 Compare and order measurable attributes of objects directly (by comparing them with each other) and indirectly (by comparing both with a third object).

Checks for Understanding (Formative/Summative Assessment):
- ✔ 0006.4.1 Identify, name, and describe a variety of shapes (i.e. circles, squares, triangles, rectangles, hexagons, trapezoids) shown in various positions.
- ✔ 0006.4.2 Identify, name, and describe three-dimensional shapes (such as sphere, cube, cone, cylinder).
- ✔ 0006.4.3 Sort plane figures into groups, name and describe the attributes of the shapes (such as number of sides and corners (vertices)).
- ✔ 0006.4.4 Sort solid figures into groups, name and describe the attributes of the shapes.
- ✔ 0006.4.5 Use basic shapes and spatial reasoning to model objects and construct more complex shapes.
- ✔ 0006.4.6 Identify positions (such as beside, inside, outside, above, below, between, on, over, under, near, far, forward, backward, top, middle, bottom, left, right) using models, illustrations, and stories.
- ✔ 0006.4.7 Make direct and indirect comparisons between objects (such as recognize which is shorter, longer, taller, lighter, heavier, or holds more).

Standard 5 – Data, Probability and Statistics

Grade Level Expectations:
- GLE 0006.5.1 Sort objects and use one or more attributes to solve problems.
- GLE 0006.5.2 Re-sort objects using new attributes.

Checks for Understanding (Formative/Summative Assessment):
- ✔ 0006.5.1 Sort objects into sets and describe how the objects were sorted.
- ✔ 0006.5.2 Sort objects in different ways.
- ✔ 0006.5.3 Collect and count data.


Tennessee Mathematics Standards
2009-2010 Implementation

Grade One Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:

GLE 0106.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0106.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0106.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0106.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0106.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0106.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0106.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0106.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):

✓ 0106.1.1 Describe the relationship between days and months.
✓ 0106.1.2 Read and write time to the hour, half-hour, and quarter-hour.
✓ 0106.1.3 Compare units of time.
✓ 0106.1.4 Count the value of a set of coins up to fifty cents.
✓ 0106.1.5 Use a thermometer to measure temperature.
✓ 0106.1.6 Recognize scales as a way of measuring weight.
✓ 0106.1.7 Apply spatial sense to recreate a figure from memory.
✓ 0106.1.8 Recognize the “word clues” and mathematical symbols for addition and subtraction.
✓ 0106.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.

Standard 2 – Number and Operations

Grade Level Expectations:

GLE 0106.2.1 Understand and use number notation and place value to 100.
GLE 0106.2.2 Compare and order whole numbers to 100.
GLE 0106.2.3 Develop strategies for learning basic addition facts and related subtraction facts.
GLE 0106.2.4 Use multiple representations (including groups of ten) to model two-digit addition and subtraction.
Checks for Understanding (Formative/Summative Assessment):

✓ 0106.2.1 Read and write numerals up to 100.
✓ 0106.2.2 Write numbers up to 10 in words.
✓ 0106.2.3 Count forward and backward by ones beginning with any number less than 100.
✓ 0106.2.4 Skip count by twos, fives, and tens.
✓ 0106.2.5 Order and compare (less than, greater than, or equal to) whole numbers to 100.
✓ 0106.2.6 Recognize the place value of numbers (tens, ones).
✓ 0106.2.7 Develop fluency with addition and subtraction facts of sums through ten.
✓ 0106.2.8 Relate “counting on” and “counting back” to addition and subtraction and understand them as inverse operations.
✓ 0106.2.9 Add three single-digit numbers.
✓ 0106.2.10 Use models (such as discrete objects, connecting cubes, and number lines) to represent “part-whole,” “adding to,” “taking away from,” and “comparing to” situations to develop understanding of the meaning of addition and subtraction.
✓ 0106.2.11 Recognize the “part-whole” relationship in representations of basic fractions such as ½ and ¼.
✓ 0106.2.12 Use various models to develop strategies for solving arithmetic problems.
✓ 0106.2.13 Solve problems that require addition and subtraction of numbers through 100.
✓ 0106.2.14 Use composition and decomposition of numbers to identify and discuss patterns.
✓ 0106.2.15 Represent whole numbers between 10 and 100 in groups of tens and ones.
✓ 0106.2.16 Represent whole numbers up to 100 on a number line.
✓ 0106.2.17 Use the number line to create visual representations of sequences (such as even numbers, tens, multiples of five).

Standard 3 – Algebra

Grade Level Expectations:

GLE 0106.3.1 Identify, describe, and extend simple number patterns to develop strategies for adding and subtracting whole numbers.
GLE 0106.3.2 Understand that addition and subtraction are inverse operations.
GLE 0106.3.3 Extend the strategies for basic facts to include other properties of number and operations.

Checks for Understanding (Formative/Summative Assessment):

✓ 0106.3.1 Find repeating patterns on the number line, addition table, and hundreds chart.
✓ 0106.3.2 Determine a reasonable next term in a given sequence and describe the rule.
✓ 0106.3.3 Use objects to illustrate the commutative property with basic facts and show that subtraction is not commutative.
✓ 0106.3.4 Demonstrate understanding of the basic equation a + b = c by using objects to illustrate the number sentences (fact families) associated with any particular sum.
✓ 0106.3.5 Use various strategies to find unknowns in problems involving addition and subtraction.
✓ 0106.3.6 Use objects to demonstrate the inverse relationship between addition and subtraction.
✓ 0106.3.7 Use the inverse relation between addition and subtraction to check arithmetic problems.
✓ 0106.3.8 Determine whether a number is odd or even by pairing objects.
✓ 0106.3.9 Recognize that zero is the identity element for addition.
Standard 4 – Geometry and Measurement

Grade Level Expectations:
GLE 0106.4.1 Recognize, describe, and draw geometric figures.
GLE 0106.4.2 Compose and decompose geometric shapes.
GLE 0106.4.3 Use non-standard units in linear measurement.

Checks for Understanding (Formative/Summative Assessment):
✓ 0106.4.1 Recognize and describe similarities and differences between 2-dimensional figures (geometric attributes and properties).
✓ 0106.4.2 Recognize 2- and 3-dimensional figures from different perspectives and orientations.
✓ 0106.4.3 Model part-whole relationships and properties of plane and solid figures by combining two or more shapes to make a larger shape or by breaking apart an object into its smaller shapes.
✓ 0106.4.4 Identify 2-dimensional shapes as faces of 3-dimensional figures.
✓ 0106.4.5 Estimate and measure length using non-standard units (counting by using groups of tens and ones) to represent addition.
✓ 0106.4.6 Recognize the essential role of units in measurement, and understand the difference between standard and non-standard units.
✓ 0106.4.7 Understand and use comparative words such as long, longer, longest; short, shorter, shortest; tall, taller, tallest; high, higher, highest.

Standard 5 – Data, Probability and Statistics

Grade Level Expectations:
GLE 0106.5.1 Use various representations to display and compare data.

Checks for Understanding (Formative/Summative Assessment):
✓ 0106.5.1 Represent measurements and discrete data using concrete objects, picture graphs, and bar graphs.
✓ 0106.5.2 Represent data in both horizontal and vertical form.
✓ 0106.5.3 Display data using appropriate titles and labels.
✓ 0106.5.4 Count and compare collected data.
Tennessee Mathematics Standards
2009-2010 Implementation

Grade Two Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:

GLE 0206.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0206.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

GLE 0206.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0206.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

GLE 0206.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0206.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0206.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

GLE 0206.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):

✓ 0206.1.1 Read and write time up to five-minute intervals.
✓ 0206.1.2 Relate days, dates, weeks, months, and years to a calendar.
✓ 0206.1.3 Use strategies to make estimates of time.
✓ 0206.1.4 Solve problems involving elapsed time in hour and half-hour intervals.
✓ 0206.1.5 Count the value of a set of coins up to one dollar and use the transitive property of equality to recognize equivalent forms of values up to $1.00.
✓ 0206.1.6 Read thermometers with Fahrenheit and Celsius scales.
✓ 0206.1.7 Measure weight to the nearest pound or kilogram.
✓ 0206.1.8 Use concrete models or pictures to show whether a fraction is less than a half, more than a half, or equal to a half.
✓ 0206.1.9 Match the spoken, written, concrete, and pictorial representations of halves, thirds, and fourths.
✓ 0206.1.10 Develop a story problem that illustrates a given addition or subtraction number sentence.
✓ 0206.1.11 Use manipulatives to demonstrate addition and subtraction sentences written symbolically.
✓ 0206.1.12 Write numbers and translate word clues to number sentences and vice versa.
✓ 0206.1.13 Use manipulatives such as pattern blocks, tangrams, etc. to explore geometric concepts of symmetry and transformations.
✓ 0206.1.14 Create and observe numerical patterns on a calculator by repeatedly adding or subtracting the same number from some starting number.
✓ 0206.1.15 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
Standard 2 – Number and Operations

Grade Level Expectations:
- GLE 0206.2.1 Understand and use place value concepts to 1000.
- GLE 0206.2.2 Understand and use the base-ten numeration system.
- GLE 0206.2.3 Use efficient and accurate strategies to develop fluency with multi-digit addition and subtraction.
- GLE 0206.2.4 Develop an initial understanding of multiplication.

Checks for Understanding (Formative/Summative Assessment):
✓ 0206.2.1 Starting at any number, count by ones, twos, fives, tens, and hundreds up to 1000.
✓ 0206.2.2 Read and write numbers up to 1000 using numerals and up to 100 using words.
✓ 0206.2.3 Locate and interpret numbers on a number line.
✓ 0206.2.4 Recognize that place-value notation represents the sums of multiples of powers of ten (e.g., 853 as 8 hundreds + 5 tens + 3 ones).
✓ 0206.2.5 Compare and order multi-digit numbers up to 1000.
✓ 0206.2.6 Use various models such as number lines, pictures, and base-ten blocks to illustrate addition and subtraction.
✓ 0206.2.7 Develop fluency at recalling basic addition facts and related subtraction facts.
✓ 0206.2.8 Use efficient procedures, and understand why they work, to solve problems involving the addition and subtraction of two- and three-digit whole numbers (including those that require regrouping).
✓ 0206.2.9 Apply appropriate methods to estimate and mentally calculate sums or differences with ones, tens, and hundreds.
✓ 0206.2.10 Add three two-digit numbers.
✓ 0206.2.11 Solve addition and subtraction problems in context using various representations.
✓ 0206.2.12 Demonstrate skip counting on the number line and relate to repeated addition and multiplication.
✓ 0206.2.13 Relate patterns in skip counting to multiplication.

Standard 3 – Algebra

Grade Level Expectations:
- GLE 0206.3.1 Develop pattern recognition.
- GLE 0206.3.2 Extend knowledge of the properties of numbers and operations to multiplication.
- GLE 0206.3.3 Solve simple arithmetic problems using various methods.
- GLE 0206.3.4 Describe quantitative change.

Checks for Understanding (Formative/Summative Assessment):
✓ 0206.3.1 Given rules, complete tables to reveal both arithmetic and geometric patterns.
✓ 0206.3.2 Given a description, extend or find a missing term in a pattern or sequence.
✓ 0206.3.3 Record and study patterns in lists of numbers created by repeated addition or subtraction.
✓ 0206.3.4 Generalize the patterns resulting from the addition, subtraction and multiplication of combinations of odd and even numbers.
✓ 0206.3.5 Understand and use the commutative and associative properties of addition and multiplication.
✓ 0206.3.6 Relate repeated addition to multiplication.
✓ 0206.3.7 Find unknowns in number sentences and problems involving addition, subtraction and multiplication.
✓ 0206.3.8 Describe change in measures according to quantitative criteria such as growing 2 inches in one year.
Standard 4 – Geometry and Measurement

Grade Level Expectations:
GLE 0206.4.1 Recognize, classify, and transform 2- and 3-dimensional geometric figures.
GLE 0206.4.2 Understand the meaning and process of linear measurement.
GLE 0206.4.3 Add, subtract, compare, compute and estimate linear measurements.
GLE 0206.4.4 Compose and decompose polygons to make other polygons.

Checks for Understanding (Formative/Summative Assessment):
✓ 0206.4.1 Describe common geometric attributes of familiar plane and solid objects.
✓ 0206.4.2 Reflect, rotate, and translate shapes to explore the effects of transformations.
✓ 0206.4.3 Understand the property of transitivity as it relates to linear measurement (for example: If A is longer than B, and B is longer then C, then A is longer than C).
✓ 0206.4.4 Estimate, measure, and calculate length to the nearest unit: meter, centimeter, yard, foot, and inch.
✓ 0206.4.5 Use rulers to measure the lengths of sides and diagonals of common 2-dimensional figures and polygons.
✓ 0206.4.6 Understand the inverse relationship between the size of a unit and the number of units used in a particular measurement (the smaller the unit, the more iterations needed to cover the length).
✓ 0206.4.7 Investigate and describe composition, decomposition, and transformations of polygons.
✓ 0206.4.8 Combine polygons to form other polygons and subdivide a polygon into other polygons.
✓ 0206.4.9 Recognize the composition and decomposition of polygons.

Standard 5 – Data, Probability and Statistics

Grade Level Expectations:
GLE 0206.5.1 Use and understand various representations to depict and analyze data measurements.
GLE 0206.5.2 Determine whether an event is likely or unlikely.

Checks for Understanding (Formative/Summative Assessment):
✓ 0206.5.1 Read, interpret, and analyze data shown in tables, bar graphs and picture graphs.
✓ 0206.5.2 Read, interpret, and create tables using tally marks.
✓ 0206.5.3 Explain whether a real world event is likely or unlikely.
✓ 0206.5.4 Predict outcomes of events based on data gathered and displayed.
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Grade Three Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:

GLE 0306.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0306.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0306.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0306.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0306.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0306.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0306.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0306.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):

✔ 0306.1.1 Read and write time to the nearest minute.
✔ 0306.1.2 Compare and order decimal amounts in the context of money.
✔ 0306.1.3 Count the value of combinations of coins and bills up to five dollars.
✔ 0306.1.4 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, and observing patterns.
✔ 0306.1.5 Determine when and how to break a problem into simpler parts.
✔ 0306.1.6 Use estimation to check answers for reasonableness, and calculators to check for accuracy.
✔ 0306.1.7 Make and investigate mathematical conjectures.
✔ 0306.1.8 Explain and justify answers on the basis of mathematical properties, structures, and relationships.
✔ 0306.1.9 Use manipulatives to demonstrate that the commutative property holds for addition but not for subtraction.
✔ 0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas.
✔ 0306.1.11 Develop strategies for solving problems involving addition and subtraction of measurements.
✔ 0306.1.12 Analyze and evaluate the mathematical thinking and strategies of others.
✔ 0306.1.13 Create and use representations to organize, record, and communicate mathematical ideas.
✔ 0306.1.14 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
State Performance Indicators:
- SPI 0306.1.1 Solve problems using a calendar.
- SPI 0306.1.2 Solve problems involving elapsed time.
- SPI 0306.1.3 Determine the correct change from a transaction less than a dollar.
- SPI 0306.1.4 Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten.
- SPI 0306.1.5 Represent problems mathematically using diagrams, numbers, and symbolic expressions.
- SPI 0306.1.6 Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.
- SPI 0306.1.7 Select appropriate units and tools to solve problems involving measures.
- SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate.

Standard 2 - Number and Operations

Grade Level Expectations:
- GLE 0306.2.1 Understand the place value of whole numbers to ten-thousands place including expanded notation for all arithmetic operations.
- GLE 0306.2.2 Develop understanding of multiplication and related division facts through multiple strategies and representations.
- GLE 0306.2.3 Relate multiplication and division as inverse operations.
- GLE 0306.2.4 Solve multiplication and division problems using various representations.
- GLE 0306.2.5 Understand the meaning and uses of fractions.
- GLE 0306.2.6 Use various strategies and models to compare and order fractions and identify equivalent fractions.
- GLE 0306.2.7 Add and subtract fractions with like denominators using various models.

Checks for Understanding (Formative/Summative Assessment):
- ✔ 0306.2.1 Represent whole numbers up to 10,000 using various models (such as base-ten blocks, number lines, place-value charts) and in standard form, written form, and expanded form.
- ✔ 0306.2.2 Understand and use the symbols =, < and > to signify order and comparison.
- ✔ 0306.2.3 Use parentheses to indicate grouping.
- ✔ 0306.2.4 Use a variety of methods to perform mental computations and compare the efficiency of those methods.
- ✔ 0306.2.5 Use highest order value (such as tens or hundreds digit) to make simple estimates.
- ✔ 0306.2.6 Solve a variety of addition and subtraction story problems including those with irrelevant information.
- ✔ 0306.2.7 Represent multiplication using various representations such as equal-size groups, arrays, area models, and equal jumps on number lines.
- ✔ 0306.2.8 Represent division using various representations such as successive subtraction, the number of equal jumps, partitioning, and sharing.
- ✔ 0306.2.9 Describe contexts for multiplication and division facts.
- ✔ 0306.2.10 Understand that symbols such as \( \frac{1}{2} \), \( \frac{1}{3} \), and \( \frac{1}{4} \) represent numbers called unit fractions.
- ✔ 0306.2.11 Identify fractions as parts of whole units, as parts of sets, as locations on number lines, and as division of two whole numbers.
- ✔ 0306.2.12 Compare fractions using drawings, concrete objects, and benchmark fractions.
- ✔ 0306.2.13 Understand that when a whole is divided into equal parts to create unit fractions, the sum of all the parts adds up to one.
State Performance Indicators:

SPI 0306.2.1 Read and write numbers up to 10,000 in numerals and up to 1,000 in words.
SPI 0306.2.2 Identify the place value of numbers in the ten-thousands, thousands, hundreds, tens, and ones positions.
SPI 0306.2.3 Convert between expanded and standard form with whole numbers to 10,000.
SPI 0306.2.4 Compare and order numbers up to 10,000 using the words less than, greater than, and equal to, and the symbols <, >, =.
SPI 0306.2.5 Identify various representations of multiplication and division.
SPI 0306.2.6 Recall basic multiplication facts through 10 times 10 and the related division facts.
SPI 0306.2.7 Compute multiplication problems that involve multiples of ten using basic number facts.
SPI 0306.2.8 Solve problems that involve the inverse relationship between multiplication and division.
SPI 0306.2.9 Solve contextual problems involving the addition (with and without regrouping) and subtraction (with and without regrouping) of two- and three digit whole numbers.
SPI 0306.2.10 Identify equivalent fractions given by various representations.
SPI 0306.2.11 Recognize and use different interpretations of fractions.
SPI 0306.2.12 Name fractions in various contexts that are less than, equal to, or greater than one.
SPI 0306.2.13 Recognize, compare, and order fractions (benchmark fractions, common numerators, or common denominators).
SPI 0306.2.14 Add and subtract fractions with like denominators.

Standard 3 – Algebra

Grade Level Expectations:

GLE 0306.3.1 Develop meaning for and apply the commutative, associative, and distributive properties using various representations.
GLE 0306.3.2 Develop understanding that a letter or a symbol can represent an unknown quantity in a simple mathematical expression/equation.
GLE 0306.3.3 Describe and analyze patterns and relationships in contexts.
GLE 0306.3.4 Create and represent patterns using words, tables, graphs, and symbols.

Checks for Understanding (Formative/Summative Assessment):

✅ 0306.3.1 Show that addition and multiplication are commutative operations.
✅ 0306.3.2 Show that subtraction and division are not commutative operations.
✅ 0306.3.3 Use commutative, associative, and distributive properties to multiply whole numbers.
✅ 0306.3.4 Solve problems using the commutative, associative, and distributive properties.
✅ 0306.3.5 Find unknowns in number sentences and problems involving addition, subtraction, multiplication, or division.
✅ 0306.3.6 Analyze patterns in words, tables, and graphs to draw conclusions.
✅ 0306.3.7 Create different representations of a pattern given a verbal description.
✅ 0306.3.8 Analyze patterns in quantitative change resulting from computation.

State Performance Indicators:

SPI 0306.3.1 Verify a conclusion using algebraic properties.
SPI 0306.3.2 Express mathematical relationships using number sentences/equations.
SPI 0306.3.3 Find the missing values in simple multiplication and division equations.
SPI 0306.3.4 Describe or extend (including finding missing terms) geometric and numeric patterns.
Standard 4 – Geometry and Measurement

Grade Level Expectations:
GLE 0306.4.1 Describe, compare, and analyze properties of polygons.
GLE 0306.4.2 Understand and apply the concepts of congruence and symmetry.
GLE 0306.4.3 Understand and use attributes of 2- and 3-dimensional figures to solve problems.
GLE 0306.4.4 Use appropriate units, strategies and tools to solve problems involving perimeter.
GLE 0306.4.5 Solve measurement problems involving fractional parts of linear units and capacity units.

Checks for Understanding (Formative/Summative Assessment):
✓ 0306.4.1 Describe properties of plane figures (such as circles, triangles, squares and rectangles) and solid shapes (such as spheres, cubes and cylinders).
✓ 0306.4.2 Classify polygons according to the number of their sides and angles.
✓ 0306.4.3 Classify lines and segments as parallel, perpendicular, or intersecting.
✓ 0306.4.4 Identify, create, and describe figures with line symmetry.
✓ 0306.4.5 Understand that all measurements require units.
✓ 0306.4.6 Recognize the use of fractions in liquid measures.
✓ 0306.4.7 Recognize the relationships among cups, pints, quarts, and gallons.
✓ 0306.4.8 Estimate and/or measure the capacity of a container.
✓ 0306.4.9 Measure weight to the nearest ounce or gram.
✓ 0306.4.10 Use reasonable units of length (i.e. kilometer, meter, centimeter; mile, yard, foot, inch) in estimates and measures.
✓ 0306.4.11 Know common equivalences for length (1 meter = 100 centimeters, 1 yard = 3 feet, 1 foot = 12 inches).
✓ 0306.4.12 Make and record measurements that use mixed units within the same system of measurement (such as feet and inches, meters and centimeters).
✓ 0306.4.13 Use common abbreviations: km, m, cm, in, ft, yd, mi.

State Performance Indicators:
SPI 0306.4.1 Recognize polygons and be able to identify examples based on geometric definitions.
SPI 0306.4.2 Determine if two figures are congruent based on size and shape.
SPI 0306.4.3 Identify the line of symmetry in a two-dimensional design or shape.
SPI 0306.4.4 Calculate the perimeter of shapes made from polygons.
SPI 0306.4.5 Choose reasonable units of measure, estimate common measurements using benchmarks, and use appropriate tools to make measurements.
SPI 0306.4.6 Measure length to the nearest centimeter or half inch.
SPI 0306.4.7 Solve problems requiring the addition and subtraction of lengths.

Standard 5 – Data Analysis, Statistics, and Probability

Grade Level Expectations:
GLE 0306.5.1 Organize, display, and analyze data using various representations to solve problems.

Checks for Understanding (Formative/Summative Assessment):
✓ 0306.5.1 Collect and organize data using observations, surveys, and experiments.
✓ 0306.5.2 Construct a frequency table, bar graph, pictograph, or line plot of collected data.
✓ 0306.5.3 Compare and interpret different representations of the same data.
✓ 0306.5.4 Solve problems using data from frequency tables, bar graphs, pictographs, or line plots.
State Performance Indicators:

- SPI 0306.5.1 Interpret a frequency table, bar graph, pictograph, or line plot.
- SPI 0306.5.2 Solve problems in which data is represented in tables or graph.
- SPI 0306.5.3 Make predictions based on various representations of data.
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Grade Four Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:

GLE 0406.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0406.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0406.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0406.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0406.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0406.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0406.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0406.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):

✓ 0406.1.1 Understand the relationship between use of answers and the accuracy of the number.
✓ 0406.1.2 Identify the range of appropriate estimates, including over-estimate and under-estimate.
✓ 0406.1.3 Connect operations with decimals to money and make estimates.
✓ 0406.1.4 Use commutative, associative, and distributive properties of numbers including oral descriptions of mathematical reasoning.
✓ 0406.1.5 Measure using ruler, meter stick, clock, thermometer, or other scaled instruments.
✓ 0406.1.6 Identify geometric or physical attributes that are appropriate to measure in a given situation.
✓ 0406.1.7 Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.
✓ 0406.1.8 Match the spoken, written, concrete (including base ten blocks), and pictorial representations of decimals.
✓ 0406.1.9 Develop a story problem that illustrates a given multiplication or division number sentence.
✓ 0406.1.10 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

State Performance Indicators:

SPI 0406.1.1 Verify a conclusion using the commutative, associative and distributive properties.
SPI 0406.1.2 Compare decimals using concrete and pictorial representations.
SPI 0406.1.3 Determine the correct change from a transaction.
SPI 0406.1.4 Compare objects with respect to a given geometric or physical attribute and select appropriate measurement instrument.

**Standard 2 - Number and Operations**

**Grade Level Expectations:**

GLE 0406.2.1 Understand place value of numbers from hundredths to the hundred-thousands place.
GLE 0406.2.2 Develop fluency with multiplication and single-digit division.
GLE 0406.2.3 Identify prime and composite numbers.
GLE 0406.2.4 Understand and use the connections between fractions and decimals.
GLE 0406.2.5 Add and subtract fractions with like and unlike denominators.
GLE 0406.2.6 Solve problems involving whole numbers, fractions, and/or decimals using all four arithmetic operations.

**Checks for Understanding (Formative/Summative Assessment):**

- ✓ 0406.2.1 Compose and decompose quantities according to place value.
- ✓ 0406.2.2 Understand decimal notation as an extension of the base-ten number system.
- ✓ 0406.2.3 Multiply two- and three-digit whole numbers.
- ✓ 0406.2.4 Understand and use a reliable algorithm for multiplying multi-digit numbers and dividing numbers by a single-digit divisor accurately and efficiently.
- ✓ 0406.2.5 Understand that division by zero is undefined.
- ✓ 0406.2.6 Divide three-digit whole numbers by one-digit divisors fluently with pencil and paper.
- ✓ 0406.2.7 Identify factors of whole numbers and model factors and products beyond basic multiplication facts using arrays and area models.
- ✓ 0406.2.8 Generate equivalent forms of whole numbers, decimals, and common fractions (e.g., $1/10, ¼, ½, ¾$).
- ✓ 0406.2.9 Compare equivalent forms whole numbers, fractions, and decimals to each other and to benchmark numbers.
- ✓ 0406.2.10 Use models to understand division as the inverse of multiplication, partitioning, and repeated subtraction.
- ✓ 0406.2.11 Use models, benchmarks, and equivalent forms to compare fractions/decimals and locate them on the number line.
- ✓ 0406.2.12 Understand and use decimal numbers up to hundredths and write them as fractions.
- ✓ 0406.2.13 Solve multi-step problems of various types using whole numbers, fractions, and decimals.
- ✓ 0406.2.14 Understand the role of the remainder in division.

**State Performance Indicators:**

- SPI 0406.2.1 Read and write numbers from hundredths to hundred-thousands in numerals and in words.
- SPI 0406.2.2 Locate and place mixed numbers on the number line.
- SPI 0406.2.3 Identify the place value of a specified digit in a number and the quantity it represents.
- SPI 0406.2.4 Find factors, common factors, multiples, and common multiples of two numbers.
- SPI 0406.2.5 Generate equivalent forms of common fractions and decimals and use them to compare size.
- SPI 0406.2.6 Use the symbols $<, >$, and $=$ to compare common fractions and decimals in both increasing and decreasing order.
- SPI 0406.2.7 Convert improper fractions into mixed numbers and/or decimals.
- SPI 0406.2.8 Add and subtract proper fractions with like and unlike denominators and simplify the answer.
- SPI 0406.2.9 Add and subtract decimals through hundredths.
- SPI 0406.2.10 Solve contextual problems using whole numbers, fractions, and decimals.
SPI 0406.2.11 Solve problems using whole number multi-digit multiplication.
SPI 0406.2.12 Solve problems using whole number division with one- or two-digit divisors.

Standard 3 – Algebra

Grade Level Expectations:
GLE 0406.3.1 Extend understanding of a variable to equations involving whole numbers, fractions, decimals, and/or mixed numbers.
GLE 0406.3.2 Use mathematical language and modeling to develop descriptions, rules and extensions of patterns.
GLE 0406.3.3 Translate between different forms of representations of whole number relationships.

Checks for Understanding (Formative/Summative Assessment):
✓ 0406.3.1 Find an unknown quantity in simple equations using whole numbers, fractions, decimals, and mixed numbers.
✓ 0406.3.2 Translate between symbols and words to represent quantities in expressions or equations.
✓ 0406.3.3 Create, explain and use a rule to generate terms of a pattern or sequence.
✓ 0406.3.4 Translate between symbolic, numerical, verbal, or pictorial representations of a whole number pattern or relationship.

State Performance Indicators:
SPI 0406.3.1 Use letters and symbols to represent an unknown quantity and write a simple mathematical expression.
SPI 0406.3.2 Make generalizations about geometric and numeric patterns.
SPI 0406.3.3 Represent and analyze patterns using words, function tables, and graphs.

Standard 4 – Geometry and Measurement

Grade Level Expectations:
GLE 0406.4.1 Understand and use the properties of lines, segments, angles, polygons, and circles.
GLE 0406.4.2 Understand and use measures of length, area, capacity, and weight.
GLE 0406.4.3 Solve problems that involve estimating and measuring length, area, capacity and weight.
GLE 0406.4.4 Understand the representation of location and movement within the first quadrant of a coordinate system.

Checks for Understanding (Formative/Summative Assessment):
✓ 0406.4.1 Identify the basic parts of circles.
✓ 0406.4.2 Understand the definition of degree as it relates to the circle.
✓ 0406.4.3 Classify angles and triangles as obtuse, acute, or right.
✓ 0406.4.4 Measure and draw angles.
✓ 0406.4.5 Determine if a figure is a polygon.
✓ 0406.4.6 Recognize the use of decimals in metric measures.
✓ 0406.4.7 Measure liquids using both standard units and metric units.
✓ 0406.4.8 Recognize that a measure of area represents the total number of same-sized units /that cover the shape without gaps or overlaps.
✓ 0406.4.9 Recognize that area does not change when 2-dimensional figures are cut apart and rearranged.
✓ 0406.4.10 Connect area measure to multiplication using a rectangular area model.
✓ 0406.4.11 Estimate areas of rectangles in square inches and square centimeters.
✓ 0406.4.12 Estimate the size of an object with respect to a given measurement attribute (length, perimeter, area, or capacity).
✓ 0406.4.13 Compare objects with respect to a given attribute such as length, area, and capacity.
✓ 0406.4.14 Explain how the components of a coordinate system are used to determine location.
✓ 0406.4.15 Explore properties of paths between points.
✓ 0406.4.16 Examine transformations in the coordinate plane.
✓ 0406.4.17 Predict the results of a transformation of a geometric shape.
✓ 0406.4.18 Determine whether a geometric shape has line and/or rotational symmetry.
✓ 0406.4.19 Design and analyze simple tilings and tessellations.
✓ 0406.4.20 Draw lines of symmetry in 2-dimensional figures.
✓ 0406.4.21 Recognize two-dimensional faces of three-dimensional shapes.

State Performance Indicators:
SPI 0406.4.1 Classify lines and line segments as parallel, perpendicular, or intersecting.
SPI 0406.4.2 Graph and interpret points with whole number or letter coordinates on grids or in the first quadrant of the coordinate plane.
SPI 0406.4.3 Construct geometric figures with vertices at points on a coordinate grid.
SPI 0406.4.4 Identify acute, obtuse, and right angles in 2-dimensional shapes.
SPI 0406.4.5 Identify attributes of simple and compound figures composed of 2- and 3-dimensional shapes.
SPI 0406.4.6 Determine situations in which a highly accurate measurement is important.
SPI 0406.4.7 Determine appropriate size of unit of measurement in problem situations involving length, capacity or weight.
SPI 0406.4.8 Convert measurements within a single system that are common in daily life (e.g., hours and minutes, inches and feet, centimeters and meters, quarts and gallons, liters and milliliters).
SPI 0406.4.9 Solve problems involving area and/or perimeter of rectangular figures.
SPI 0406.4.10 Identify images resulting from reflections, translations, or rotations.

Standard 5 – Data, Probability and Statistics

Grade Level Expectations:
GLE 0406.5.1 Collect, record, arrange, present, and interpret data using tables and various representations.
GLE 0406.5.2 Use probability to describe chance events.

Checks for Understanding (Formative/Summative Assessment):
✓ 0406.5.1 Create and label appropriate scales for graphs.
✓ 0406.5.2 Evaluate how well various representations show the collected data.
✓ 0406.5.3 Interpret and prepare pie charts using appropriate measurements of angles.
✓ 0406.5.4 Develop and use stem-and-leaf plots.
✓ 0406.5.5 Use measures of central tendency to compare two sets of related data.
✓ 0406.5.6 Determine a simple probability.
✓ 0406.5.7 Express a probability pictorially.

State Performance Indicators:
SPI 0406.5.1 Depict data using various representations (e.g., tables, pictographs, line graphs, bar graphs).
SPI 0406.5.2 Solve problems using estimation and comparison within a single set of data.
SPI 0406.5.3 Given a set of data or a graph, describe the distribution of the data using median, range, or mode.
SPI 0406.5.4 List all possible outcomes of a given situation or event.
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Grade Five Mathematics  

Standard 1 – Mathematical Processes  

Grade Level Expectations:  

GLE 0506.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.  
GLE 0506.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.  
GLE 0506.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.  
GLE 0506.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.  
GLE 0506.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.  
GLE 0506.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.  
GLE 0506.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.  
GLE 0506.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.  

Checks for Understanding (Formative/Summative Assessment):  

✓ 0506.1.1 Make and test conjectures about geometric properties and develop logical arguments to justify conclusions.  
✓ 0506.1.2 Make reasonable estimates of fraction and decimal sums or differences using models.  
✓ 0506.1.3 Explore different methods of estimation including rounding and truncating.  
✓ 0506.1.4 Explore problems in different contexts to interpret the meaning of remainders as discrete values or not.  
✓ 0506.1.5 Solve problems in more than one way and explain why one process may be more effective than another.  
✓ 0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units.  
✓ 0506.1.7 Organize and consolidate verbal statements involving fractions and mixed numbers into diagrams, symbols, and numerical expressions.  
✓ 0506.1.8 Use patterns, models, and relationships as contexts for writing inequalities and simple equations.  
✓ 0506.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.  

State Performance Indicators:  

SPI 0506.1.1 Given a series of geometric statements, draw a conclusion about the figure described.  
SPI 0506.1.2 Estimate fraction and decimal sums or differences.  
SPI 0506.1.3 Recognize the unit associated with the remainder in a division problem or the meaning of the fractional part of a whole given in either decimal or fraction form.  
SPI 0506.1.4 Identify missing information and/or too much information in contextual problems.
Standard 2 - Number and Operations

Grade Level Expectations:

GLE 0506.2.1 Extend the understanding of place value through millions and millionths in various contexts and representations.

GLE 0506.2.2 Write natural numbers (to 50) as a product of prime factors and understand that this is unique (apart from order).

GLE 0506.2.3 Develop fluency with division of whole numbers. Understand the relationship of divisor, dividend, and quotient in terms of multiplication and division.

GLE 0506.2.4 Develop fluency with addition and subtraction of proper and improper fractions and mixed numbers; explain and model the algorithm.

GLE 0506.2.5 Develop fluency in solving multi-step problems using whole numbers, fractions, mixed numbers, and decimals.

Checks for Understanding (Formative/Summative Assessment):

✓ 0506.2.1 Identify prime numbers up to 50.
✓ 0506.2.2 Use the prime factorization of two whole numbers to determine the greatest common factor and the least common multiple.
✓ 0506.2.3 Use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals.
✓ 0506.2.4 Use divisibility rules to factor numbers.
✓ 0506.2.5 Make reasonable estimates of fraction and decimal sums and differences.
✓ 0506.2.6 Add and subtract mixed numbers.
✓ 0506.2.7 Understand the placement of the decimal point in calculations of multiplication and long division, including the placement in the estimation of the answer.
✓ 0506.2.8 Understand that division by zero is undefined.
✓ 0506.2.9 Explore numbers less than 0 by extending the number line through familiar applications (e.g., temperatures below zero, owing money, measuring elevation below sea level).
✓ 0506.2.10 Use exponential notation to represent repeated multiplication of whole numbers.

State Performance Indicators:

SPI 0506.2.1 Read and write numbers from millions to millionths in various contexts.
SPI 0506.2.2 Write the prime factorization of numbers through 50 using both exponential and standard notation.
SPI 0506.2.3 Select a reasonable solution to a real-world division problem in which the remainder must be considered.
SPI 0506.2.4 Solve problems involving the division of two- and three-digit whole numbers by one- and two-digit whole numbers.
SPI 0506.2.5 Solve addition and subtraction problems involving both fractions and decimals.
SPI 0506.2.6 Add and subtract proper and improper fractions as well as mixed numbers.
SPI 0506.2.7 Recognize equivalent representations for the same number.
SPI 0506.2.8 Write terminating decimals in the form of fractions or mixed numbers.
SPI 0506.2.9 Compare whole numbers, decimals and fractions using the symbols <, >, and =.
Standard 3 – Algebra

Grade Level Expectations:
GLE 0506.3.1 Understand and use order of operations.
GLE 0506.3.2 Develop and apply the concept of variable.
GLE 0506.3.3 Understand and apply the substitution property.
GLE 0506.3.4 Solve single-step linear equations and inequalities.

Checks for Understanding (Formative/Summative Assessment):
✓ 0506.3.1 Evaluate an expression by substituting non-negative rational number values for letter variables in the expression.
✓ 0506.3.2 Use variables appropriately to represent numbers whose values are not yet known.
✓ 0506.3.3 Solve single-step linear equations using inverse operations.
✓ 0506.3.4 Solve single-step linear inequalities and graph solutions on a number line.
✓ 0506.3.5 Determine if a given value is a solution to a linear equation/inequality.
✓ 0506.3.6 Recognize there are many numbers between any two whole numbers on the number line.

State Performance Indicators:
SPI 0506.3.1 Evaluate algebraic expressions involving decimals and fractions using order of operations.
SPI 0506.3.2 Evaluate multi-step numerical expressions involving fractions using order of operations.
SPI 0506.3.3 Find the unknown in single-step equations involving fractions and mixed numbers.
SPI 0506.3.4 Given a set of values, identify those that make an inequality a true statement.

Standard 4 – Geometry and Measurement

Grade Level Expectations:
GLE 0506.4.1 Use basic formulas and visualization to find the area of geometric figures.
GLE 0506.4.2 Describe polyhedral solids and analyze their properties, including volume and surface area.
GLE 0506.4.3 Describe length/distance relationships using the first quadrant of the coordinate system.
GLE 0506.4.4 Solve problems that require attention to both approximation and precision of measurement.

Checks for Understanding (Formative/Summative Assessment):
✓ 0506.4.1 Develop the formula for the area of a triangle as it relates to the area of a parallelogram/rectangle.
✓ 0506.4.2 Find the area of a convex polygon by decomposing it into triangles/rectangles.
✓ 0506.4.3 Build, draw, and work with prisms by means of orthogonal views, projective views, and nets.
✓ 0506.4.4 Describe and identify the five regular (Platonic) solids and their properties with respect to faces, shapes of faces, edges, and vertices.
✓ 0506.4.5 Quantify total volume as filling space with same-sized units of volume without gaps or overlap.
✓ 0506.4.6 Decompose prisms to calculate surface area and volume.
✓ 0506.4.7 Understand, select and use units of appropriate size and type to measure angles, lengths/distances, area, surface area and volume.
✓ 0506.4.8 Identify characteristics of the set of points that define vertical and horizontal line segments.
✓ 0506.4.9 Correctly interpret significant digits in the accuracy of measurements and associated calculations.
✓ 0506.4.10 Recognize that measurements are never exact.
✓ 0506.4.11 Understand the usefulness of approximations.
✓ 0506.4.12 Develop strategies for choosing correct tools of measurement.
✓ 0506.4.13 Recognize and use measures of weight and temperature.

State Performance Indicators:
SPI 0506.4.1 Solve contextual problems that require calculating the area of triangles and parallelograms.
SPI 0506.4.2 Decompose irregular shapes to find perimeter and area.
SPI 0506.4.3 Identify a three-dimensional object from two-dimensional representations of that object and vice versa.
SPI 0506.4.4 Solve problems involving surface area and volume of rectangular prisms and polyhedral solids.
SPI 0506.4.5 Find the length of vertical or horizontal line segments in the first quadrant of the coordinate system, including problems that require the use of fractions and decimals.
SPI 0506.4.6 Record measurements in context to reasonable degree of accuracy using decimals and/or fractions.

Standard 5 – Data, Probability and Statistics

Grade Level Expectations:
GLE 0506.5.1 Make, record, display and interpret data and graphs that include whole numbers, decimals, and fractions.
GLE 0506.5.2 Describe the shape and important features of a set of data using the measures of central tendency.

Checks for Understanding (Formative/Summative Assessment):
✓ 0506.5.1 Construct and analyze double bar and line graphs.
✓ 0506.5.2 Represent data using ordered pairs in the first quadrant of the coordinate system.
✓ 0506.5.3 Design investigations to address a question and consider how data collection methods affect the nature of the data set.
✓ 0506.5.4 Recognize the differences in representing categorical and numerical data.
✓ 0506.5.5 Evaluate how different measures of central tendency describe data.
✓ 0506.5.6 Identify outliers and determine their effect on mean, median, mode and range.

State Performance Indicators:
SPI 0506.5.1 Depict data using various representations, including decimal and/or fractional data.
SPI 0506.5.2 Make predictions based on various data representations, including double bar and line graphs.
SPI 0506.5.3 Calculate measures of central tendency to analyze data.
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Grade Six Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:

GLE 0606.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0606.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

GLE 0606.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0606.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

GLE 0606.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0606.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0606.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

GLE 0606.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):

✓ 0606.1.1 Recognize different conventions used in calculator and computer spreadsheets (e.g., * for multiplication, ^ for exponent), but use mathematical notation in written work.

✓ 0606.1.2 Recognize when an estimate is more appropriate than an exact answer in a variety of problem situations.

✓ 0606.1.3 Recognize errors generated by rounding.

✓ 0606.1.4 Describe how changes in one quantity or variable result in changes in another.

✓ 0606.1.5 Illustrate properties of operations by showing that two expressions are equivalent in a given context (e.g., using an area model for distributive property, and grouping/set models for commutative and associative properties).

✓ 0606.1.6 Model situations by devising and carrying out experiments and simulations.

✓ 0606.1.7 Formulate questions, design studies, and collect real world data.

✓ 0606.1.8 Determine an appropriate sample to test an hypothesis.

✓ 0606.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

✓ 0606.1.10 Use various methods (such as dynamic geometry software) to explore properties of triangles and quadrilaterals.

✓ 0606.1.11 Model algebraic expressions with manipulatives, technology, and pencil and paper.
State Performance Indicators:
- SPI 0606.1.1 Make conjectures and predictions based on data.
- SPI 0606.1.2 Judge the reasonableness of the results of rational number estimates and/or computations.
- SPI 0606.1.3 Use concrete, pictorial, and symbolic representation for integers.
- SPI 0606.1.4 Select the representation that models one of the arithmetic properties (commutative, associative, or distributive).
- SPI 0606.1.5 Model algebraic expressions using algebra tiles.

Standard 2 – Number & Operations

Grade Level Expectations:
- GLE 0606.2.1 Understand and explain the procedures for multiplication and division of fractions, mixed numbers, and decimals.
- GLE 0606.2.2 Solve multi-step mathematical, contextual and verbal problems using fractions, mixed numbers, and decimals.
- GLE 0606.2.3 Understand and use ratios, rates and percents.
- GLE 0606.2.4 Understand and convert between fraction, decimal, and percent forms of rational numbers.
- GLE 0606.2.5 Develop meaning for integers; represent and compare quantities with integers.

Checks for Understanding (Formative/Summative Assessment):
- Efficiently compare and order fractions, decimals and percents; determine their approximate locations on a number line.
- Use area models to represent multiplication of fractions.
- Create and solve contextual problems that lead naturally to division of fractions.
- Understand ratio as a fraction used to compare two quantities by division.
- Recognize a:b, a/b, and “a to b” as notations for ratios.
- Recognize common percentages as ratios based on fractions whose denominators are 2, 3, 4, 5, or 10.
- Connect ratio and rate to multiplication and division.
- Recognize that a terminating decimal equals a fraction with a denominator that is a power of ten.
- Recognize that the decimal form of a rational number either terminates or repeats.
- Explore contexts that can be described with negative numbers (such as money, elevation, and temperature).

State Performance Indicators:
- SPI 0606.2.1 Solve problems involving the multiplication and division of fractions.
- SPI 0606.2.2 Solve problems involving the addition, subtraction, multiplication, and division of mixed numbers.
- SPI 0606.2.3 Solve problems involving the addition, subtraction, multiplication, and division of decimals.
- SPI 0606.2.4 Solve multi-step arithmetic problems using fractions, mixed numbers, and decimals.
- SPI 0606.2.5 Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers).
- SPI 0606.2.6 Solve problems involving ratios, rates and percents.
- SPI 0606.2.7 Locate positive rational numbers on the number line.
- SPI 0606.2.8 Locate integers on the number line.
Standard 3 – Algebra

Grade Level Expectations:
GLE 0606.3.1 Write and solve two-step equations and inequalities.
GLE 0606.3.2 Interpret and represent algebraic relationships with variables in expressions, simple equations and inequalities.
GLE 0606.3.3 Extend order of operations to include grouping symbols and exponents.
GLE 0606.3.4 Use expressions, equations and formulas to solve problems.
GLE 0606.3.5 Use multiple representations including symbolic algebra to model and/or solve contextual problems that involve linear relationships.
GLE 0606.3.6 Understand and use the Cartesian coordinate system.

Checks for Understanding (Formative/Summative Assessment):
✓ 0606.3.1 Write and solve two-step linear equations corresponding to given situations (non-negative numbers only).
✓ 0606.3.2 Write and solve one-step inequalities corresponding to given situations (non-negative numbers only).
✓ 0606.3.3 Recognize the use of juxtaposition (such as 3x, ab) to stand for multiplication, and the convention in these cases of writing numbers before letters.
✓ 0606.3.4 Generate data and graph relationships concerning measurement of length, area, volume, weight, time, temperature, money, and information.
✓ 0606.3.5 Use the commutative, associative and distributive properties to show that two expressions are equivalent.
✓ 0606.3.6 Use equations to describe simple relationships shown in a table or graph.
✓ 0606.3.7 Move fluently between different representations (such as verbal, tabular, numerical, algebraic, and graphical) of equations and expressions.
✓ 0606.3.8 Represent patterns using words, graphs, and simple symbolic notation.
✓ 0606.3.9 Write a contextual story modeled by a given graph.
✓ 0606.3.10 Understand that in an ordered pair (x, y), the x represents horizontal location and y represents vertical location.
✓ 0606.3.11 Identify the quadrant of the coordinate system in which a point lies.

State Performance Indicators:
SPI 0606.3.1 Represent on a number line the solution of a linear inequality.
SPI 0606.3.2 Use order of operations and parentheses to simplify expressions and solve problems.
SPI 0606.3.3 Write equations that correspond to given situations or represent a given mathematical relationship.
SPI 0606.3.4 Rewrite expressions to represent quantities in different ways.
SPI 0606.3.5 Translate between verbal expressions/sentences and algebraic expressions/equations.
SPI 0606.3.6 Solve two-step linear equations using number sense, properties, and inverse operations.
SPI 0606.3.7 Use algebraic expressions and properties to analyze numeric and geometric patterns.
SPI 0606.3.8 Select the qualitative graph that models a contextual situation (e.g., water filling then draining from a bathtub).
SPI 0606.3.9 Graph ordered pairs of integers in all four quadrants of the Cartesian coordinate system.
Standard 4 – Geometry & Measurement

Grade Level Expectations:

GLE 0606.4.1 Understand and use basic properties of triangles, quadrilaterals, and other polygons.
GLE 0606.4.2 Use the concepts of translation, rotation, reflection, and symmetry to understand congruence in the plane.
GLE 0606.4.3 Develop and use formulas to determine the circumference and area of circles, and the area of trapezoids, and develop strategies to find the area of composite shapes.
GLE 0606.4.4 Develop and use formulas for surface area and volume of 3-dimensional figures.

Checks for Understanding (Formative/Summative Assessment):

✓ 0606.4.1 Investigate the sum of the angles in a triangle and a quadrilateral using various methods.
✓ 0606.4.2 Relate the sum of the angles in a triangle to the sum of the angles in polygons.
✓ 0606.4.3 Verify the basic properties of triangles and quadrilaterals using a protractor and ruler.
✓ 0606.4.4 Classify triangles by side lengths (scalene, isosceles, and equilateral) and angle measure (acute, right, obtuse, isosceles and equiangular).
✓ 0606.4.5 Model and use the Triangle Inequality Theorem.
✓ 0606.4.6 Use the properties of interior and exterior angles of polygons to solve problems.
✓ 0606.4.7 Work with transformations in a plane and explore their meanings through drawings and manipulatives.
✓ 0606.4.8 Understand scaling, dilation and their relation to similarity.
✓ 0606.4.9 Analyze the differences between congruence and similarity.
✓ 0606.4.10 Describe the effect of a transformation on a 2-dimensional figure and the resulting symmetry.
✓ 0606.4.11 Relate the circumference of a circle with the perimeter of a polygonal figure.
✓ 0606.4.12 Derive the meaning of Pi using concrete models and/or appropriate technology.
✓ 0606.4.13 Understand the relationships among the radius, diameter, circumference and area of a circle, and that the ratio of the circumference to the diameter is the same as the ratio of the area to the square of the radius, and that this ratio is called Pi.
✓ 0606.4.14 Relate the area of a trapezoid to the area of a parallelogram.
✓ 0606.4.15 Find lengths given areas or volumes, and vice versa.
✓ 0606.4.16 Solve contextual problems involving area and circumference of circles, surface areas and volumes of prisms, pyramids, cones, and cylinders.
✓ 0606.4.17 Use manipulatives to discover the volume of a pyramid is one-third the volume of the related prism (the heights and base areas are equal).
✓ 0606.4.18 Use manipulatives to discover the volume of a cone is one-third the volume of the related cylinder (the heights and base areas are equal).

State Performance Indicators:

SPI 0606.4.1 Identify, define or describe geometric shapes given a visual representation or a written description of its properties.
SPI 0606.4.2 Find a missing angle measure in problems involving interior/exterior angles and/or their sums.
SPI 0606.4.3 Solve problems using the Triangle Inequality Theorem.
SPI 0606.4.4 Calculate with circumferences and areas of circles.
SPI 0606.4.5 Determine the surface area and volume of prisms, pyramids and cylinders.
SPI 0606.4.6 Given the volume of a cone/pyramid, find the volume of the related cylinder/prism or vice versa.
Standard 5 – Data Analysis, Statistics, & Probability

Grade Level Expectations:
GLE 0606.5.1 Understand the meaning of probability and how it is expressed.
GLE 0606.5.2 Interpret representations of data from surveys and polls, and describe sample bias and how data representations can be misleading.

Checks for Understanding (Formative/Summative Assessment):
✓ 0606.5.1 Understand that the probability of an event is a number between zero and one that expresses the likelihood of its occurrence.
✓ 0606.5.2 Identify the probability of an event as the ratio of the number of its actual occurrences to the total number of its possible occurrences.
✓ 0606.5.3 Express probabilities in different ways.
✓ 0606.5.4 Understand the difference between probability and odds.
✓ 0606.5.5 Analyze a situation that involves probability of an independent event.
✓ 0606.5.6 Estimate the probability of simple and compound events through experimentation or simulation.
✓ 0606.5.7 Apply procedures to calculate the probability of complimentary events.
✓ 0606.5.8 Connect data sets and their graphical representations (such as bar graphs, circle, graphs, and stem-and-leaf plots).
✓ 0606.5.9 Determine the sample space for a given situation.
✓ 0606.5.10 Distinguish between a random and nonrandom sample.
✓ 0606.5.11 Select the appropriate measure of center to describe a data set.
✓ 0606.5.12 Predict the characteristics of a population based on the analysis of sample data.

State Performance Indicators:
SPI 0606.5.1 Determine the theoretical probability of simple and compound events in familiar contexts.
SPI 0606.5.2 Identify features of graphs that may be misleading.
SPI 0606.5.3 Determine whether or not a sample is biased.
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Grade Seven Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:

GLE 0706.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0706.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

GLE 0706.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0706.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

GLE 0706.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0706.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0706.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

GLE 0706.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):

✓ 0706.1.1 Recognize common abbreviations (such as gcd/gcf and lcm).
✓ 0706.1.2 Recognize round-off error and the inaccuracies it introduces.
✓ 0706.1.3 Check answers both by estimation and by appropriate independent calculations, using calculators or computers judiciously.
✓ 0706.1.4 Recognize quantities that are inversely proportional (such as the relationship between the lengths of the base and the side of a rectangle with fixed area).
✓ 0706.1.5 Understand that a linear function in which f(0) = 0 is called a directly proportional relationship.
✓ 0706.1.6 Develop meaning of intercept and rate of change in contextual problems.
✓ 0706.1.7 Explain and demonstrate how scale in maps and drawings shows relative size and distance.
✓ 0706.1.8 Recognize the applications of scale factor by exploring blueprints, shadow measuring, and scale models.
✓ 0706.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0706.1.10 Model algebraic equations with manipulatives, technology, and pencil and paper.
✓ 0706.1.11 Translate from calculator notation to scientific/standard notation.
✓ 0706.1.12 Use dynamic geometry software to explore scale factor and similarity.
State Performance Indicators:

SPI 0706.1.1 Use proportional reasoning to solve mixture/concentration problems.
SPI 0706.1.2 Generalize a variety of patterns to a symbolic rule from tables, graphs, or words.
SPI 0706.1.3 Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship.
SPI 0706.1.4 Use scales to read maps.

Standard 2 – Number & Operations

Grade Level Expectations:

GLE 0706.2.1 Extend understandings of addition, subtraction, multiplication and division to integers.
GLE 0706.2.2 Understand and work with the properties of and operations on the system of rational numbers.
GLE 0706.2.3 Develop an understanding of and apply proportionality.
GLE 0706.2.4 Use ratios, rates and percents to solve single- and multi-step problems in various contexts.
GLE 0706.2.5 Understand and work with squares, cubes, square roots and cube roots.
GLE 0706.2.6 Introduce the concept of negative exponents.
GLE 0706.2.7 Understand and use scientific notation.

Checks for Understanding (Formative/Summative Assessment):

✓ 0706.2.1 Understand that the set of rational numbers includes any number that can be written as a ratio of two integers in which the denominator is not zero.
✓ 0706.2.2 Develop and analyze algorithms and compute efficiently with integers and rational numbers.
✓ 0706.2.3 Recognize that rational numbers satisfy the commutative and associative laws of addition and multiplication and the distributive law.
✓ 0706.2.4 Understand that a and –a are additive inverses and are located the same distance from zero on the number line; relate distance from zero to absolute value.
✓ 0706.2.5 Understand that –(–a) = a for any number a.
✓ 0706.2.6 Use the number line to demonstrate addition and subtraction with integers.
✓ 0706.2.7 Write number sentences to solve contextual problems involving ratio and percent.
✓ 0706.2.8 Apply ratios, rates, proportions and percents (such as discounts, interest, taxes, tips, distance/rate/time, and percent increase or decrease).
✓ 0706.2.9 Efficiently compare and order rational numbers and roots of perfect squares/cubes; determine their approximate locations on a number line.
✓ 0706.2.10 Recognize that when a whole number is not a perfect square, then its square root is not rational and cannot be written as the ratio of two integers.
✓ 0706.2.11 Estimate square/cube roots and use calculators to find approximations.
✓ 0706.2.12 Recognize $\sqrt{mn} = \sqrt{m} \cdot \sqrt{n}$ and $(\sqrt{m})^2 = m$
✓ 0706.2.13 Use the meaning of negative exponents to represent small numbers; translate between scientific and standard notation.
✓ 0706.2.14 Express numbers in scientific notation and recognize its importance in representing the magnitude of a number.
✓ 0706.2.15 Report results of calculations appropriately in a given context (i.e. using rules of rounding, degree of accuracy, and/or significant digits).
State Performance Indicators:

SPI 0706.2.1 Simplify numerical expressions involving rational numbers.
SPI 0706.2.2 Compare rational numbers using appropriate inequality symbols.
SPI 0706.2.3 Use rational numbers and roots of perfect squares/cubes to solve contextual problems.
SPI 0706.2.4 Determine the approximate location of square/cube roots on a number line.
SPI 0706.2.5 Solve contextual problems that involve operations with integers.
SPI 0706.2.6 Express the ratio between two quantities as a percent, and a percent as a ratio or fraction.
SPI 0706.2.7 Use ratios and proportions to solve problems.

Standard 3 – Algebra

Grade Level Expectations:

GLE 0706.3.1 Recognize and generate equivalent forms for simple algebraic expressions.
GLE 0706.3.2 Understand and compare various representations of relations and functions.
GLE 0706.3.3 Understand the concept of function as a rule that assigns to a given input one and only one number (the output).
GLE 0706.3.4 Use function notation where f(x) represents the output that the function f assigns to the input x.
GLE 0706.3.5 Understand and graph proportional relationships.
GLE 0706.3.6 Conceptualize the meanings of slope using various interpretations, representations, and contexts.
GLE 0706.3.7 Use mathematical models involving linear equations to analyze real-world phenomena.
GLE 0706.3.8 Use a variety of strategies to efficiently solve linear equations and inequalities.

Checks for Understanding (Formative/Summative Assessment):

✓ 0706.3.1 Perform basic operations on linear expressions (including grouping, order of operations, exponents, simplifying and expanding).
✓ 0706.3.2 Represent and analyze mathematical situations using algebraic symbols.
✓ 0706.3.3 Identify a function from a written description, table, graph, rule, set of ordered pairs, and/or mapping.
✓ 0706.3.4 Make tables of inputs x and outputs f(x) for a variety of rules that include rational numbers (including negative numbers) as inputs.
✓ 0706.3.5 Plot points to represent tables of linear function values.
✓ 0706.3.6 Understand that the graph of a linear function f is the set of points on a line representing the ordered pairs (x, f(x)).
✓ 0706.3.7 Distinguish proportional relationships (y/x = k, or y = kx) from other relationships, including inverse proportionality (xy = k, or y = k/x).
✓ 0706.3.8 Understand slope as the ratio of vertical change to horizontal change.
✓ 0706.3.9 Identify a function exhibiting a constant rate of change as a linear function and identify the slope as a unit rate.
✓ 0706.3.10 Solve problems involving unit rates (e.g., miles per hour, words per minute).
✓ 0706.3.11 Relate the features of a linear equation to a table and/or graph of the equation.
✓ 0706.3.12 Use linear equations to solve problems and interpret the meaning of slope, m, and the y-intercept, b, in f(x) = mx + b in terms of the context.
✓ 0706.3.13 Given a graph that exhibits the intersection of a line and the y-axis, write a linear function in slope-intercept form: y = mx + b.
✓ 0706.3.14 Understand that when solving linear inequalities, multiplication or division by a negative reverses the inequality symbol.
**State Performance Indicators:**
- SPI 0706.3.1 Evaluate algebraic expressions involving rational values for coefficients and/or variables.
- SPI 0706.3.2 Determine whether a relation (represented in various ways) is a function.
- SPI 0706.3.3 Given a table of inputs \(x\) and outputs \(f(x)\), identify the function rule and continue the pattern.
- SPI 0706.3.4 Interpret the slope of a line as a unit rate given the graph of a proportional relationship.
- SPI 0706.3.5 Represent proportional relationships with equations, tables and graphs.
- SPI 0706.3.6 Solve linear equations with rational coefficients symbolically or graphically.
- SPI 0706.3.7 Translate between verbal and symbolic representations of real-world phenomena involving linear equations.
- SPI 0706.3.8 Solve contextual problems involving two-step linear equations.
- SPI 0706.3.9 Solve linear inequalities in one variable with rational coefficients symbolically or graphically.

**Standard 4 – Geometry & Measurement**

**Grade Level Expectations:**
- GLE 0706.4.1 Understand the application of proportionality with similar triangles.
- GLE 0706.4.2 Apply proportionality to converting among different units of measurements to solve problems involving rates such as motion at a constant speed.
- GLE 0706.4.3 Understand and use scale factor to describe the relationships between length, area, and volume.
- GLE 0706.4.4 Understand and use ratios, derived quantities, and indirect measurements.

**Checks for Understanding (Formative/Summative Assessment):**
- **✓ 0706.4.1** Solve problems involving indirect measurement such as finding the height of a building by comparing its shadow with the height and shadow of a known object.
- **✓ 0706.4.2** Use similar triangles and proportionality to find the lengths of unknown line segments in a triangle.
- **✓ 0706.4.3** Understand that if a scale factor describes how corresponding lengths in two similar objects are related, then the square of the scale factor describes how corresponding areas are related, and the cube of the scale factor describes how corresponding volumes are related.
- **✓ 0706.4.4** Compare angles, side lengths, perimeters and areas of similar shapes.
- **✓ 0706.4.5** Solve problems using ratio quantities: velocity (measured in units such as miles per hour), density (measured in units such as kilograms per liter), pressure (measured in units such as pounds per square foot), and population density (measured in units such as persons per square mile).

**State Performance Indicators:**
- SPI 0706.4.1 Solve contextual problems involving similar triangles.
- SPI 0706.4.2 Use SSS, SAS, and AA to determine if two triangles are similar.
- SPI 0706.4.3 Apply scale factor to solve problems involving area and volume.
Standard 5 – Data Analysis, Statistics, & Probability

Grade Level Expectations:
- GLE 0706.5.1 Collect, organize, and analyze both single- and two-variable data.
- GLE 0706.5.2 Select, create, and use appropriate graphical representations of data.
- GLE 0706.5.3 Formulate questions and design studies to collect data about a characteristic shared by two populations, or different characteristics within one population.
- GLE 0706.5.4 Use descriptive statistics to summarize and compare data.
- GLE 0706.5.5 Understand and apply basic concepts of probability.

Checks for Understanding (Formative/Summative Assessment):
- ✓ 0706.5.1 Create and interpret box-and-whisker plots and stem-and-leaf plots.
- ✓ 0706.5.2 Interpret and solve problems using information presented in various visual forms.
- ✓ 0706.5.3 Predict and compare the characteristics of two populations based on the analysis of sample data.
- ✓ 0706.5.4 Use proportional reasoning to make predictions about results of experiments and simulations.
- ✓ 0706.5.5 Evaluate the design of an experiment.
- ✓ 0706.5.6 Apply percentages to make and interpret histograms and circle graphs.
- ✓ 0706.5.7 Use a tree diagram or organized list to determine all possible outcomes of a simple probability experiment.

State Performance Indicators:
- SPI 0706.5.1 Interpret and employ various graphs and charts to represent data.
- SPI 0706.5.2 Select suitable graph types (such as bar graphs, histograms, line graphs, circle graphs, box-and-whisker plots, and stem-and-leaf plots) and use them to create accurate representations of given data.
- SPI 0706.5.3 Calculate and interpret the mean, median, upper-quartile, lower-quartile, and interquartile range of a set of data.
- SPI 0706.5.4 Use theoretical probability to make predictions.
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Grade Eight Mathematics

Standard 1 – Mathematical Processes

Grade Level Expectations:
GLE 0806.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0806.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0806.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0806.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0806.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0806.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0806.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0806.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment):
✓ 0806.1.1 Relate nonlinear functions to geometric contexts of length, area, and volume.
✓ 0806.1.2 Draw qualitative graphs (trend graphs) of functions and describe their general shape/trend.
✓ 0806.1.3 Research the contributions of Pythagoras to mathematics.
✓ 0806.1.4 Relate data concepts to relevant concepts in the earth and space, life, and physical sciences.
✓ 0806.1.5 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0806.1.6 Use models (such as dynamic geometry software, patty paper and geo boards) to explore relationships among angles (complementary, supplementary, interior, exterior, vertical, and corresponding).
✓ 0806.1.7 Use a graphing calculator or spreadsheet to create scatterplots of data and approximate lines of best fit.
✓ 0806.1.8 Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g., manipulatives, technology, pencil and paper).

State Performance Indicators:
SPI 0806.1.1 Solve problems involving rate/time/distance (i.e., d = rt).
SPI 0806.1.2 Interpret a qualitative graph representing a contextual situation.
SPI 0806.1.3 Calculates rates involving cost per unit to determine the best buy.
Standard 2 – Number & Operations

Grade Level Expectations:
- GLE 0806.2.1 Extend understanding of the real number system to include irrational numbers.
- GLE 0806.2.2 Solve problems involving exponents and scientific notation using technology appropriately.
- GLE 0806.2.3 Solve real-world problems using rational and irrational numbers.
- GLE 0806.2.4 Understand and use the laws of exponents.

Checks for Understanding (Formative/Summative Assessment):
- ✓ 0806.2.1 Recognize and use exponential, scientific, and calculator notation.
- ✓ 0806.2.2 Square numbers and simplify square roots.
- ✓ 0806.2.3 Solve contextual problems involving powers and roots.
- ✓ 0806.2.4 Use a Venn diagram to represent the subsets of the real number system.
- ✓ 0806.2.5 Identify the subset(s) of the real number system to which a number belongs.
- ✓ 0806.2.6 Simplify expressions using the laws of exponents.
- ✓ 0806.2.7 Add, subtract, multiply, and divide numbers expressed scientific notation.

State Performance Indicators:
- SPI 0806.2.1 Order and compare rational and irrational numbers and locate on the number line.
- SPI 0806.2.2 Identify numbers and square roots as rational or irrational.
- SPI 0806.2.3 Use scientific notation to compute products and quotients.
- SPI 0806.2.4 Solve real-world problems requiring scientific notation.

Standard 3 – Algebra

Grade Level Expectations:
- GLE 0806.3.1 Recognize and generate equivalent forms for algebraic expressions.
- GLE 0806.3.2 Represent, analyze, and solve problems involving linear equations and inequalities in one and two variables.
- GLE 0806.3.3 Solve systems of linear equations in two variables.
- GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions.
- GLE 0806.3.5 Use slope to analyze situations and solve problems.
- GLE 0806.3.6 Compare and contrast linear and nonlinear functions.

Checks for Understanding (Formative/Summative Assessment):
- ✓ 0806.3.1 Perform basic operations on algebraic expressions (including grouping, order of operations, exponents, square/cube roots, simplifying and expanding).
- ✓ 0806.3.2 Represent algebraic relationships with equations and inequalities.
- ✓ 0806.3.3 Solve systems of linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line.
- ✓ 0806.3.4 Understand the relationship between the graph of a linear inequality and its solutions.
- ✓ 0806.3.5 Solve linear inequalities in two variables (including those whose solutions require multiplication or division by a negative number).
- ✓ 0806.3.6 Identify x- and y-intercepts and slope of linear equations from an equation, graph or table.
✓ 0806.3.7 Analyze situations and solve problems involving constant rate of change.
✓ 0806.3.8 Recognize a proportion as a special case of a linear equation and understand that the constant of proportionality is the slope, and the resulting graph is a line through the origin.
✓ 0806.3.9 Given a function rule, create tables of values for \( x \) and \( y \), and plot graphs of nonlinear functions.
✓ 0806.3.10 Distinguish quadratic and exponential functions as nonlinear using a graph and/or a table of values.
✓ 0806.3.11 Distinguish between the equations of linear, quadratic, and exponential functions (e.g. function families such as \( y = x^2 \), \( y = 2^x \), and \( y = 2x \)).
✓ 0806.3.12 Understand how rates of change of nonlinear functions contrast with constant rates of change of linear functions.
✓ 0806.3.13 Represent situations and solve real-world problems using symbolic algebra.

State Performance Indicators:
- SPI 0806.3.1 Find solutions to systems of two linear equations in two variables.
- SPI 0806.3.2 Solve the linear equation \( f(x) = g(x) \).
- SPI 0806.3.3 Solve and graph linear inequalities in two variables.
- SPI 0806.3.4 Translate between various representations of a linear function.
- SPI 0806.3.5 Determine the slope of a line from an equation, two given points, a table or a graph.
- SPI 0806.3.6 Analyze the graph of a linear function to find solutions and intercepts.
- SPI 0806.3.7 Identify, compare and contrast functions as linear or nonlinear.

Standard 4 – Geometry & Measurement

Grade Level Expectations:
- GLE 0806.4.1 Derive the Pythagorean theorem and understand its applications.
- GLE 0806.4.2 Understand the relationships among the angles formed by parallel lines cut by transversals.
- GLE 0806.4.3 Understand the necessary levels of accuracy and precision in measurement.
- GLE 0806.4.4 Understand both metric and customary units of measurement.
- GLE 0806.4.5 Use visualization to describe or identify intersections, cross-sections, and various views of geometric figures.

Checks for Understanding (Formative/Summative Assessment):
✓ 0806.4.1 Model the Pythagorean Theorem.
✓ 0806.4.2 Use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle.
✓ 0806.4.3 Select or use the appropriate measurement instrument to determine or create a given length, area, volume, angle, weight, or mass.
✓ 0806.4.4 Understand how the precision of measurement influences accuracy of quantities derived from these measurements.
✓ 0806.4.5 Analyze the congruent and supplementary relationships of angles formed by parallel lines and transversals (such as alternate interior, alternate exterior, corresponding, and adjacent).
✓ 0806.4.6 Make within-system and between-system conversions of derived quantities including distance, temperature, and money.
✓ 0806.4.7 Visualize or describe the cross-section resulting from the intersection of a plane with a 3-dimensional figure.
✓ 0806.4.8 Build, draw, and work with 2- and 3-dimensional figures by means of orthogonal views, projective views, and/or nets.

**State Performance Indicators:**

SPI 0806.4.1 Use the Pythagorean Theorem to solve contextual problems.
SPI 0806.4.2 Apply the Pythagorean theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra.
SPI 0806.4.3 Find measures of the angles formed by parallel lines cut by a transversal.
SPI 0806.4.4 Convert between and within the U.S. Customary System and the metric system.
SPI 0806.4.5 Identify the intersection of two or more geometric figures in the plane.

**Standard 5 – Data Analysis, Statistics, & Probability**

**Grade Level Expectations:**

GLE 0806.5.1 Explore probabilities for compound, independent and/or dependent events.
GLE 0806.5.2 Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures.
GLE 0806.5.3 Evaluate the use of statistics in media reports.

**Checks for Understanding (Formative/Summative Assessment):**

✓ 0806.5.1 Solve simple problems involving probability and relative frequency.
✓ 0806.5.2 Compare probabilities of two or more events and recognize when certain events are equally likely.
✓ 0806.5.3 Recognize common misconceptions associated with dependent and independent events.
✓ 0806.5.4 Explain the benefits and the limitations of various representations (i.e., bar graphs, line graphs, circle graphs, histograms, stem-and-leaf plots, box plots, scatterplots) of data.
✓ 0806.5.5 Create and interpret box-and-whisker plots and scatterplots.
✓ 0806.5.6 Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken.
✓ 0806.5.7 Estimate lines of best fit to make and test conjectures.
✓ 0806.5.8 Consider the source, design, analysis, and display of data to evaluate statistics reported in the media.

**State Performance Indicators:**

SPI 0806.5.1 Calculate probabilities of events for simple experiments with equally probable outcomes.
SPI 0806.5.2 Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models).
SPI 0806.5.3 Generalize the relationship between two sets of data using scatterplots and lines of best fit.
SPI 0806.5.4 Recognize misrepresentations of published data in the media.
Tennessee Mathematics Standards
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Algebra I

Standard 1 – Mathematical Processes

Course Level Expectations:
CLE 3102.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.
CLE 3102.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.
CLE 3102.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.
CLE 3102.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.
CLE 3102.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.
CLE 3102.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
CLE 3102.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Checks for Understanding (Formative/Summative Assessment):
✓ 3102.1.1 Develop meaning for mathematical vocabulary.
✓ 3102.1.2 Use the terminology of mathematics correctly.
✓ 3102.1.3 Understand and use mathematical symbols, notation, and common mathematical abbreviations correctly.
✓ 3102.1.4 Write a rule with variables that expresses a pattern.
✓ 3102.1.5 Use formulas, equations, and inequalities to solve real-world problems including time/rate/distance, percent increase/decrease, ratio/proportion, and mixture problems.
✓ 3102.1.6 Use a variety of strategies to estimate and compute solutions, including real-world problems.
✓ 3102.1.7 Identify missing or irrelevant information in problems.
✓ 3102.1.8 Recognize and perform multiple steps in problem solving when necessary.
✓ 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure, reflexive, symmetric, transitive, operation properties of equality).
✓ 3102.1.10 Use algebraic properties to develop a valid mathematical argument.
✓ 3102.1.11 Use manipulatives to model algebraic concepts.
✓ 3102.1.12 Create and work flexibly among representations of relations (including verbal, equations, tables, mappings, graphs).
✓ 3102.1.13 Change from one representation of a relation to another representation, for example, change from a verbal description to a graph.
✓ 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients and constants in functions.
✓ 3102.1.15 Apply arithmetic concepts in algebraic contexts.
✓ 3102.1.16 Understand and express the meaning of the slope and y-intercept of linear functions in real-world contexts.
✓ 3102.1.17 Connect the study of algebra to the historical development of algebra.
✓ 3102.1.18 Translate syntax of technology to appropriate mathematical notation.
✓ 3102.1.19 Recognize and practice appropriate use of technology in representations and in problem solving.
✓ 3102.1.20 Estimate solutions to evaluate the reasonableness of results and to check technological computation.

State Performance Indicators:
SPI 3102.1.1 Interpret patterns found in sequences, tables, and other forms of quantitative information using variables or function notation.
SPI 3102.1.2 Write an equation symbolically to express a contextual problem.
SPI 3102.1.3 Apply properties to evaluate expressions, simplify expressions, and justify solutions to problems.
SPI 3102.1.4 Translate between representations of functions that depict real-world situations.
SPI 3102.1.5 Recognize and express the effect of changing constants and/or coefficients in problem solving.
SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems.

Standard 2 – Number & Operations

Course Level Expectations:
CLE 3102.2.1 Understand computational results and operations involving real numbers in multiple representations.
CLE 3102.2.2 Understand properties of and relationships between subsets and elements of the real number system.

Checks for Understanding (Formative/Summative Assessment):
✓ 3102.2.1 Recognize and use like terms to simplify expressions.
✓ 3102.2.2 Apply the order of operations to simplify and evaluate algebraic expressions.
✓ 3102.2.3 Operate with and simplify radicals (index 2, 3, n) and radical expressions including rational numbers and variables in the radicand.
✓ 3102.2.4 Operate efficiently with both rational and irrational numbers.
✓ 3102.2.5 Perform operations with numbers in scientific notation (multiply, divide, powers).
✓ 3102.2.6 Use appropriate technologies to apply scientific notation to real-world problems.
✓ 3102.2.7 Identify the subsets in the real number system and understand their relationships.
✓ 3102.2.8 Use multiple strategies to approximate the value of an irrational number including irrational square roots and including location on the real number line.
State Performance Indicators:
SPI 3102.2.1 Operate (add, subtract, multiply, divide, simplify, powers) with radicals and radical expressions including radicands involving rational numbers and algebraic expressions.
SPI 3102.2.2 Multiply, divide, and square numbers expressed in scientific notation.
SPI 3102.2.3 Describe and/or order a given set of real numbers including both rational and irrational numbers.

Standard 3 – Algebra

Course Level Expectations:
CLE 3102.3.1 Use algebraic thinking to analyze and generalize patterns.
CLE 3102.3.2 Understand and apply properties in order to perform operations with, evaluate, simplify, and factor expressions and polynomials.
CLE 3102.3.3 Understand and apply operations with rational expressions and equations.
CLE 3102.3.4 Solve problems involving linear equations and linear inequalities.
CLE 3102.3.5 Manipulate formulas and solve literal equations.
CLE 3102.3.6 Understand and use relations and functions in various representations to solve contextual problems.
CLE 3102.3.7 Construct and solve systems of linear equations and inequalities in two variables by various methods.
CLE 3102.3.8 Solve and understand solutions of quadratic equations with real roots.
CLE 3102.3.9 Understand and use exponential functions to solve contextual problems.

Checks for Understanding (Formative/Summative Assessment):
✓ 3102.3.1 Recognize and extend arithmetic and geometric sequences.
✓ 3102.3.2 Explore patterns including Pascal’s Triangle and the Fibonacci sequence.
✓ 3102.3.3 Justify correct results of algebraic procedures using extension of properties of real numbers to algebraic expressions.
✓ 3102.3.4 Simplify expressions using exponent rules including negative exponents and zero exponents.
✓ 3102.3.5 Add, subtract, and multiply polynomials including squaring a binomial.
✓ 3102.3.6 Find the quotient of a polynomial and a monomial.
✓ 3102.3.7 Use various models (including area models) to represent products of polynomials.
✓ 3102.3.8 Find the GCF of the terms in a polynomial.
✓ 3102.3.9 Find two binomial factors of a quadratic expression.
✓ 3102.3.10 Add, subtract, multiply, and divide rational expressions and simplify results.
✓ 3102.3.11 Solve multi-step linear equations with one variable.
✓ 3102.3.12 Recognize and articulate when an equation has no solution, a single solution, or all real numbers as solutions.
✓ 3102.3.13 Solve multi-step linear inequalities with one variable and graph the solution on a number line.
✓ 3102.3.14 Solve absolute value equations and inequalities (including compound inequalities) with one variable and graph their solutions on a number line.
✓ 3102.3.15 Determine domain and range of a relation and articulate restrictions imposed either by the operations or by the real life situation that the function represents.
✓ 3102.3.16 Determine if a relation is a function from its graph or from a set of ordered pairs.
✓ 3102.3.17 Recognize “families” of functions.
✓ 3102.3.18 Analyze the characteristics of graphs of basic linear relations and linear functions including constant function, direct variation, identity function, vertical lines, absolute value of linear functions. Use technology where appropriate.
3102.3.19 Explore the characteristics of graphs of various nonlinear relations and functions including inverse variation, quadratic, and square root function. Use technology where appropriate.
3102.3.20 Understand that a linear equation has a constant rate of change called slope and represent slope in various forms.
3102.3.21 Determine the equation of a line using given information including a point and slope, two points, a point and a line parallel or perpendicular, graph, intercepts.
3102.3.22 Express the equation of a line in standard form, slope-intercept, and point-slope form.
3102.3.23 Determine the graph of a linear equation including those that depict contextual situations.
3102.3.24 Interpret the changes in the slope-intercept form and graph of a linear equation by looking at different values of the parameters, m and b.
3102.3.25 Find function values using f(x) notation or graphs.
3102.3.26 Graph linear inequalities on the coordinate plane and identify regions of the graph containing ordered pairs in the solution.
3102.3.27 Determine the number of solutions for a system of linear equations (0, 1, or infinitely many solutions).
3102.3.28 Solve systems of linear equations graphically, algebraically, and with technology.
3102.3.29 Solve contextual problems involving systems of linear equations or inequalities and interpret solutions in context.
3102.3.30 Solve quadratic equations using multiple methods: factoring, graphing, quadratic formula, or square root principle.
3102.3.31 Determine the number of real solutions for a quadratic equation including using the discriminant and its graph.
3102.3.32 Recognize the connection among factors, solutions (roots), zeros of related functions, and x-intercepts in equations that arise from quadratic functions.
3102.3.33 Recognize data that can be modeled by an exponential function.
3102.3.34 Graph exponential functions in the form $y = a(b^x)$ where $b \neq 0$.
3102.3.35 Apply growth/decay and simple/compound interest formulas to solve contextual problems.

**State Performance Indicators:**

SPI 3102.3.1 Express a generalization of a pattern in various representations including algebraic and function notation.
SPI 3102.3.2 Operate with polynomials and simplify results.
SPI 3102.3.3 Factor polynomials.
SPI 3102.3.4 Operate with, evaluate, and simplify rational expressions including determining restrictions on the domain of the variables.
SPI 3102.3.5 Write and/or solve linear equations, inequalities, and compound inequalities including those containing absolute value.
SPI 3102.3.6 Interpret various relations in multiple representations.
SPI 3102.3.7 Determine domain and range of a relation, determine whether a relation is a function and/or evaluate a function at a specified rational value.
SPI 3102.3.8 Determine the equation of a line and/or graph a linear equation.
SPI 3102.3.9 Solve systems of linear equation/inequalities in two variables.
SPI 3102.3.10 Find the solution of a quadratic equation and/or zeros of a quadratic function.
SPI 3102.3.11 Analyze nonlinear graphs including quadratic and exponential functions that model a contextual situation.
Standard 4 – Geometry & Measurement

Course Level Expectations:
CLE 3102.4.1 Use algebraic reasoning in applications involving geometric formulas and contextual problems.
CLE 3102.4.2 Apply appropriate units of measure and convert measures in problem solving situations.

Checks for Understanding (Formative/Summative Assessment)
✓ 3102.4.1 Using algebraic expressions solve for measures in geometric figures as well as for perimeter, area, and volume.
✓ 3102.4.2 Use the Pythagorean Theorem to find the missing measure in a right triangle including those from contextual situations.
✓ 3102.4.3 Understand horizontal/vertical distance in a coordinate system as absolute value of the difference between coordinates; develop the distance formula for a coordinate plane using the Pythagorean Theorem.
✓ 3102.4.4 Develop the midpoint formula for segments on a number line or in the coordinate plane.
✓ 3102.4.5 Use dimensional analysis to convert rates and measurements both within a system and between systems and check the appropriateness of the solution.

State Performance Indicators:
SPI 3102.4.1 Develop and apply strategies to estimate the area of any shape on a plane grid.
SPI 3102.4.2 Solve contextual problems using the Pythagorean Theorem.
SPI 3102.4.3 Solve problems involving the distance between points or midpoint of a segment.
SPI 3102.4.4 Convert rates and measurements.

Standard 5 – Data Analysis, Statistics, & Probability

Course Level Expectations:
CLE 3102.5.1 Describe and interpret quantitative information.
CLE 3102.5.2 Use statistical thinking to draw conclusions and make predictions.
CLE 3102.5.3 Understand basic counting procedures and concepts of probability.

Checks for Understanding (Formative/Summative Assessment):
✓ 3102.5.1 Identify patterns or trends in data.
✓ 3102.5.2 Develop a meaning for and identify outliers in a data set and verify.
✓ 3102.5.3 When a set of data is changed, identify effects on measures of central tendency, range, and inter-quartile range.
✓ 3102.5.4 Explore quartiles, deciles, and percentiles of a distribution.
✓ 3102.5.5 Construct and interpret various forms of data representations, (including line graphs, bar graphs, circle graphs, histograms, scatter-plots, box-and-whiskers, stem-and-leaf, and frequency tables).
✓ 3102.5.6 Draw qualitative graphs of functions and describe a general trend or shape.
✓ 3102.5.7 Compare two data sets using graphs and descriptive statistics.
✓ 3102.5.8 Examine real-world graphical relationship (including scatter-plots) to determine type of relationship (linear or nonlinear) and any association (positive, negative or none) between the variables of the data set.
✓ 3102.5.9 Determine an equation for a line that fits real-world linear data; interpret the meaning of the slope and y-intercept in context of the data.
✓ 3102.5.10 Using technology with a set of contextual linear data to examine the line of best fit; determine and interpret the correlation coefficient.
✓ 3102.5.11 Use an equation that fits data to make a prediction.
✓ 3102.5.12 Use techniques (Venn Diagrams, tree diagrams, or counting procedures) to identify the possible outcomes of an experiment or sample space and compute the probability of an event.
✓ 3102.5.13 Determine the complement of an event and the probability of that complement.
✓ 3102.5.14 Determine if two events are independent or dependent.
✓ 3102.5.15 Explore joint and conditional probability.
✓ 3102.5.16 Identify situations for which the Law of Large Numbers applies.
✓ 3102.5.17 Perform simulations to estimate probabilities.
✓ 3102.5.18 Make informed decisions about practical situations using probability concepts.

State Performance Indicators:
SPI 3102.5.1 Interpret displays of data to answer questions about the data set(s) (e.g., identify pattern, trends, and/or outliers in a data set).
SPI 3102.5.2 Identify the effect on mean, median, mode, and range when values in the data set are changed.
SPI 3102.5.3 Using a scatter-plot, determine if a linear relationship exists and describe the association between variables.
SPI 3102.5.4 Generate the equation of a line that fits linear data and use it to make a prediction.
SPI 3102.5.5 Determine theoretical and/or experimental probability of an event and/or its complement including using relative frequency.
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Geometry

Standard 1 – Mathematical Processes

Course Level Expectations:

CLE 3108.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

CLE 3108.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.

CLE 3108.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.

CLE 3108.1.4 Move flexibly between multiple representations (contextual, physical written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.

CLE 3108.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.

CLE 3108.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.

CLE 3108.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Checks for Understanding (Formative/Summative Assessment):

✓ 3108.1.1 Check solutions after making reasonable estimates in appropriate units of quantities encountered in contextual situations.

✓ 3108.1.2 Determine position using spatial sense with two and three-dimensional coordinate systems.

✓ 3108.1.3 Comprehend the concept of length on the number line.

✓ 3108.1.4 Recognize that a definition depends on undefined terms and on previous definitions.

✓ 3108.1.5 Use technology, hands-on activities, and manipulatives to develop the language and the concepts of geometry, including specialized vocabulary (e.g. graphing calculators, interactive geometry software such as Geometer’s Sketchpad and Cabri, algebra tiles, pattern blocks, tessellation tiles, MIRAs, mirrors, spinners, geoboards, conic section models, volume demonstration kits, Polydrons, measurement tools, compasses, PentaBlocks, pentominoes, cubes, tangrams).

✓ 3108.1.6 Use inductive reasoning to write conjectures and/or conditional statements.

✓ 3108.1.7 Recognize the capabilities and the limitations of calculators and computers in solving problems.

✓ 3108.1.8 Understand how the similarity of right triangles allows the trigonometric functions sine, cosine, and tangent to be defined as ratio of sides.

✓ 3108.1.9 Expand analysis of units of measure to include area and volume.
3108.1.10 Use visualization, spatial reasoning, and geometric modeling to solve problems.

3108.1.11 Identify and sketch solids formed by revolving two-dimensional figures around lines.

3108.1.12 Connect the study of geometry to the historical development of geometry.

3108.1.13 Use proofs to further develop and deepen the understanding of the study of geometry (e.g. two-column, paragraph, flow, indirect, coordinate).

3108.1.14 Identify and explain the necessity of postulates, theorems, and corollaries in a mathematical system.

State Performance Indicators:

SPI 3108.1.1 Give precise mathematical descriptions or definitions of geometric shapes in the plane and space.

SPI 3108.1.2 Determine areas of planar figures by decomposing them into simpler figures without a grid.

SPI 3108.1.3 Use geometric understanding and spatial visualization of geometric solids to solve problems and/or create drawings.

SPI 3108.1.4 Use definitions, basic postulates, and theorems about points, lines, angles, and planes to write/complete proofs and/or to solve problems.

Standard 2 – Number & Operations

Course Level Expectations:

CLE3108.2.1 Establish the relationships between the real numbers and geometry; explore the importance of irrational numbers to geometry.

CLE3108.2.2 Explore vectors as a numeric system, focusing on graphic representations and the properties of the operation.

CLE3108.2.3 Establish an ability to estimate, select appropriate units, evaluate accuracy of calculations and approximate error in measurement in geometric settings.

Checks for Understanding (Formative/Summative Assessment):

3108.2.1 Analyze properties and aspects of pi (e.g. classical methods of approximating pi, irrational numbers, Buffon’s needle, use of dynamic geometry software).

3108.2.2 Approximate pi from a table of values for the circumference and diameter of circles using various methods (e.g. line of best fit).

3108.2.3 Recognize and apply real number properties to vector operations and geometric proofs (e.g. reflexive, symmetric, transitive, addition, subtraction, multiplication, division, distributive, and substitution properties).

3108.2.4 Add vectors graphically and algebraically.

3108.2.5 Multiply a vector by a scalar graphically and algebraically.

3108.2.6 Analyze precision, accuracy, and approximate error in measurement situations.

State Performance Indicators:

SPI 3108.2.1 Analyze, apply, or interpret the relationships between basic number concepts and geometry (e.g. rounding and pattern identification in measurement, the relationship of pi to other rational and irrational numbers)

SPI 3108.2.2 Perform operations on vectors in various representations.
Standard 3 – Algebra

Course Level Expectations:
CLE 3108.3.1 Use analytic geometry tools to explore geometric problems involving parallel and perpendicular lines, circles, and special points of polygons.
CLE 3108.3.2 Explore the effect of transformations on geometric figures and shapes in the coordinate plane.

Checks for Understanding (Formative/Summative Assessment):
✓ 3108.3.1 Prove two lines are parallel, perpendicular, or oblique using coordinate geometry.
✓ 3108.3.2 Connect coordinate geometry to geometric figures in the plane (e.g. midpoints, distance formula, slope, and polygons).
✓ 3108.3.3 Find the equation of a circle given its center and radius and vice versa.
✓ 3108.3.4 Apply the midpoint and distance formulas to points and segments to find midpoints, distances, and missing information in two and three dimensions.
✓ 3108.3.5 Use mapping notation to identify the image of a transformation given the coordinates of the pre-image.
✓ 3108.3.6 Identify a transformation given its mapping notation.

State Performance Indicators:
SPI 3108.3.1 Use algebra and coordinate geometry to analyze and solve problems about geometric figures (including circles).
SPI 3108.3.2 Use coordinate geometry to prove characteristics of polygonal figures.
SPI 3108.3.3 Describe algebraically the effect of a single transformation (reflections in the x- or y-axis, rotations, translations, and dilations) on two-dimensional geometric shapes in the coordinate plane.

Standard 4 – Geometry & Measurement

Course Level Expectations:
CLE 3108.4.1 Develop the structures of geometry, such as lines, angles, planes, and planar figures, and explore their properties and relationships.
CLE 3108.4.2 Describe the properties of regular polygons, including comparative classification of them and special points and segments.
CLE 3108.4.3 Develop an understanding of the tools of logic and proof, including aspects of formal logic as well as construction of proofs.
CLE 3108.4.4 Develop geometric intuition and visualization through performing geometric constructions with straightedge/compass and with technology.
CLE 3108.4.5 Extend the study of planar figures to three-dimensions, including the classical solid figures, and develop analysis through cross-sections.
CLE 3108.4.6 Generate formulas for perimeter, area, and volume, including their use, dimensional analysis, and applications.
CLE 3108.4.7 Apply the major concepts of transformation geometry to analyzing geometric objects and symmetry.
CLE 3108.4.8 Establish processes for determining congruence and similarity of figures, especially as related to scale factor, contextual applications, and transformations.
CLE 3108.4.9 Develop the role of circles in geometry, including angle measurement, properties as a geometric figure, and aspects relating to the coordinate plane.
CLE 3108.4.10 Develop the tools of right triangle trigonometry in the contextual applications, including the Pythagorean Theorem, Law of Sines and Law of Cosines.
Checks for Understanding (Formative/Summative Assessment):

✓ 3108.4.1 Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true and discuss unique properties of each.
✓ 3108.4.2 Compare and contrast inductive reasoning and deductive reasoning for making predictions and valid conclusions based on contextual situations.
✓ 3108.4.3 Solve problems involving betweeness of points and distance between points (including segment addition).
✓ 3108.4.4 Describe and recognize minimal conditions necessary to define geometric objects.
✓ 3108.4.5 Use vertical, adjacent, complementary, and supplementary angle pairs to solve problems and write proofs.
✓ 3108.4.6 Describe the intersection of lines (in the plane and in space), a line and a plane, or of two planes.
✓ 3108.4.7 Identify perpendicular planes, parallel planes, a line parallel to a plane, skew lines, and a line perpendicular to a plane.
✓ 3108.4.8 Apply properties and theorems about angles associated with parallel and perpendicular lines to solve problems.
✓ 3108.4.9 Classify triangles, quadrilaterals, and polygons (regular, non-regular, convex and concave) using their properties.
✓ 3108.4.10 Identify and apply properties and relationships of special figures (e.g., isosceles and equilateral triangles, family of quadrilaterals, polygons, and solids).
✓ 3108.4.11 Use the triangle inequality theorems (e.g., Exterior Angle Inequality Theorem, Hinge Theorem, SSS Inequality Theorem, Triangle Inequality Theorem) to solve problems.
✓ 3108.4.12 Apply the Angle Sum Theorem for polygons to find interior and exterior angle measures given the number of sides, to find the number of sides given angle measures, and to solve contextual problems.
✓ 3108.4.13 Locate, describe, and draw a locus in a plane or space (e.g., fixed distance from a point on a plane, fixed distance from a point in space, fixed distance from a line, equidistant from two points, equidistant from two parallel lines, and equidistant from two intersecting lines).
✓ 3108.4.14 Identify and use medians, midsegments, altitudes, angle bisectors, and perpendicular bisectors of triangles to solve problems (e.g., find segment lengths, angle measures, points of concurrency).
✓ 3108.4.15 Identify, write, and interpret conditional and bi-conditional statements along with the converse, inverse, and contra-positive of a conditional statement.
✓ 3108.4.16 Analyze and create truth tables to evaluate conjunctions, disjunctions, conditionals, inverses, contra-positives, and bi-conditionals.
✓ 3108.4.17 Use the Law of Detachment, Law of Syllogism, conditional statements, and bi-conditional statements to draw conclusions.
✓ 3108.4.18 Use counterexamples, when appropriate, to disprove a statement.
✓ 3108.4.19 Use coordinate geometry to prove properties of plane figures.
✓ 3108.4.20 Prove key basic theorems in geometry (i.e., Pythagorean Theorem, the sum of the angles of a triangle is 180 degrees, characteristics of quadrilaterals, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length).
✓ 3108.4.21 Use properties of and theorems about parallel lines, perpendicular lines, and angles to prove basic theorems in Euclidean geometry (e.g., two lines parallel to a third line are parallel to each other, the perpendicular bisectors of line segments are the set of all points equidistant from the endpoints, and two lines are parallel when the alternate interior angles they make with a transversal are congruent).
3108.4.22 Perform basic geometric constructions using a straight edge and a compass, paper folding, graphing calculator programs, and computer software packages (i.e., bisect and trisect segments, congruent angles, congruent segments, a line parallel to a given line through a point not on the line, angle bisector, and perpendicular bisector).

3108.4.23 Describe the polyhedron or solid that can be made from a given net including the Platonic Solids.

3108.4.24 Develop and use special formulas relating to polyhedra (e.g., Euler’s Formula).

3108.4.25 Use properties of prisms, pyramids, cylinders, cones, spheres, and hemispheres to solve problems.

3108.4.26 Describe and draw cross-sections (including the conic sections) of prisms, cylinders, pyramids, spheres, and cones.

3108.4.27 Use right triangle trigonometry to find the area and perimeter of quadrilaterals (e.g. square, rectangle, rhombus, parallelogram, trapezoid, and kite).

3108.4.28 Derive and use the formulas for the area and perimeter of a regular polygon. (A=1/2 ap)

3108.4.29 Extend the effect of a scale factor k in similar objects to include the impact on volume calculations and transformations.

3108.4.30 Use right triangle relationships or the Pythagorean Theorem to find the lateral area (if possible), surface area, and volume of prisms, cylinders, cones, pyramids, spheres, and hemispheres.

3108.4.31 Use properties of single transformations and compositions of transformations to determine their effect on geometric figures (e.g. reflections across lines of symmetry, rotations, translations, glide reflections, and dilations).

3108.4.32 Recognize, identify and apply types of symmetries (point, line, rotational) of two- and three-dimensional figures.

3108.4.33 Use transformations to create and analyze tessellations and investigate the use of tessellations in architecture, mosaics, and artwork.

3108.4.34 Create and analyze geometric designs using rigid motions (compositions of reflections, translations, and rotations).

3108.4.35 Prove that two triangles are congruent by applying the SSS, SAS, ASA, AAS, and HL congruence statements.

3108.4.36 Use several methods, including AA, SSS, and SAS, to prove that two triangles are similar.

3108.4.37 Identify similar figures and use ratios and proportions to solve mathematical and real-world problems (e.g., Golden Ratio).

3108.4.38 Use the principle that corresponding parts of congruent triangles are congruent to solve problems.

3108.4.39 Identify lines and line segments associated with circles.

3108.4.40 Find angle measures, intercepted arc measures, and segment lengths formed by radii, chords, secants, and tangents intersecting inside and outside circles.

3108.4.41 Use inscribed and circumscribed polygons to solve problems concerning segment length and angle measures.

3108.4.42 Use geometric mean to solve problems involving relationships that exist when the altitude is drawn to the hypotenuse of a right triangle.

3108.4.43 Apply the Pythagorean Theorem and its converse to triangles to solve mathematical and contextual problems in two- or three-dimensional situations.

3108.4.44 Identify and use Pythagorean triples in right triangles to find lengths of an unknown side in two- or three-dimensional situations.

3108.4.45 Use the converse of the Pythagorean Theorem to classify a triangle by its angles (right, acute, or obtuse).

3108.4.46 Apply properties of 30° - 60° - 90° and 45° - 45° - 90° to determine side lengths of triangles.
✓ 3108.4.47 Find the sine, cosine and tangent ratios of an acute angle of a right triangle given the side lengths.
✓ 3108.4.48 Define, illustrate, and apply angles of elevation and angles of depression in real-world situations.
✓ 3108.4.49 Use the Law of Sines (excluding the ambiguous case) and the Law of Cosines to find missing side lengths and/or angle measures in non-right triangles.

State Performance Indicators:
SPI 3108.4.1 Differentiate between Euclidean and non-Euclidean geometries.
SPI 3108.4.2 Define, identify, describe, and/or model plane figures using appropriate mathematical symbols (including collinear and non-collinear points, lines, segments, rays, angles, triangles, quadrilaterals, and other polygons).
SPI 3108.4.3 Identify, describe and/or apply the relationships and theorems involving different types of triangles, quadrilaterals and other polygons.
SPI 3108.4.4 Analyze different types and formats of proofs.
SPI 3108.4.5 Describe solids and/or surfaces in three-dimensional space when given two-dimensional representations for the surfaces of three-dimensional objects.
SPI 3108.4.6 Use various area of triangle formulas to solve contextual problems (e.g., Heron’s formula, the area formula for an equilateral triangle, and \( A = \frac{1}{2} ab \sin C \)).
SPI 3108.4.7 Compute the area and/or perimeter of triangles, quadrilaterals and other polygons when one or more additional steps are required (e.g. find missing dimensions given area or perimeter of the figure, using trigonometry).
SPI 3108.4.8 Solve problems involving area, circumference, area of a sector, and/or arc length of a circle.
SPI 3108.4.9 Use right triangle trigonometry and cross-sections to solve problems involving surface areas and/or volumes of solids.
SPI 3108.4.10 Identify, describe, and/or apply transformations on two and three dimensional geometric shapes.
SPI 3108.4.11 Use basic theorems about similar and congruent triangles to solve problems.
SPI 3108.4.12 Solve problems involving congruence, similarity, proportional reasoning and/or scale factor of two similar figures or solids.
SPI 3108.4.13 Identify, analyze and/or use basic properties and theorems of circles to solve problems (including those relating right triangles and circles).
SPI 3108.4.14 Use properties of right triangles to solve problems (such as involving the relationship formed when the altitude to the hypotenuse of a right triangle is drawn).
SPI 3108.4.15 Determine and use the appropriate trigonometric ratio for a right triangle to solve a contextual problem.

Standard 5 – Data Analysis, Statistics, & Probability

Course Level Expectations:
CLE 3108.5.1 Analyze, interpret, employ and construct accurate statistical graphs.
CLE 3108.5.2 Develop the basic principles of geometric probability.

Checks for Understanding (Formative/Summative Assessment):
✓ 3108.5.1 Determine the area of each sector and the degree measure of each intercepted arc in a pie chart.
✓ 3108.5.2  Translate from one representation of data to another (e.g., bar graph to pie graph, pie graph to bar graph, table to pie graph, pie graph to chart) accurately using the area of a sector.

✓ 3108.5.3  Estimate or calculate simple geometric probabilities (e.g., number line, area model, using length, circles).

State Performance Indicators:
SPI 3108.5.1  Use area to solve problems involving geometric probability (e.g. dartboard problem, shaded sector of a circle, shaded region of a geometric figure).
Algebra II

Standard 1 – Mathematical Processes

Course Level Expectations:
CLE 3103.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.
CLE 3103.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.
CLE 3103.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.
CLE 3103.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.
CLE 3103.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.
CLE 3103.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
CLE 3103.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Checks for Understanding (Formative/Summative Assessment):
✓ 3103.1.1 Create and analyze scatter-plots of non-linear and transcendental functions.
✓ 3103.1.2 Compare and contrast sampling techniques and identify the best technique for a given situation.
✓ 3103.1.3 Use calculators to identify regression equations for nonlinear data.
✓ 3103.1.4 Identify the weaknesses of calculators and other technologies in representing non-linear data, such as graphs approaching vertical asymptotes, and use alternative techniques to identify these issues and correctly solve problems.
✓ 3103.1.5 Determine the accuracy and reliability of a mathematical model.
✓ 3103.1.6 Use graphical representations to perform operations on complex numbers.
✓ 3103.1.7 Use the unit circle to determine the exact value of trigonometric functions for commonly used angles (0°, 30°, 45°, 60°…).
✓ 3103.1.8 Understand and describe the inverse relationship between exponential and logarithmic functions.
✓ 3103.1.9 Translate the syntax of technology to appropriate mathematical notation for non-linear and transcendental functions.
✓ 3103.1.10 Interpret the results of mathematical modeling in various contexts to answer questions.
State Performance Indicators:

SPI 3103.1.1 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic) of non-linear and transcendental functions to solve problems, to model mathematical ideas, and to communicate solution strategies.

SPI 3103.1.2 Recognize and describe errors in data collection and analysis as well as identifying representations of data as being accurate or misleading.

SPI 3103.1.3 Use technology tools to identify and describe patterns in data using non-linear and transcendental functions that approximate data as well as using those functions to solve contextual problems.

SPI 3103.1.4 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely to effectively communicate reasoning in the process of solving problems via mathematical modeling with both linear and non-linear functions.

Standard 2 – Number & Operations

Course Level Expectations:

CLE 3103.2.1 Understand the hierarchy of the complex number system and relationships between the elements, properties and operations.

CLE 3103.2.2 Connect numeric, analytic, graphical and verbal representations of both real and complex numbers.

CLE 3103.2.3 Use appropriate technology (including graphing calculators and computer spreadsheets) to solve problems, recognize patterns and collect and analyze data.

CLE 3103.2.4 Understand the capabilities and limitations of technology when performing operations, graphing, and solving equations involving complex numbers.

Checks for Understanding (Formative/Summative Assessment):

✓ 3103.2.1 Understand that to solve certain problems and equations, the real number system needs to be extended from real numbers to complex numbers.

✓ 3103.2.2 Define and give examples of each of the types of numbers in the complex number system.

✓ 3103.2.3 Identify and apply properties of complex numbers (including simplification and standard form).

✓ 3103.2.4 Add and subtract complex numbers.

✓ 3103.2.5 Multiply complex numbers.

✓ 3103.2.6 Define and utilize the complex conjugates to write the quotient of two complex numbers in standard form.

✓ 3103.2.7 Graph complex numbers in the complex plane and recognize differences and similarities with the graphical representations of real numbers graphed on the number line.

✓ 3103.2.8 Solve quadratic equations over the complex number system.

✓ 3103.2.9 Find and describe geometrically the absolute value of a complex number.

✓ 3103.2.10 Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers over complex numbers.

✓ 3103.2.11 Understand the capabilities and limitations of technology. Make estimations without a calculator to detect potential errors.

✓ 3103.2.12 Select and use appropriate methods to make estimations without technology when solving contextual problems.

✓ 3103.2.13 Analyze and evaluate contextual situations involving any type of number from the complex number system.
State Performance Indicators:
SPI 3103.2.1 Describe any number in the complex number system.
SPI 3103.2.2 Compute with all real and complex numbers.
SPI 3103.2.3 Use the number system, from real to complex, to solve equations and contextual problems.

Standard 3 – Algebra

Course Level Expectations:
CLE 3103.3.1 Understand and apply properties of rational exponents and perform basic operations to simplify algebraic expressions.
CLE 3103.3.2 Understand, analyze, transform and generalize mathematical patterns, relations and functions using properties and various representations.
CLE 3103.3.3 Analyze and apply various methods to solve equations, absolute values, inequalities, and systems of equations over complex numbers.
CLE 3103.3.4 Graph and compare equations and inequalities in two variables. Identify and understand the relationships between the algebraic and geometric properties of the graph.
CLE 3103.3.5 Use mathematical models involving equations and systems of equations to represent, interpret and analyze quantitative relationships, change in various contexts, and other real-world phenomena.

Checks for Understanding (Formative/Summative Assessment)
✓ 3103.3.1 Perform operations on algebraic expressions and justify the procedures.
✓ 3103.3.2 Determine the domain of a function represented in either symbolic or graphical form.
✓ 3103.3.3 Determine and graph the inverse of a function with and without technology.
✓ 3103.3.4 Analyze the effect of changing various parameters on functions and their graphs.
✓ 3103.3.5 Graph piece-wise and step functions.
✓ 3103.3.6 Simplify expressions and solve equations containing radicals.
✓ 3103.3.7 Solve quadratic equations by factoring, graphing, completing the square, extracting square roots and using the quadratic formula.
✓ 3103.3.8 Solve a three by three system of linear equations algebraically and by using inverse matrices and determinants with and without technology.
✓ 3103.3.9 Find an equation for a parabola when given its graph or when given its roots.
✓ 3103.3.10 Given a quadratic equation use the discriminant to determine the nature of the roots.
✓ 3103.3.11 Describe and articulate the characteristics and parameters of a parent function.
✓ 3103.3.12 Understand the relationship between real zeros of a function and the x-intercepts of its graph.
✓ 3103.3.13 Solve problems using exponential functions requiring the use of logarithms for their solutions.
✓ 3103.3.14 Define and use arithmetic and geometric sequences and series including using sigma and pi notation.
✓ 3103.3.15 Find the sum of an geometric series whose common ratio, r, is in the interval (-1,1).
✓ 3103.3.16 Prove basic properties of logarithms using properties of exponents and apply those properties to solve problems.
✓ 3103.3.17 Know that the logarithm and exponential functions are inverses and use this information to solve real-world problems.
✓ 3103.3.18 Solve compound inequalities involving disjunction and conjunction and linear inequalities containing absolute values.
✓ 3103.3.19 Solve linear programming problems.
✓ 3103.3.20 Understand the relationships between the equations of conic sections and their graphs.
✓ 3103.3.21 Factor polynomials using a variety of methods including the factor theorem, synthetic division, long division, sums and differences of cubes, and grouping.
✓ 3103.3.22 Determine the number and possible types of zeros for a polynomial function and find the rational roots.
✓ 3103.3.23 Understand the connection between the roots, zeros, x-intercepts, factors of polynomials, and solutions of polynomial equations.

State Performance Indicators
SPI 3103.3.1 Add, subtract and multiply polynomials; divide a polynomial by a lower degree polynomial.
SPI 3103.3.2 Solve quadratic equations and systems, and determine roots of a higher order polynomial.
SPI 3103.3.3 Add, subtract, multiply, divide and simplify rational expressions including those with rational and negative exponents.
SPI 3103.3.4 Use the formulas for the general term and summation of finite arithmetic and both finite and infinite geometric series.
SPI 3103.3.5 Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the contextual situations which the functions represent.
SPI 3103.3.6 Combine functions (such as polynomial, rational, radical and absolute value expressions) by addition, subtraction, multiplication, division, or by composition and evaluate at specified values of their variables.
SPI 3103.3.7 Identify whether a function has an inverse, whether two functions are inverses of each other, and/or explain why their graphs are reflections over the line y = x.
SPI 3103.3.8 Solve systems of three linear equations in three variables.
SPI 3103.3.9 Graph the solution set of two or three linear or quadratic inequalities.
SPI 3103.3.10 Identify and/or graph a variety of functions and their transformations.
SPI 3103.3.11 Graph conic sections (circles, parabolas, ellipses and hyperbolas) and understand the relationship between the standard form and the key characteristics of the graph.
SPI 3103.3.12 Interpret graphs that depict real-world phenomena.
SPI 3103.3.13 Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.
SPI 3103.3.14 Solve problems involving the binomial theorem and its connection to Pascal’s Triangle, combinatorics, and probability.

Standard 4 – Geometry & Measurement

Course Level Expectations:
CLE 3103.4.1 Understand the trigonometric functions and their relationship to the unit circle.
CLE 3103.4.2 Know and use the basic identities of sine, cosine, and tangent as well as their reciprocals.
CLE 3103.4.3 Graph all six trigonometric functions and identify their key characteristics.
CLE 3103.4.4 Know and use the Law of Sines to find missing sides and angles of a triangle, including the ambiguous case.
CLE 3103.4.5 Use trigonometric concepts, properties and graphs to solve problems.

Checks for Understanding (Formative/Summative Assessment):
✓ 3103.4.1 Convert between radians and degrees and vice versa.
✓ 3103.4.2 Determine the period and the amplitude of a periodic function.
✓ 3103.4.3 Extend the trigonometric functions to periodic functions on the real line by defining them as functions on the unit circle.
✓ 3103.4.4 Understand the relationship between the radius, the central angle, and radian measure.
✓ 3103.4.5 Determine the domain and range of the six trigonometric functions given a graph.
✓ 3103.4.6 Know and be able to use the fundamental trigonometric identities, including the Pythagorean identities, reciprocal identities, sum of sine and cosine, and odd and even identities.

State Performance Indicators:
SPI 3103.4.1 Exhibit knowledge of unit circle trigonometry.
SPI 3103.4.2 Match graphs of basic trigonometric functions with their equations.
SPI 3103.4.3 Describe and articulate the characteristics and parameters of parent trigonometric functions to solve contextual problems.

Standard 5 – Data Analysis, Statistics, & Probability

Course Level Expectations:
CLE 3103.5.1 Describe, interpret, and apply quantitative data.
CLE 3103.5.2 Evaluate and critique various ways of collecting data and using information based on data published in the media.
CLE 3103.5.3 Use data and statistical thinking to draw inferences, make predictions, justify conclusions and identify and explain misleading uses of data.
CLE 3103.5.4 Develop an understanding of probability concepts in order to make informed decisions.

Checks for Understanding (Formative/Summative Assessment):
✓ 3103.5.1 Collect, represent and describe both linear and non-linear data developed from contextual situations.
✓ 3103.5.2 Organize and display data using appropriate methods (including spreadsheets and technology tools) to detect patterns and departures from patterns.
✓ 3103.5.3 Read and interpret data from a two-way table.
✓ 3103.5.4 Understand the impact of various sampling methods and use them to draw valid conclusions.
✓ 3103.5.5 Calculate measures of central tendency and spread (variance and standard deviation).
✓ 3103.5.6 Use technology to find the appropriate regression equation for both linear and non-linear data.
✓ 3103.5.7 Recognize when the correlation coefficient measures goodness of fit and does not imply causation.
✓ 3103.5.8 Know the Empirical Rule for one, two and three standard deviations for a normal distribution.
✓ 3103.5.9 Use data to detect patterns.
✓ 3103.5.10 Design simple experiments to collect data to answer questions of interest.
✓ 3103.5.11 Evaluate published data by considering the source, the design of the study and the analysis and representation (or misrepresentation) of the data.
✓ 3103.5.12 Investigate bias and the phrasing of questions during data acquisition to formulate reasonable conclusions.
✓ 3103.5.13 Apply both theoretical and experimental probability to analyze the likelihood of an event.

State Performance Indicators:
SPI 3103.5.1 Compute, compare and explain summary statistics for distributions of data including measures of center and spread.
SPI 3103.5.2 Compare data sets using graphs and summary statistics.
SPI 3103.5.3 Analyze patterns in a scatter-plot and describe relationships in both linear and non-linear data.

SPI 3103.5.4 Apply the characteristics of the normal distribution.

SPI 3103.5.5 Determine differences between randomized experiments and observational studies.

SPI 3103.5.6 Find the regression curve that best fits both linear and non-linear data (using technology such as a graphing calculator) and use it to make predictions.

SPI 3103.5.7 Determine/recognize when the correlation coefficient measures goodness of fit.

SPI 3103.5.8 Apply probability concepts such as conditional probability and independent events to calculate simple probability.
APPENDIX B
(Formative and Summative Assessment Mapping)
A suggested alignment provided to the
Tennessee Department of Education
by a Tennessee field practioner
Mapping GLEs to Checks for Understanding and SPIs
for the K – 12 Tennessee Mathematics Framework
Kindergarten Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0006.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0006.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
✓ 0006.1.2 Begin to develop the concept of estimation using concrete objects.

GLE 0006.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0006.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

GLE 0006.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
✓ 0006.1.1 Model addition and subtraction (e.g., using a number chart, number line and/or concrete objects).
✓ 0006.1.8 Recognize a thermometer as a way of measuring temperature.

GLE 0006.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
✓ 0006.1.3 Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, tomorrow).
✓ 0006.1.4 Tell time to the hour.
✓ 0006.1.7 Use words to describe temperature (e.g., hot, warm, cool, cold).

GLE 0006.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
✓ 0006.1.5 Recognize a calendar as a way of measuring time.
✓ 0006.1.6 Name and identify coins and their values.
✓ 0006.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0006.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Standard 2 – Number and Operations
GLE 0006.2.1 Count objects in a set and use numbers, including written numerals to 25.
✓ 0006.2.1 Count objects to 25 using one-to-one correspondence and identify the quantity in the counted group.
✓ 0006.2.2 Match quantities to 25 with numerals and written words.
✓ 0006.2.3 Count backward from 10 to 1.
✓ 0006.2.4 Count to 20 by twos.
GLE 0006.2.2 Create, represent and recognize a set with a given number of objects.
   ✓ 0006.2.5 Create a set with a given number of objects.
   ✓ 0006.2.6 Quickly recognize the number of objects in a small set.
   ✓ 0006.2.7 Recognize zero (0) as a set with “no objects”.
   ✓ 0006.2.8 Compare sets of ten or fewer objects and identify which are equal to, more than, or less than others.

GLE 0006.2.3 Recognize, compare and order sets of numerals by using both cardinal and ordinal meanings.
   ✓ 0006.2.9 Order the numbers through 25 using numerals and words.
   ✓ 0006.2.11 Recognize and use ordinal numbers (e.g., first, fourth, last).

GLE 0006.2.4 Understand addition as “putting together” and subtraction as “breaking apart.”
   ✓ 0006.2.12 Model simple joining and separating situations with objects.
   ✓ 0006.2.13 Add and subtract single-digit numbers whose total or difference is between 0 and 10.
   ✓ 0006.2.14 Understand add as “put together” or “count on” and solve addition problems with sums less than 20.
   ✓ 0006.2.15 Understand subtraction as “break apart” or “take away” and solve subtraction problems using numbers 1 through 10.
   ✓ 0006.2.16 Model, demonstrate, and solve story problems that illustrate addition and subtraction.

GLE 0006.2.5 Model the numbers 1 through 10 as sums or differences of different sets of whole numbers (composing and decomposing numbers).
   ✓ 0006.2.10 Recognize 6 through 10 as “five and some ones.”
   ✓ 0006.2.17 Understand that numbers can be represented by different groupings.

Standard 3 – Algebra
GLE 0006.3.1 Identify, duplicate, and extend simple number patterns and sequential and growing patterns.
   ✓ 0006.3.2 Name, copy, and extend patterns.
   ✓ 0006.3.3 Translate simple patterns into rules.

GLE 0006.3.2 Recognize attributes (such as color, shape, size) and patterns (such as repeated pairs, bilateral symmetry).
   ✓ 0006.3.1 Use a variety of manipulatives (such as connecting cubes, number cards, shapes) to create patterns.
   ✓ 0006.3.4 Sort, order and classify objects by attribute and identify objects that do not belong in a particular group.

GLE 0006.3.3 Describe qualitative change.
   ✓ 0006.3.5 Describe change in attributes according to qualitative criteria such as longer/shorter, colder/warmer, heavier/lighter.

Standard 4 – Geometry and Measurement
GLE 0006.4.1 Interpret and describe the physical world with geometric ideas and vocabulary.
   ✓ 0006.4.1 Identify, name, and describe a variety of shapes (i.e. circles, squares, triangles, rectangles, hexagons, trapezoids) shown in various positions.
   ✓ 0006.4.2 Identify, name, and describe three-dimensional shapes (such as sphere, cube, cone, cylinder).
   ✓ 0006.4.3 Sort plane figures into groups, name and describe the attributes of the shapes (such as number of sides and corners (vertices).
   ✓ 0006.4.4 Sort solid figures into groups, name and describe the attributes of the shapes.
   ✓ 0006.4.5 Use basic shapes and spatial reasoning to model objects and construct more complex shapes.
GLE 0006.4.2 Use positional terms to specify locations with simple relationships.
- Identify positions (such as beside, inside, outside, above, below, between, on, over, under, near, far, forward, backward, top, middle, bottom, left, right) using models, illustrations, and stories.

GLE 0006.4.3 Compare and order measurable attributes of objects directly (by comparing them with each other) and indirectly (by comparing both with a third object).
- Make direct and indirect comparisons between objects (such as recognize which is shorter, longer, taller, lighter, heavier, or holds more).

Standard 5 – Data, Probability and Statistics
GLE 0006.5.1 Sort objects and use one or more attributes to solve problems.
- Sort objects into sets and describe how the objects were sorted.
- Collect and count data

GLE 0006.5.2 Re-sort objects using new attributes.
- Sort objects in different ways.

Grade One Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0106.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
- Recognize the “word clues” and mathematical symbols for addition and subtraction.

GLE 0106.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

GLE 0106.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0106.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
- Apply spatial sense to recreate a figure from memory.
- Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.

GLE 0106.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
- Compare units of time.
- Use a thermometer to measure temperature.
- Recognize scales as a way of measuring weight.

GLE 0106.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
- Describe the relationship between days and months.
- Read and write time to the hour, half-hour, and quarter-hour.
GLE 0106.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
   ✓0106.1.4 Count the value of a set of coins up to fifty cents.
   ✓0106.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0106.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Standard 2 – Number and Operations
GLE 0106.2.1 Understand and use number notation and place value to 100.
   ✓0106.2.1 Read and write numerals up to 100.
   ✓0106.2.6 Recognize the place value of numbers (tens, ones).
   ✓0106.2.15 Represent whole numbers between 10 and 100 in groups of tens and ones.

GLE 0106.2.2 Compare and order whole numbers to 100.
   ✓0106.2.2 Write numbers up to 10 in words.
   ✓0106.2.3 Count forward and backward by ones beginning with any number less than 100.
   ✓0106.2.4 Skip count by twos, fives, and tens.
   ✓0106.2.5 Order and compare (less than, greater than, or equal to) whole numbers to 100.
   ✓0106.2.16 Represent whole numbers up to 100 on a number line.
   ✓0106.2.17 Use the number line to create visual representations of sequences (such as even numbers, tens, multiples of five).

GLE 0106.2.3 Develop strategies for learning basic addition facts and related subtraction facts.
   ✓0106.2.7 Develop fluency with addition and subtraction facts of sums through ten.
   ✓0106.2.8 Relate “counting on” and “counting back” to addition and subtraction and understand them as inverse operations.
   ✓0106.2.9 Add three single-digit numbers.
   ✓0106.2.10 Use models (such as discrete objects, connecting cubes, and number lines) to represent “part-whole,” “adding to,” “taking away from,” and “comparing to” situations to develop understanding of the meaning of addition and subtraction.

GLE 0106.2.4 Use multiple representations (including groups of ten) to model two-digit addition and subtraction.
   ✓0106.2.12 Use various models to develop strategies for solving arithmetic problems.
   ✓0106.2.13 Solve problems that require addition and subtraction of numbers through 100.
   ✓0106.2.14 Use composition and decomposition of numbers to identify and discuss patterns.
   ✓0106.2.11 Recognize the “part-whole” relationship in representations of basic fractions such as ½, ¼.

Standard 3 – Algebra
GLE 0106.3.1 Identify, describe, and extend simple number patterns to develop strategies for adding and subtracting whole numbers.
   ✓0106.3.1 Find repeating patterns on the number line, addition table, and hundreds chart.
   ✓0106.3.2 Determine a reasonable next term in a given sequence and describe the rule.
GLE 0106.3.2 Understand that addition and subtraction are inverse operations.
  ✓0106.3.3 Use objects to illustrate the commutative property with basic facts and show that subtraction is not commutative.
  ✓0106.3.4 Demonstrate understanding of the basic equation \( a + b = c \) by using objects to illustrate the number sentences (fact families) associated with any particular sum.
  ✓0106.3.5 Use various strategies to find unknowns in problems involving addition and subtraction.
  ✓0106.3.6 Use objects to demonstrate the inverse relationship between addition and subtraction.
  ✓0106.3.7 Use the inverse relation between addition and subtraction to check arithmetic problems.

GLE 0106.3.3 Extend the strategies for basic facts to include other properties of number and operations.
  ✓0106.3.8 Determine whether a number is odd or even by pairing objects.
  ✓0106.3.9 Recognize that zero is the identity element for addition.

Standard 4 – Geometry and Measurement
GLE 0106.4.1 Recognize, describe, and draw geometric figures.
  ✓0106.4.1 Recognize and describe similarities and differences between 2-dimensional figures (geometric attributes and properties).
  ✓0106.4.2 Recognize 2- and 3-dimensional figures from different perspectives and orientations.
  ✓0106.4.4 Identify 2-dimensional shapes as faces of 3-dimensional figures.

GLE 0106.4.2 Compose and decompose geometric shapes.
  ✓0106.4.3 Model part-whole relationships and properties of plane and solid figures by combining two or more shapes to make a larger shape or by breaking apart an object into its smaller shapes.

GLE 0106.4.3 Use non-standard units in linear measurement.
  ✓0106.4.5 Estimate and measure length using non-standard units (counting by using groups of tens and ones) to represent addition.
  ✓0106.4.6 Recognize the essential role of units in measurement, and understand the difference between standard and non-standard units.
  ✓0106.4.7 Understand and use comparative words such as long, longer, longest; short, shorter, shortest; tall, taller, tallest; high, higher, highest.

Standard 5 – Data, Probability and Statistics
GLE 0106.5.1 Use various representations to display and compare data.
  ✓0106.5.1 Represent measurements and discrete data using concrete objects, picture graphs, and bar graphs.
  ✓0106.5.2 Represent data in both horizontal and vertical form.
  ✓0106.5.3 Display data using appropriate titles and labels.
  ✓0106.5.4 Count and compare collected data.
Grade Two Mathematics

Standard – Processes or Content Strand

GLE – Grade Level Expectation

☑ – Check for Understanding

Standard 1 – Mathematical Processes

GLE 0206.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0206.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

☑ 0206.1.3 Use strategies to make estimates of time.
☑ 0206.1.4 Solve problems involving elapsed time in hour and half-hour intervals.

GLE 0206.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0206.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

☑ 0206.1.8 Use concrete models or pictures to show whether a fraction is less than a half, more than a half, or equal to a half.
☑ 0206.1.9 Match the spoken, written, concrete, and pictorial representations of halves, thirds, and fourths.

GLE 0206.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

☑ 0206.1.6 Read thermometers with Fahrenheit and Celsius scales.
☑ 0206.1.7 Measure weight to the nearest pound or kilogram.

GLE 0206.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

☑ 0206.1.10 Develop a story problem that illustrates a given addition or subtraction number sentence.
☑ 0206.1.12 Write numbers and translate word clues to number sentences and vice versa.

GLE 0206.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

☑ 0206.1.1 Read and write time up to five-minute intervals.
☑ 0206.1.2 Relate days, dates, weeks, months, and years to a calendar.
☑ 0206.1.5 Count the value of a set of coins up to one dollar and use the transitive property of equality to recognize equivalent forms of values up to $1.00.
☑ 0206.1.15 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0206.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

☑ 0206.1.11 Use manipulatives to demonstrate addition and subtraction sentences written symbolically.
☑ 0206.1.13 Use manipulatives such as pattern blocks, tangrams, etc. to explore geometric concepts of symmetry and transformations.
☑ 0206.1.14 Create and observe numerical patterns on a calculator by repeatedly adding or subtracting the same number from some starting number.
Standard 2 – Number and Operations

GLE 0206.2.1 Understand and use place value concepts to 1000.
✓ 0206.2.2 Read and write numbers up to 1000 using numerals and up to 100 using words.
✓ 0206.2.5 Compare and order multi-digit numbers up to 1000.

GLE 0206.2.2 Understand and use the base-ten numeration system.
✓ 0206.2.1 Starting at any number, count by ones, twos, fives, tens, and hundreds up to 1000.
✓ 0206.2.3 Locate and interpret numbers on a number line.
✓ 0206.2.4 Recognize that place-value notation represents the sums of multiples of powers of ten (e.g., 853 as 8 hundreds + 5 tens + 3 ones).

GLE 0206.2.3 Use efficient and accurate strategies to develop fluency with multi-digit addition and subtraction.
✓ 0206.2.6 Use various models such as number lines, pictures, and base-ten blocks to illustrate addition and subtraction.
✓ 0206.2.7 Develop fluency at recalling basic addition facts and related subtraction facts.
✓ 0206.2.8 Use efficient procedures, and understand why they work, to solve problems involving the addition and subtraction of two- and three-digit whole numbers (including those that require regrouping for addition only).
✓ 0206.2.9 Apply appropriate methods to estimate and mentally calculate sums or differences with ones, tens, and hundreds.
✓ 0206.2.10 Add three two-digit numbers.
✓ 0206.2.11 Solve addition and subtraction problems in context using various representations.

GLE 0206.2.4 Develop an initial understanding of multiplication.
✓ 0206.2.12 Demonstrate skip counting on the number line and relate to repeated addition and multiplication.
✓ 0206.2.13 Relate patterns in skip counting to multiplication.

Standard 3 – Algebra

GLE 0206.3.1 Develop pattern recognition.
✓ 0206.3.1 Given rules, complete tables to reveal both arithmetic and geometric patterns.
✓ 0206.3.2 Given a description, extend or find a missing term in a pattern or sequence.
✓ 0206.3.3 Record and study patterns in lists of numbers created by repeated addition or subtraction.
✓ 0206.3.4 Generalize the patterns resulting from the addition, subtraction and multiplication of combinations of odd and even numbers.

GLE 0206.3.2 Extend knowledge of the properties of numbers and operations to multiplication.
✓ 0206.3.5 Understand and use the commutative and associative properties of addition and multiplication.
✓ 0206.3.6 Relate repeated addition to multiplication.

GLE 0206.3.3 Solve simple arithmetic problems using various methods.
✓ 0206.3.7 Find unknowns in number sentences and problems involving addition, subtraction and multiplication.

GLE 0206.3.4 Describe quantitative change.
✓ 0206.3.8 Describe change in measures according to quantitative criteria such as growing 2 inches in one year.

Standard 4 – Geometry and Measurement

GLE 0206.4.1 Recognize, classify, and transform 2- and 3-dimensional geometric figures.
✓ 0206.4.1 Describe common geometric attributes of familiar plane and solid objects.
✓ 0206.4.2 Reflect, rotate, and translate shapes to explore the effects of transformations.
GLE 0206.4.2 Understand the meaning and process of linear measurement.
- 0206.4.4 Estimate, measure, and calculate length to the nearest unit: meter, centimeter, yard, foot, and inch.
- 0206.4.5 Use rulers to measure the lengths of sides and diagonals of common 2-dimensional figures and polygons.

GLE 0206.4.3 Add, subtract, compare, compute and estimate linear measurements.
- 0206.4.3 Understand the property of transitivity as it relates to linear measurement (for example: If A is longer than B, and B is longer than C, then A is longer than C).
- 0206.4.6 Understand the inverse relationship between the size of a unit and the number of units used in a particular measurement (the smaller the unit, the more iterations needed to cover the length).

GLE 0206.4.4 Compose and decompose polygons to make other polygons.
- 0206.4.7 Investigate and describe composition, decomposition, and transformations of polygons.
- 0206.4.8 Combine polygons to form other polygons and subdivide a polygon into other polygons.
- 0206.4.9 Recognize the composition and decomposition of polygons.

Standard 5 – Data, Probability and Statistics
GLE 0206.5.1 Use and understand various representations to depict and analyze data measurements.
- 0206.5.1 Read, interpret, and analyze data shown in tables, bar graphs and picture graphs.
- 0206.5.2 Read, interpret, and create tables using tally marks.

GLE 0206.5.2 Determine whether an event is likely or unlikely.
- 0206.5.3 Explain whether a real world event is likely or unlikely.
- 0206.5.4 Predict outcomes of events based on data gathered and displayed.

Grade Three Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0306.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

SPI 0306.1.6 Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.

GLE 0306.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
- 0306.1.4 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, and observing patterns.
- 0306.1.5 Determine when and how to break a problem into simpler parts.
- 0306.1.6 Use estimation to check answers for reasonableness, and calculators to check for accuracy.
- 0306.1.11 Develop strategies for solving problems involving addition and subtraction of measurements.
GLE 0306.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
- 0306.1.7 Make and investigate mathematical conjectures.
- 0306.1.8 Explain and justify answers on the basis of mathematical properties, structures, and relationships.
- 0306.1.12 Analyze and evaluate the mathematical thinking and strategies of others.

GLE 0306.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
- SPI 0306.1.4 Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten.
- SPI 0306.1.5 Represent problems mathematically using diagrams, numbers, and symbolic expressions.

GLE 0306.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
- SPI 0306.1.7 Select appropriate units and tools to solve problems involving measures.
- SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate.
- 0306.1.13 Create and use representations to organize, record, and communicate mathematical ideas.

GLE 0306.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
- 0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas.

GLE 0306.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
- SPI 0306.1.1 Solve problems using a calendar.
- SPI 0306.1.2 Solve problems involving elapsed time.
- SPI 0306.1.3 Determine the correct change from a transaction less than a dollar.
- 0306.1.11 Read and write time to the nearest minute.
- 0306.1.2 Compare and order decimal amounts in the context of money.
- 0306.1.3 Count the value of combinations of coins and bills up to five dollars.
- 0306.1.14 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0306.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.
- 0306.1.9 Use manipulatives to demonstrate that the commutative property holds for addition but not for subtraction.

Standard 2 - Number and Operations
GLE 0306.2.1 Understand the place value of whole numbers to ten-thousands place including expanded notation for all arithmetic operations.
- SPI 0306.2.1 Read and write numbers up to 10,000 in numerals and up to 1,000 in words.
- SPI 0306.2.2 Identify the place value of numbers in the ten-thousands, thousands, hundreds, tens, and ones positions.
SPI 0306.2.3 Convert between expanded and standard form with whole numbers to 10,000.
SPI 0306.2.4 Compare and order numbers up to 10,000 using the words less than, greater than, and equal to, and the symbols <, >, =.
   ✓0306.2.1 Represent whole numbers up to 10,000 using various models (such as base-ten blocks, number lines, place-value charts) and in standard form, written form, and expanded form.
   ✓0306.2.2 Understand and use the symbols =, < and > to signify order and comparison.
   ✓0306.2.5 Use highest order value (such as tens or hundreds digit) to make simple estimates.
SPI 0306.2.9 Solve contextual problems involving the addition and subtraction (both with and without regrouping) of two- and three-digit whole numbers.
   ✓0306.2.6 Solve a variety of addition and subtraction story problems including those with irrelevant information.
   ✓0306.2.4 Use a variety of methods to perform mental computations and compare the efficiency of those methods.

GLE 0306.2.2 Develop understanding of multiplication and related division facts through multiple strategies and representations.
SPI 0306.2.5 Identify various representations of multiplication and division.
SPI 0306.2.7 Compute multiplication problems that involve multiples of ten using basic number facts.
   ✓0306.2.7 Represent multiplication using various representations such as equal-size groups, arrays, area models, and equal jumps on number lines.

GLE 0306.2.3 Relate multiplication and division as inverse operations.
SPI 0306.2.6 Recall basic multiplication facts through 10 times10 and the related division facts.
SPI 0306.2.8 Solve problems that involve the inverse relationship between multiplication and division.

GLE 0306.2.4 Solve multiplication and division problems using various representations.
   ✓0306.2.3 Use parentheses to indicate grouping.
   ✓0306.2.4 Use a variety of methods to perform mental computations and compare the efficiency of those methods.
   ✓0306.2.8 Represent division using various representations such as successive subtraction, the number of equal jumps, partitioning, and sharing.
   ✓0306.2.9 Describe contexts for multiplication and division facts.

GLE 0306.2.5 Understand the meaning and uses of fractions.
SPI 0306.2.10 Identify equivalent fractions given by various representations.
SPI 0306.2.11 Recognize and use different interpretations of fractions.
   ✓0306.2.11 Identify fractions as parts of whole units, as parts of sets, as locations on number lines, and as division of two whole numbers.
   ✓0306.2.13 Understand that when a whole is divided into equal parts to create unit fractions, the sum of all the parts adds up to one.

GLE 0306.2.6 Use various strategies and models to compare and order fractions and identify equivalent fractions.
SPI 0306.2.12 Name fractions in various contexts that are less than, equal to, or greater than one.
SPI 0306.2.13 Recognize, compare, and order fractions (benchmark fractions, common numerators, or common denominators).
   ✓0306.2.2 Understand and use the symbols =, < and > to signify order and comparison.
   ✓0306.2.10 Understand that symbols such as ¼, 1/3, and ¼ represent numbers called unit fractions.
   ✓0306.2.12 Compare fractions using drawings, concrete objects, and benchmark fractions.
GLE 0306.2.7 Add and subtract fractions with like denominators using various models.

SPI 0306.2.14 Add and subtract fractions with like denominators.

✓0306.2.4 Use a variety of methods to perform mental computations and compare the efficiency of those methods.

Standard 3 – Algebra

GLE 0306.3.1 Develop meaning for and apply the commutative, associative, and distributive properties using various representations.

SPI 0306.3.1 Verify a conclusion using algebraic properties.

✓0306.3.1 Show that addition and multiplication are commutative operations.

✓0306.3.2 Show that subtraction and division are not commutative operations.

✓0306.3.3 Use commutative, associative, and distributive properties to multiply whole numbers.

✓0306.3.4 Solve problems using the commutative, associative, and distributive properties.

GLE 0306.3.2 Develop understanding that a letter or a symbol can represent an unknown quantity in a simple mathematical expression/equation.

SPI 0306.3.2 Express mathematical relationships using number sentences/equations.

SPI 0306.3.3 Find the missing values in simple multiplication and division equations.

✓0306.3.5 Find unknowns in number sentences and problems involving addition, subtraction, multiplication, or division.

GLE 0306.3.3 Describe and analyze patterns and relationships in contexts.

✓0306.3.6 Analyze patterns in words, tables, and graphs to draw conclusions.

✓0306.3.8 Analyze patterns in quantitative change resulting from computation.

GLE 0306.3.4 Create and represent patterns using words, tables, graphs, and symbols

SPI 0306.3.4 Describe or extend (including finding missing terms) geometric and numeric patterns.

✓0306.3.7 Create different representations of a pattern given a verbal description.

Standard 4 – Geometry and Measurement

GLE 0306.4.1 Describe, compare, and analyze properties of polygons.

SPI 0306.4.1 Recognize polygons and be able to identify examples based on geometric definitions.

✓0306.4.1 Describe properties of plane figures (such as circles, triangles, squares and rectangles) and solid shapes (such as spheres, cubes and cylinders).

✓0306.4.2 Classify polygons according to the number of their sides and angles.

✓0306.4.3 Classify lines and segments as parallel, perpendicular, or intersecting.

GLE 0306.4.2 Understand and apply the concepts of congruence and symmetry.

SPI 0306.4.2 Determine if two figures are congruent based on size and shape.

SPI 0306.4.3 Identify the line of symmetry in a two-dimensional design or shape.

✓0306.4.4 Identify, create, and describe figures with line symmetry.

GLE 0306.4.3 Understand and use attributes of 2- and 3-dimensional figures to solve problems.

GLE 0306.4.4 Use appropriate units, strategies and tools to solve problems involving perimeter.

SPI 0306.4.4 Calculate the perimeter of shapes made from polygons.
GLE 0306.4.5 Solve measurement problems involving fractional parts of linear units and capacity units.

SPI 0306.4.5 Choose reasonable units of measure, estimate common measurements using benchmarks, and use appropriate tools to make measurements.
   ✓ 0306.4.5 Understand that all measurements require units.
   ✓ 0306.4.6 Recognize the use of fractions in liquid measures.
   ✓ 0306.4.7 Recognize the relationships among cups, pints, quarts, and gallons.
   ✓ 0306.4.8 Estimate and/or measure the capacity of a container.
   ✓ 0306.4.9 Measure weight to the nearest ounce or gram.
   ✓ 0306.4.10 Use reasonable units of length (i.e. kilometer, meter, centimeter; mile, yard, foot, inch) in estimates and measures.
   ✓ 0306.4.11 Know common equivalences for length (1 meter = 100 centimeters, 1 yard = 3 feet, 1 foot = 12 inches).
   ✓ 0306.4.12 Make and record measurements that use mixed units within the same system of measurement (such as feet and inches, meters and centimeters).
   ✓ 0306.4.13 Use common abbreviations: km, m, cm, in, ft, yd, mi.

SPI 0306.4.6 Measure length to the nearest centimeter or half inch.

SPI 0306.4.7 Solve problems requiring the addition and subtraction of lengths.

Standard 5 – Data Analysis, Statistics, and Probability

GLE 0306.5.1 Organize, display, and analyze data using various representations to solve problems.
   ✓ 0306.5.1 Collect and organize data using observations, surveys, and experiments.
   ✓ 0306.5.2 Construct a frequency table, bar graph, pictograph, or line plot of collected data.

SPI 0306.5.1 Interpret a frequency table, bar graph, pictograph, or line plot.
   ✓ 0306.5.3 Compare and interpret different representations of the same data.
   ✓ 0306.5.4 Solve problems using data from frequency tables, bar graphs, pictographs, or line plots.

SPI 0306.5.2 Solve problems in which data is represented in tables or graph.
   ✓ 0306.5.4 Solve problems using data from frequency tables, bar graphs, pictographs, or line plots.

SPI 0306.5.3 Make predictions based on various representations of data.
Grade Four Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0406.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0406.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

SPI 0406.1.4 Compare objects with respect to a given geometric or physical attribute and select appropriate measurement instrument.
✓ 0406.1.1 Understand the relationship between use of answers and the accuracy of the number.
✓ 0406.1.2 Identify the range of appropriate estimates, including over-estimate and under-estimate.
✓ 0406.1.5 Measure using ruler, meter stick, clock, thermometer, or other scaled instruments.
✓ 0406.1.6 Identify geometric or physical attributes that are appropriate to measure in a given situation.

GLE 0406.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

SPI 0406.1.1 Verify a conclusion using the commutative, associative and distributive properties.
✓ 0406.1.4 Use commutative, associative, and distributive properties of numbers including oral descriptions of mathematical reasoning.

GLE 0406.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

SPI 0406.1.2 Compare decimals using concrete and pictorial representations.
✓ 0406.1.7 Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.
✓ 0406.1.8 Match the spoken, written, concrete (including base ten blocks), and pictorial representations of decimals.
✓ 0406.1.9 Develop a story problem that illustrates a given multiplication or division number sentence.

GLE 0406.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0406.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0406.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

SPI 0406.1.3 Determine the correct change from a transaction.
✓ 0406.1.3 Connect operations with decimals to money and make estimates.
✓ 0406.1.10 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0406.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.
Standard 2 - Number and Operations

GLE 0406.2.1 Understand place value of numbers from hundredths to the hundred-thousands place.

SPI 0406.2.1 Read and write numbers from hundredths to hundred-thousands in numerals and in words.

SPI 0406.2.3 Identify the place value of a specified digit in a number and the quantity it represents.

 ✓ 0406.2.1 Compose and decompose quantities according to place value.

 ✓ 0406.2.2 Understand decimal notation as an extension of the base-ten number system.

GLE 0406.2.2 Develop fluency with multiplication and single-digit division.

SPI 0406.2.11 Solve problems using whole number multi-digit multiplication.

SPI 0406.2.12 Solve problems using whole number division with one- or two-digit divisors

 ✓ 0406.2.3 Multiply two- and three-digit whole numbers.

 ✓ 0406.2.4 Understand and use a reliable algorithm for multiplying multi-digit numbers and dividing numbers by a single-digit divisor accurately and efficiently.

 ✓ 0406.2.5 Understand that division by zero is undefined.

 ✓ 0406.2.6 Divide three-digit whole numbers by one-digit divisors fluently with pencil and paper.

 ✓ 0406.2.10 Use models to understand division as the inverse of multiplication, partitioning, and repeated subtraction.

 ✓ 0406.2.14 Understand the role of the remainder in division.

GLE 0406.2.3 Identify prime and composite numbers.

SPI 0406.2.4 Find factors, common factors, multiples, and common multiples of two numbers.

 ✓ 0406.2.7 Identify factors of whole numbers and model factors and products beyond basic multiplication facts using arrays and area models.

GLE 0406.2.4 Understand and use the connections between fractions and decimals.

SPI 0406.2.2 Locate and place mixed numbers on the number line.

SPI 0406.2.5 Generate equivalent forms of common fractions and decimals and use them to compare size.

SPI 0406.2.6 Use the symbols <, > and = to compare common fractions and decimals in both increasing and decreasing order.

SPI 0406.2.7 Convert improper fractions into mixed numbers and/or decimals.

 ✓ 0406.2.8 Generate equivalent forms of whole numbers, decimals, and common fractions (e.g., 1/10, ¼, ½, ¾).

 ✓ 0406.2.9 Compare equivalent forms whole numbers, fractions, and decimals to each other and to benchmark numbers.

 ✓ 0406.2.11 Use models, benchmarks, and equivalent forms to compare fractions/decimals and locate them on the number line.

 ✓ 0406.2.12 Understand and use decimal numbers up to hundredths and write them as fractions.

GLE 0406.2.5 Add and subtract fractions with like and unlike denominators.

SPI 0406.2.8 Add and subtract proper fractions with like and unlike denominators and simplify the answer.

GLE 0406.2.6 Solve problems involving whole numbers, fractions, and/or decimals using all four arithmetic operations.

SPI 0406.2.9 Add and subtract decimals through hundredths.

SPI 0406.2.10 Solve contextual problems using whole numbers, fractions, and decimals.

 ✓ 0406.2.13 Solve multi-step problems of various types using whole numbers, fractions, and decimals.
Standard 3 – Algebra

GLE 0406.3.1 Extend understanding of a variable to equations involving whole numbers, fractions, decimals, and/or mixed numbers.

  SPI 0406.3.1 Use letters and symbols to represent an unknown quantity and write a simple mathematical expression.
    ✓0406.3.1 Find an unknown quantity in simple equations using whole numbers, fractions, decimals, and mixed numbers.
    ✓0406.3.2 Translate between symbols and words to represent quantities in expressions or equations.

GLE 0406.3.2 Use mathematical language and modeling to develop descriptions, rules and extensions of patterns.

  SPI 0406.3.2 Make generalizations about geometric and numeric patterns.
  SPI 0406.3.3 Represent and analyze patterns using words, function tables, and graphs
    ✓0406.3.3 Create, explain and use a rule to generate terms of a pattern or sequence.

GLE 0406.3.3 Translate between different forms of representations of whole number relationships.

    ✓0406.3.4 Translate between symbolic, numerical, verbal, or pictorial representations of a whole number pattern or relationship.

Standard 4 – Geometry and Measurement

GLE 0406.4.1 Understand and use the properties of lines, segments, angles, polygons, and circles.

  SPI 0406.4.1 Classify lines and line segments as parallel, perpendicular, or intersecting.
  SPI 0406.4.4 Identify acute, obtuse, and right angles in 2-dimensional shapes.
  SPI 0406.4.5 Identify attributes of simple and compound figures composed of 2- and 3- dimensional shapes.
    ✓0406.4.1 Identify the basic parts of circles.
    ✓0406.4.2 Understand the definition of degree as it relates to the circle.
    ✓0406.4.3 Classify angles and triangles as obtuse, acute, or right.
    ✓0406.4.4 Measure and draw angles.
    ✓0406.4.5 Determine if a figure is a polygon.
    ✓0406.4.21 Recognize two-dimensional faces of three-dimensional shapes.

GLE 0406.4.2 Understand and use measures of length, area, capacity, and weight.

  SPI 0406.4.6 Determine situations in which a highly accurate measurement is important.
  SPI 0406.4.7 Determine appropriate size of unit of measurement in problem situations involving length, capacity or weight.
  ✓0406.4.6 Recognize the use of decimals in metric measures.
  ✓0406.4.7 Measure liquids using both standard units and metric units.
  ✓0406.4.8 Recognize that a measure of area represents the total number of same-sized units /that cover the shape without gaps or overlaps.
  ✓0406.4.9 Recognize that area does not change when 2-dimensional figures are cut apart and rearranged.
  ✓0406.4.10 Connect area measure to multiplication using a rectangular area model.
  ✓0406.4.13 Compare objects with respect to a given attribute such as length, area, and capacity.
GLE 0406.4.3 Solve problems that involve estimating and measuring length, area, capacity and weight.

SPI 0406.4.8 Convert measurements within a single system that are common in daily life (e.g., hours and minutes, inches and feet, centimeters and meters, quarts and gallons, liters and milliliters).

SPI 0406.4.9 Solve problems involving area and/or perimeter of rectangular figures.

0406.4.11 Estimate areas of rectangles in square inches and square centimeters.
0406.4.12 Estimate the size of an object with respect to a given measurement attribute (length, perimeter, area, or capacity).

GLE 0406.4.4 Understand the representation of location and movement within the first quadrant of a coordinate system.

SPI 0406.4.2 Graph and interpret points with whole number or letter coordinates on grids or in the first quadrant of the coordinate plane.

SPI 0406.4.3 Construct geometric figures with vertices at points on a coordinate grid.

SPI 0406.4.10 Identify images resulting from reflections, translations, or rotations.

0406.4.14 Explain how the components of a coordinate system are used to determine location.
0406.4.15 Explore properties of paths between points.
0406.4.16 Examine transformations in the coordinate plane.
0406.4.17 Predict the results of a transformation of a geometric shape.
0406.4.18 Determine whether a geometric shape has line and/or rotational symmetry.
0406.4.19 Design and analyze simple tilings and tessellations.
0406.4.20 Draw lines of symmetry in 2-dimensional figures.

Standard 5 – Data, Probability and Statistics

GLE 0406.5.1 Collect, record, arrange, present, and interpret data using tables and various representations.

SPI 0406.5.1 Depict data using various representations (e.g., tables, pictographs, line graphs, bar graphs).

SPI 0406.5.2 Solve problems using estimation and comparison within a single set of data.

SPI 0406.5.3 Given a set of data or a graph, describe the distribution of the data using median, range, or mode.

0406.5.1 Create and label appropriate scales for graphs.
0406.5.2 Evaluate how well various representations show the collected data.
0406.5.3 Interpret and prepare pie charts using appropriate measurements of angles.
0406.5.4 Develop and use stem-and-leaf plots.
0406.5.5 Use measures of central tendency to compare two sets of related data.

GLE 0406.5.2 Use probability to describe chance events.

SPI 0406.5.4 List all possible outcomes of a given situation or event.

0406.5.6 Determine a simple probability.
0406.5.7 Express a probability pictorially.
Grade Five Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0506.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
✓ 0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units.

GLE 0506.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
SPI 0506.1.2 Estimate fraction and decimal sums or differences.
SPI 0506.1.4 Identify missing information and/or too much information in contextual problems.
✓ 0506.1.2 Make reasonable estimates of fraction and decimal sums or differences using models.
✓ 0506.1.3 Explore different methods of estimation including rounding and truncating.
✓ 0506.1.5 Solve problems in more than one way and explain why one process may be more effective than another.

GLE 0506.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
SPI 0506.1.1 Given a series of geometric statements, draw a conclusion about the figure described.
✓ 0506.1.1 Make and test conjectures about geometric properties and develop logical arguments to justify conclusions.

GLE 0506.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
✓ 0506.1.7 Organize and consolidate verbal statements involving fractions and mixed numbers into diagrams, symbols, and numerical expressions.
✓ 0506.1.8 Use patterns, models, and relationships as contexts for writing inequalities and simple equations.

GLE 0506.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0506.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
SPI 0506.1.3 Recognize the unit associated with the remainder in a division problem or the meaning of the fractional part of a whole given in either decimal or fraction form.
✓ 0506.1.4 Explore problems in different contexts to interpret the meaning of remainders as discrete values or not.
✓ 0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units.

GLE 0506.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
✓ 0506.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
GLE 0506.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Standard 2 - Number and Operations

GLE 0506.2.1 Extend the understanding of place value through millions and millionths in various contexts and representations.

  SPI 0506.2.1 Read and write numbers from millions to millionths in various contexts.

GLE 0506.2.2 Write natural numbers (to 50) as a product of prime factors and understand that this is unique (apart from order).

  SPI 0506.2.2 Write the prime factorization of numbers through 50 using both exponential and standard notation.

  ✓ 0506.2.1 Identify prime numbers up to 50.
  ✓ 0506.2.2 Use the prime factorization of two whole numbers to determine the greatest common factor and the least common multiple.
  ✓ 0506.2.4 Use divisibility rules to factor numbers.
  ✓ 0506.2.10 Use exponential notation to represent repeated multiplication of whole numbers.

GLE 0506.2.3 Develop fluency with division of whole numbers. Understand the relationship of divisor, dividend, and quotient in terms of multiplication and division.

  SPI 0506.2.3 Select a reasonable solution to a real-world division problem in which the remainder must be considered.
  SPI 0506.2.4 Solve problems involving the division of two- and three-digit whole numbers by one- and two-digit whole numbers.

  ✓ 0506.2.7 Understand the placement of the decimal point in calculations of multiplication and long division, including the placement in the estimation of the answer.
  ✓ 0506.2.8 Understand that division by zero is undefined.

GLE 0506.2.4 Develop fluency with addition and subtraction of proper and improper fractions and mixed numbers; explain and model the algorithm.

  SPI 0506.2.5 Solve addition and subtraction problems involving both fractions and decimals.
  SPI 0506.2.6 Add and subtract proper and improper fractions as well as mixed numbers.

  ✓ 0506.2.3 Use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals.
  ✓ 0506.2.5 Make reasonable estimates of fraction and decimal sums and differences.
  ✓ 0506.2.6 Add and subtract mixed numbers.

GLE 0506.2.5 Develop fluency in solving multi-step problems using whole numbers, fractions, mixed numbers, and decimals.

  SPI 0506.2.7 Recognize equivalent representations for the same number.
  SPI 0506.2.8 Write terminating decimals in the form of fractions or mixed numbers.
  SPI 0506.2.9 Compare whole numbers, decimals and fractions using the symbols <, >, and =.

  ✓ 0506.2.9 Explore numbers less than 0 by extending the number line through familiar applications (e.g., temperatures below zero, owing money, measuring elevation below sea level).
Standard 3 – Algebra

GLE 0506.3.1 Understand and use order of operations.
   SPI 0506.3.1 Evaluate algebraic expressions involving decimals and fractions using order of operations.
   SPI 0506.3.2 Evaluate multi-step numerical expressions involving fractions using order of operations.

GLE 0506.3.2 Develop and apply the concept of variable.
   ✓ 0506.3.2 Use variables appropriately to represent numbers whose values are not yet known.
   ✓ 0506.3.6 Recognize there are many numbers between any two whole numbers on the number line.

GLE 0506.3.3 Understand and apply the substitution property.
   ✓ 0506.3.1 Evaluate an expression by substituting non-negative rational number values for letter variables in the expression.

GLE 0506.3.4 Solve single-step linear equations and inequalities.
   SPI 0506.3.3 Find the unknown in single-step equations involving fractions and mixed numbers.
   SPI 0506.3.4 Given a set of values, identify those that make an inequality a true statement.
   ✓ 0506.3.3 Solve single-step linear equations using inverse operations.
   ✓ 0506.3.4 Solve single-step linear inequalities and graph solutions on a number line.
   ✓ 0506.3.5 Determine if a given value is a solution to a linear equation/inequality.

Standard 4 – Geometry and Measurement

GLE 0506.4.1 Use basic formulas and visualization to find the area of geometric figures.
   SPI 0506.4.1 Solve contextual problems that require calculating the area of triangles and parallelograms.
   SPI 0506.4.2 Decompose irregular shapes to find perimeter and area.
   ✓ 0506.4.1 Develop the formula for the area of a triangle as it relates to the area of a parallelogram/rectangle.
   ✓ 0506.4.2 Find the area of a convex polygon by decomposing it into triangles/rectangles.

GLE 0506.4.2 Describe polyhedral solids and analyze their properties, including volume and surface area.
   SPI 0506.4.3 Identify a three-dimensional object from two-dimensional representations of that object and vice versa.
   SPI 0506.4.4 Solve problems involving surface area and volume of rectangular prisms and polyhedral solids.
   ✓ 0506.4.3 Build, draw, and work with prisms by means of orthogonal views, projective views, and nets.
   ✓ 0506.4.4 Describe and identify the five regular (Platonic) solids and their properties with respect to faces, shapes of faces, edges, and vertices.
   ✓ 0506.4.5 Quantify total volume as filling space with same-sized units of volume without gaps or overlap.
   ✓ 0506.4.6 Decompose prisms to calculate surface area and volume.

GLE 0506.4.3 Describe length/distance relationships using the first quadrant of the coordinate system.
   SPI 0506.4.5 Find the length of vertical or horizontal line segments in the first quadrant of the coordinate system, including problems that require the use of fractions and decimals.
   ✓ 0506.4.8 Identify characteristics of the set of points that define vertical and horizontal line segments.
GLE 0506.4.4 Solve problems that require attention to both approximation and precision of measurement.

SPI 0506.4.6 Record measurements in context to reasonable degree of accuracy using decimals and/or fractions.

- 0506.4.7 Understand, select and use units of appropriate size and type to measure angles, lengths/distances, area, surface area and volume.
- 0506.4.9 Correctly interpret significant digits in the accuracy of measurements and associated calculations.
- 0506.4.10 Recognize that measurements are never exact.
- 0506.4.11 Understand the usefulness of approximations.
- 0506.4.12 Develop strategies for choosing correct tools of measurement.
- 0506.4.13 Recognize and use measures of weight and temperature.

Standard 5 – Data, Probability and Statistics

GLE 0506.5.1 Make, record, display and interpret data and graphs that include whole numbers, decimals, and fractions.

SPI 0506.5.1 Depict data using various representations, including decimal and/or fractional data.

SPI 0506.5.2 Make predictions based on various data representations, including double bar and line graphs.

- 0506.5.1 Construct and analyze double bar and line graphs.
- 0506.5.2 Represent data using ordered pairs in the first quadrant of the coordinate system.
- 0506.5.3 Design investigations to address a question and consider how data collection methods affect the nature of the data set.
- 0506.5.4 Recognize the differences in representing categorical and numerical data.

GLE 0506.5.2 Describe the shape and important features of a set of data using the measures of central tendency.

SPI 0506.5.3 Calculate measures of central tendency to analyze data.

- 0506.5.5 Evaluate how different measures of central tendency describe data.
- 0506.5.6 Identify outliers and determine their effect on mean, median, mode and range.
Grade Six Mathematics

Standard – Processes or Content Strand

GLE – Grade Level Expectation

SPI – State Performance Indicator

✓ – Check for Understanding

Standard 1 – Mathematical Processes

GLE 0606.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0606.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

SPI 0606.1.2 Judge the reasonableness of the results of rational number estimates and/or computations.

✓ 0606.1.2 Recognize when an estimate is more appropriate than an exact answer in a variety of problem situations.

✓ 0606.1.3 Recognize errors generated by rounding.

GLE 0606.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

SPI 0606.1.4 Select the representation that models one of the arithmetic properties (commutative, associative, or distributive).

GLE 0606.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

SPI 0606.1.3 Use concrete, pictorial, and symbolic representation for integers.

✓ 0606.1.5 Illustrate properties of operations by showing that two expressions are equivalent in a given context (e.g., using an area model for distributive property, and grouping/set models for commutative and associative properties).

GLE 0606.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

SPI 0606.1.1 Make conjectures and predictions based on data.

✓ 0606.1.4 Describe how changes in one quantity or variable result in changes in another.

✓ 0606.1.6 Model situations by devising and carrying out experiments and simulations.

✓ 0606.1.7 Formulate questions, design studies, and collect real world data.

✓ 0606.1.8 Determine an appropriate sample to test an hypothesis.

GLE 0606.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0606.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

✓ 0606.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
GLE 0606.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

**SPI 0606.1.5 Model algebraic expressions using algebra tiles.**
- 0606.1.1 Recognize different conventions used in calculator and computer spreadsheets (e.g., * for multiplication, \(^\) for exponent), but use mathematical notation in written work.
- 0606.1.10 Use various methods (such as dynamic geometry software) to explore properties of triangles and quadrilaterals.
- 0606.1.11 Model algebraic expressions with manipulatives, technology, and pencil and paper.

**Standard 2 – Number & Operations**

GLE 0606.2.1 Understand and explain the procedures for multiplication and division of fractions, mixed numbers, and decimals.

**SPI 0606.2.1 Solve problems involving the multiplication and division of fractions.**
- 0606.2.2 Use area models to represent multiplication of fractions.
- 0606.2.3 Create and solve contextual problems that lead naturally to division of fractions.

**SPI 0606.2.2 Solve problems involving the addition, subtraction, multiplication, and division of mixed numbers.**

**SPI 0606.2.3 Solve problems involving the addition, subtraction, multiplication, and division of decimals.**

GLE 0606.2.2 Solve multi-step mathematical, contextual and verbal problems using fractions, mixed numbers, and decimals.

**SPI 0606.2.4 Solve multi-step arithmetic problems using fractions, mixed numbers, and decimals.**

GLE 0606.2.3 Understand and use ratios, rates and percents.

**SPI 0606.2.5 Solve problems involving ratios, rates and percents.**
- 0606.2.4 Understand ratio as a fraction used to compare two quantities by division.
- 0606.2.5 Recognize a:b, a/b, and “a to b” as notations for ratios.
- 0606.2.6 Recognize common percentages as ratios based on fractions whose denominators are 2, 3, 4, 5, or 10.
- 0606.2.7 Connect ratio and rate to multiplication and division.

GLE 0606.2.4 Understand and convert between fraction, decimal, and percent forms of rational numbers.

**SPI 0606.2.6 Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers).**
- 0606.2.8 Recognize that a terminating decimal equals a fraction with a denominator that is a power of ten.
- 0606.2.9 Recognize that the decimal form of a rational number either terminates or repeats.

GLE 0606.2.5 Develop meaning for integers; represent and compare quantities with integers.

**SPI 0606.2.7 Locate positive rational numbers on the number line.**

**SPI 0606.2.8 Locate integers on the number line.**
- 0606.2.1 Efficiently compare and order fractions, decimals and percents; determine their approximate locations on a number line.
- 0606.2.10 Explore contexts that can be described with negative numbers (such as money, elevation, and temperature).
Standard 3 – Algebra

GLE 0606.3.1 Write and solve two-step equations and inequalities.

SPI 0606.3.1 Represent on a number line the solution of a linear inequality.
  ✓ 0606.3.2 Write and solve one-step inequalities corresponding to given situations (non-negative numbers only).

SPI 0606.3.6 Solve two-step linear equations using number sense, properties, and inverse operations.
  ✓ 0606.3.1 Write and solve two-step linear equations corresponding to given situations (non-negative numbers only).

GLE 0606.3.2 Interpret and represent algebraic relationships with variables in expressions, simple equations and inequalities.
  ✓ 0606.3.3 Recognize the use of juxtaposition (such as 3x, ab) to stand for multiplication, and the convention in these cases of writing numbers before letters.
  ✓ 0606.3.5 Use the commutative, associative and distributive properties to show that two expressions are equivalent.
  ✓ 0606.3.7 Move fluently between different representations (such as verbal, tabular, numerical, algebraic, and graphical) of equations and expressions.
  ✓ 0606.3.8 Represent patterns using words, graphs, and simple symbolic notation.

GLE 0606.3.3 Extend order of operations to include grouping symbols and exponents.

SPI 0606.3.2 Use order of operations and parentheses to simplify expressions and solve problems.

GLE 0606.3.4 Use expressions, equations and formulas to solve problems.

GLE 0606.3.5 Use multiple representations including symbolic algebra to model and/or solve contextual problems that involve linear relationships.

SPI 0606.3.3 Write equations that correspond to given situations or represent a given mathematical relationship.

SPI 0606.3.4 Rewrite expressions to represent quantities in different ways.

SPI 0606.3.5 Translate between verbal expressions/sentences and algebraic expressions/equations.

SPI 0606.3.8 Select the qualitative graph that models a contextual situation (e.g., water filling then draining from a bathtub).
  ✓ 0606.3.6 Use equations to describe simple relationships shown in a table or graph.
  ✓ 0606.3.9 Write a contextual story modeled by a given graph.

GLE 0606.3.6 Understand and use the Cartesian coordinate system.

SPI 0606.3.7 Use algebraic expressions and properties to analyze numeric and geometric patterns.

SPI 0606.3.9 Graph ordered pairs of integers in all four quadrants of the Cartesian coordinate system.
  ✓ 0606.3.4 Generate data and graph relationships concerning measurement of length, area, volume, weight, time, temperature, money, and information.
  ✓ 0606.3.10 Understand that in an ordered pair (x, y), the x represents horizontal location and y represents vertical location.
  ✓ 0606.3.11 Identify the quadrant of the coordinate system in which a point lies.
Standard 4 – Geometry & Measurement

GLE 0606.4.1 Understand and use basic properties of triangles, quadrilaterals, and other polygons.

SPI 0606.4.1 Identify, define or describe geometric shapes given a visual representation or a written description of its properties.

- 0606.4.3 Verify the basic properties of triangles and quadrilaterals using a protractor and ruler.
- 0606.4.4 Classify triangles by side lengths (scalene, isosceles, and equilateral) and angle measure (acute, right, obtuse, isosceles and equiangular).

SPI 0606.4.2 Find a missing angle measure in problems involving interior/exterior angles and/or their sums.

- 0606.4.1 Investigate the sum of the angles in a triangle and a quadrilateral using various methods.
- 0606.4.2 Relate the sum of the angles in a triangle to the sum of the angles in polygons.
- 0606.4.6 Use the properties of interior and exterior angles of polygons to solve problems.

SPI 0606.4.3 Solve problems using the Triangle Inequality Theorem.

- 0606.4.5 Model and use the Triangle Inequality Theorem.

GLE 0606.4.2 Use the concepts of translation, rotation, reflection, and symmetry to understand congruence in the plane.

- 0606.4.7 Work with transformations in a plane and explore their meanings through drawings and manipulatives.
- 0606.4.8 Understand scaling, dilation and their relation to similarity.
- 0606.4.9 Analyze the differences between congruence and similarity.
- 0606.4.10 Describe the effect of a transformation on a 2-dimensional figure and the resulting symmetry.

GLE 0606.4.3 Develop and use formulas to determine the circumference and area of circles, and the area of trapezoids, and develop strategies to find the area of composite shapes.

SPI 0606.4.4 Calculate with circumferences and areas of circles.

- 0606.4.11 Relate the circumference of a circle with the perimeter of a polygonal figure.
- 0606.4.12 Derive the meaning of Pi using concrete models and/or appropriate technology.
- 0606.4.13 Understand the relationships among the radius, diameter, circumference and area of a circle, and that the ratio of the circumference to the diameter is the same as the ratio of the area to the square of the radius, and that this ratio is called Pi.
- 0606.4.14 Relate the area of a trapezoid to the area of a parallelogram.

GLE 0606.4.4 Develop and use formulas for surface area and volume of 3-dimensional figures.

SPI 0606.4.5 Determine the surface area and volume of prisms, pyramids and cylinders.

SPI 0606.4.6 Given the volume of a cone/pyramid, find the volume of the related cylinder/prism or vice versa.

- 0606.4.15 Find lengths given areas or volumes, and vice versa.
- 0606.4.16 Solve contextual problems involving area and circumference of circles, surface areas and volumes of prisms, pyramids, cones, and cylinders.
- 0606.4.17 Use manipulatives to discover the volume of a pyramid is one-third the volume of the related prism (the heights and base areas are equal).
- 0606.4.18 Use manipulatives to discover the volume of a cone is one-third the volume of the related cylinder (the heights and base areas are equal).
Standard 5 – Data Analysis, Statistics, & Probability

GLE 0606.5.1 Understand the meaning of probability and how it is expressed.

SPI 0606.5.1 Determine the theoretical probability of simple and compound events in familiar contexts.

- 0606.5.1 Understand that the probability of an event is a number between zero and one that expresses the likelihood of its occurrence.
- 0606.5.2 Identify the probability of an event as the ratio of the number of its actual occurrences to the total number of its possible occurrences.
- 0606.5.3 Express probabilities in different ways.
- 0606.5.4 Understand the difference between probability and odds.
- 0606.5.5 Analyze a situation that involves probability of an independent event.
- 0606.5.6 Estimate the probability of simple and compound events through experimentation or simulation.
- 0606.5.7 Apply procedures to calculate the probability of complimentary events.

GLE 0606.5.2 Interpret representations of data from surveys and polls, and describe sample bias and how data representations can be misleading.

SPI 0606.5.2 Identify features of graphs that may be misleading.

SPI 0606.5.3 Determine whether or not a sample is biased.

- 0606.5.8 Connect data sets and their graphical representations (such as bar graphs, circle graphs, and stem-and-leaf plots).
- 0606.5.9 Determine the sample space for a given situation.
- 0606.5.10 Distinguish between a random and nonrandom sample.
- 0606.5.11 Select the appropriate measure of center to describe a data set.
- 0606.5.12 Predict the characteristics of a population based on the analysis of sample data.
Grade Seven Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0706.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
✓0706.1.1 Recognize common abbreviations (such as gcd/gcf and lcm).

GLE 0706.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
✓0706.1.2 Recognize round-off error and the inaccuracies it introduces.
✓0706.1.3 Check answers both by estimation and by appropriate independent calculations, using calculators or computers judiciously.

GLE 0706.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0706.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
SPI 0706.1.2 Generalize a variety of patterns to a symbolic rule from tables, graphs, or words.

GLE 0706.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
SPI 0706.1.1 Use proportional reasoning to solve mixture/concentration problems.
SPI 0706.1.3 Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship.
SPI 0706.1.4 Use scales to read maps.
✓0706.1.4 Recognize quantities that are inversely proportional (such as the relationship between the lengths of the base and the side of a rectangle with fixed area).
✓0706.1.5 Understand that a linear function in which f(0) = 0 is called a directly proportional relationship.
✓0706.1.6 Develop meaning of intercept and rate of change in contextual problems.
✓0706.1.7 Explain and demonstrate how scale in maps and drawings shows relative size and distance.
✓0706.1.8 Recognize the applications of scale factor by exploring blueprints, shadow measuring, and scale models.

GLE 0706.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0706.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
✓0706.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
GLE 0706.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

- 0706.1.10 Model algebraic equations with manipulatives, technology, and pencil and paper.
- 0706.1.11 Translate from calculator notation to scientific/standard notation.
- 0706.1.12 Use dynamic geometry software to explore scale factor and similarity.

Standard 2 – Number & Operations

GLE 0706.2.1 Extend understandings of addition, subtraction, multiplication and division to integers.

**SPI 0706.2.5 Solve contextual problems that involve operations with integers.**

- 0706.2.2 Develop and analyze algorithms and compute efficiently with integers and rational numbers.
- 0706.2.4 Understand that a and –a are additive inverses and are located the same distance from zero on the number line; relate distance from zero to absolute value.
- 0706.2.5 Understand that –(–a) = a for any number a.
- 0706.2.6 Use the number line to demonstrate addition and subtraction with integers.

GLE 0706.2.2 Understand and work with the properties of and operations on the system of rational numbers.

**SPI 0706.2.1 Simplify numerical expressions involving rational numbers.**

**SPI 0706.2.2 Compare rational numbers using appropriate inequality symbols.**

- 0706.2.1 Understand that the set of rational numbers includes any number that can be written as a ratio of two integers in which the denominator is not zero.
- 0706.2.2 Develop and analyze algorithms and compute efficiently with integers and rational numbers.
- 0706.2.3 Recognize that rational numbers satisfy the commutative and associative laws of addition and multiplication and the distributive law.

GLE 0706.2.3 Develop an understanding of and apply proportionality.

GLE 0706.2.4 Use ratios, rates and percents to solve single- and multi-step problems in various contexts.

**SPI 0706.2.6 Express the ratio between two quantities as a percent, and a percent as a ratio or fraction.**

**SPI 0706.2.7 Use ratios and proportions to solve problems.**

- 0706.2.7 Write number sentences to solve contextual problems involving ratio and percent.
- 0706.2.8 Apply ratios, rates, proportions and percents (such as discounts, interest, taxes, tips, distance/rate/time, and percent increase or decrease).

GLE 0706.2.5 Understand and work with squares, cubes, square roots and cube roots.

**SPI 0706.2.3 Use rational numbers and roots of perfect squares/cubes to solve contextual problems.**

**SPI 0706.2.4 Determine the approximate location of square/cube roots on a number line.**

- 0706.2.9 Efficiently compare and order rational numbers and roots of perfect squares/cubes; determine their approximate locations on a number line.
- 0706.2.10 Recognize that when a whole number is not a perfect square, then its square root is not rational and cannot be written as the ratio of two integers.
- 0706.2.11 Estimate square/cube roots and use calculators to find approximations.
- 0706.2.12 Recognize $\sqrt{mn} = \sqrt{m} \cdot \sqrt{n}$ and $(\sqrt{m})^2 = m$.

GLE 0706.2.6 Introduce the concept of negative exponents.

- 0706.2.13 Use the meaning of negative exponents to represent small numbers; translate between scientific and standard notation.
GLE 0706.2.7 Understand and use scientific notation.
- 0706.2.14 Express numbers in scientific notation and recognize its importance in representing the magnitude of a number.
- 0706.2.15 Report results of calculations appropriately in a given context (i.e. using rules of rounding, degree of accuracy, and/or significant digits).

Standard 3 – Algebra
GLE 0706.3.1 Recognize and generate equivalent forms for simple algebraic expressions.
- SPI 0706.3.1 Evaluate algebraic expressions involving rational values for coefficients and/or variables.
  - 0706.3.1 Perform basic operations on linear expressions (including grouping, order of operations, exponents, simplifying and expanding).

GLE 0706.3.2 Understand and compare various representations of relations and functions.
- SPI 0706.3.7 Translate between verbal and symbolic representations of real-world phenomena involving linear equations.
  - 0706.3.2 Represent and analyze mathematical situations using algebraic symbols.

GLE 0706.3.3 Understand the concept of function as a rule that assigns to a given input one and only one number (the output).
- SPI 0706.3.2 Determine whether a relation (represented in various ways) is a function.
- SPI 0706.3.3 Given a table of inputs x and outputs f(x), identify the function rule and continue the pattern.
  - 0706.3.3 Identify a function from a written description, table, graph, rule, set of ordered pairs, and/or mapping.
  - 0706.3.4 Make tables of inputs x and outputs f(x) for a variety of rules that include rational numbers (including negative numbers) as inputs.

GLE 0706.3.4 Use function notation where f(x) represents the output that the function f assigns to the input x.
- 0706.3.5 Plot points to represent tables of linear function values.
- 0706.3.6 Understand that the graph of a linear function f is the set of points on a line representing the ordered pairs (x, f(x)).

GLE 0706.3.5 Understand and graph proportional relationships.
- SPI 0706.3.5 Represent proportional relationships with equations, tables and graphs.
  - 0706.3.7 Distinguish proportional relationships (y/x = k, or y = kx) from other relationships, including inverse proportionality (xy = k, or y = k/x).

GLE 0706.3.6 Conceptualize the meanings of slope using various interpretations, representations, and contexts.
- SPI 0706.3.4 Interpret the slope of a line as a unit rate given the graph of a proportional relationship.
  - 0706.3.8 Understand slope as the ratio of vertical change to horizontal change.
  - 0706.3.9 Identify a function exhibiting a constant rate of change as a linear function and identify the slope as a unit rate.
  - 0706.3.10 Solve problems involving unit rates (e.g., miles per hour, words per minute).
  - 0706.3.12 Use linear equations to solve problems and interpret the meaning of slope, m, and the y-intercept, b, in f(x)= mx + b in terms of the context.
  - 0706.3.13 Given a graph that exhibits the intersection of a line and the y-axis, write a linear function in slope-intercept form: y = mx + b.

GLE 0706.3.7 Use mathematical models involving linear equations to analyze real-world phenomena.
- SPI 0706.3.7 Translate between verbal and symbolic representations of real-world phenomena involving linear equations.
  - 0706.3.11 Relate the features of a linear equation to a table and/or graph of the equation.

GLE 0706.3.8 Use a variety of strategies to efficiently solve linear equations and inequalities.
- SPI 0706.3.6 Solve linear equations with rational coefficients symbolically or graphically.
SPI 0706.3.8 Solve contextual problems involving two-step linear equations.
SPI 0706.3.9 Solve linear inequalities in one variable with rational coefficients symbolically or graphically.

✓ 0706.3.14 Understand that when solving linear inequalities, multiplication or division by a negative reverses the inequality symbol.

Standard 4 – Geometry & Measurement
GLE 0706.4.1 Understand the application of proportionality with similar triangles.
SPI 0706.4.1 Solve contextual problems involving similar triangles.
SPI 0706.4.2 Use SSS, SAS, and AA to determine if two triangles are similar.

✓ 0706.4.2 Use similar triangles and proportionality to find the lengths of unknown line segments in a triangle.
✓ 0706.4.4 Compare angles, side lengths, perimeters and areas of similar shapes.

GLE 0706.4.2 Apply proportionality to converting among different units of measurements to solve problems involving rates such as motion at a constant speed.

✓ 0706.4.5 Solve problems using ratio quantities: velocity (measured in units such as miles per hour), density (measured in units such as kilograms per liter), pressure (measured in units such as pounds per square foot), and population density (measured in units such as persons per square mile).

GLE 0706.4.3 Understand and use scale factor to describe the relationships between length, area, and volume.

SPI 0706.4.3 Apply scale factor to solve problems involving area and volume.

✓ 0706.4.3 Understand that if a scale factor describes how corresponding lengths in two similar objects are related, then the square of the scale factor describes how corresponding areas are related, and the cube of the scale factor describes how corresponding volumes are related.

GLE 0706.4.4 Understand and use ratios, derived quantities, and indirect measurements.

✓ 0706.4.1 Solve problems involving indirect measurement such as finding the height of a building by comparing its shadow with the height and shadow of a known object.

Standard 5 – Data Analysis, Statistics, & Probability
GLE 0706.5.1 Collect, organize, and analyze both single- and two-variable data.
GLE 0706.5.2 Select, create, and use appropriate graphical representations of data.

SPI 0706.5.1 Interpret and employ various graphs and charts to represent data.
SPI 0706.5.2 Select suitable graph types (such as bar graphs, histograms, line graphs, circle graphs, box-and-whisker plots, and stem-and-leaf plots) and use them to create accurate representations of given data.

✓ 0706.5.1 Create and interpret box-and-whisker plots and stem-and-leaf plots.
✓ 0706.5.2 Interpret and solve problems using information presented in various visual forms.
✓ 0706.5.5 Apply percentages to make and interpret histograms and circle graphs.

GLE 0706.5.3 Formulate questions and design studies to collect data about a characteristic shared by two populations, or different characteristics within one population.

✓ 0706.5.3 Predict and compare the characteristics of two populations based on the analysis of sample data.
✓ 0706.5.4 Use proportional reasoning to make predictions about results of experiments and simulations.
✓ 0706.5.5 Evaluate the design of an experiment.

GLE 0706.5.4 Use descriptive statistics to summarize and compare data.

SPI 0706.5.3 Calculate and interpret the mean, median, upper-quartile, lower-quartile, and interquartile range of a set of data.

GLE 0706.5.5 Understand and apply basic concepts of probability.

SPI 0706.5.4 Use theoretical probability to make predictions.

✓ 0706.5.6 Use a tree diagram or organized list to determine all possible outcomes of a simple probability experiment.
Grade Eight Mathematics

Standard – Processes or Content Strand
GLE – Grade Level Expectation
SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes
GLE 0806.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0806.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
   ✓ 0806.1.8 Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g., manipulatives, technology, pencil and paper).

GLE 0806.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0806.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

GLE 0806.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
   SPI 0806.1.2 Interpret a qualitative graph representing a contextual situation.
   ✓ 0806.1.1 Relate nonlinear functions to geometric contexts of length, area, and volume.
   ✓ 0806.1.2 Draw qualitative graphs (trend graphs) of functions and describe their general shape/trend.

GLE 0806.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0806.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
   ✓ 0806.1.3 Research the contributions of Pythagoras to mathematics.
   ✓ 0806.1.4 Relate data concepts to relevant concepts in the earth and space, life, and physical sciences.
   ✓ 0806.1.5 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0806.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.
   SPI 0806.1.1 Solve problems involving rate/time/distance (i.e., d = rt).
   SPI 0806.1.3 Calculates rates involving cost per unit to determine the best buy
   ✓ 0806.1.6 Use models (such as dynamic geometry software, patty paper and geo boards) to explore relationships among angles (complementary, supplementary, interior, exterior, vertical, and corresponding).
   ✓ 0806.1.7 Use a graphing calculator or spreadsheet to create scatterplots of data and approximate lines of best fit.
   ✓ 0806.1.8 Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g., manipulatives, technology, pencil and paper).
Standard 2 – Number & Operations

GLE 0806.2.1 Extend understanding of the real number system to include irrational numbers.

SPI 0806.2.1 Order and compare rational and irrational numbers and locate on the number line.

SPI 0806.2.2 Identify numbers and square roots as rational or irrational.
- 0806.2.2 Square numbers and simplify square roots.
- 0806.2.4 Use a Venn diagram to represent the subsets of the real number system.
- 0806.2.5 Identify the subset(s) of the real number system to which a number belongs.

GLE 0806.2.2 Solve problems involving exponents and scientific notation using technology appropriately.

SPI 0806.2.3 Use scientific notation to compute products and quotients.

SPI 0806.2.4 Solve real-world problems requiring scientific notation.
- 0806.2.1 Recognize and use exponential, scientific, and calculator notation.
- 0806.2.7 Add, subtract, multiply, and divide numbers expressed scientific notation.

GLE 0806.2.3 Solve real-world problems using rational and irrational numbers.
- 0806.2.3 Solve contextual problems involving powers and roots.

GLE 0806.2.4 Understand and use the laws of exponents.
- 0806.2.6 Simplify expressions using the laws of exponents.

Standard 3 – Algebra

GLE 0806.3.1 Recognize and generate equivalent forms for algebraic expressions.
- 0806.3.1 Perform basic operations on algebraic expressions (including grouping, order of operations, exponents, square/cube roots, simplifying and expanding).

GLE 0806.3.2 Represent, analyze, and solve problems involving linear equations and inequalities in one and two variables.

SPI 0806.3.2 Solve the linear equation \( f(x) = g(x) \).

SPI 0806.3.3 Solve and graph linear inequalities in two variables.
- 0806.3.2 Represent algebraic relationships with equations and inequalities.
- 0806.3.4 Understand the relationship between the graph of a linear inequality and its solutions.
- 0806.3.5 Solve linear inequalities in two variables (including those whose solutions require multiplication or division by a negative number).
- 0806.3.13 Represent situations and solve real-world problems using symbolic algebra.

GLE 0806.3.3 Solve systems of linear equations in two variables.

SPI 0806.3.1 Find solutions to systems of two linear equations in two variables.
- 0806.3.3 Solve systems of linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line.

GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions.

SPI 0806.3.4 Translate between various representations of a linear function.

SPI 0806.3.6 Analyze the graph of a linear function to find solutions and intercepts.
- 0806.3.6 Identify x- and y-intercepts and slope of linear equations from an equation, graph or table.
- 0806.3.9 Given a function rule, create tables of values for \( x \) and \( y \), and plot graphs of nonlinear functions.
GLE 0806.3.5 Use slope to analyze situations and solve problems.
  SPI 0806.3.5 Determine the slope of a line from an equation, two given points, a table or a graph.
  ✔0806.3.7 Analyze situations and solve problems involving constant rate of change.
  ✔0806.3.8 Recognize a proportion as a special case of a linear equation and understand that the constant of proportionality is the slope, and the resulting graph is a line through the origin.

GLE 0806.3.6 Compare and contrast linear and nonlinear functions.
  SPI 0806.3.7 Identify, compare and contrast functions as linear or nonlinear.
  ✔0806.3.10 Distinguish quadratic and exponential functions as nonlinear using a graph and/or a table of values.
  ✔0806.3.11 Distinguish between the equations of linear, quadratic, and exponential functions (e.g. function families such as \( y=x^2, y=2^x, \) and \( y=2x \)).
  ✔0806.3.12 Understand how rates of change of nonlinear functions contrast with constant rates of change of linear functions.

Standard 4 – Geometry & Measurement
GLE 0806.4.1 Derive the Pythagorean theorem and understand its applications.
  SPI 0806.4.1 Use the Pythagorean Theorem to solve contextual problems.
  SPI 0806.4.2 Apply the Pythagorean theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra.
  ✔0806.4.1 Model the Pythagorean Theorem.
  ✔0806.4.2 Use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle.

GLE 0806.4.2 Understand the relationships among the angles formed by parallel lines cut by transversals.
  SPI 0806.4.3 Find measures of the angles formed by parallel lines cut by a transversal.
  ✔0806.4.5 Analyze the congruent and supplementary relationships of angles formed by parallel lines and transversals (such as alternate interior, alternate exterior, corresponding, and adjacent).

GLE 0806.4.3 Understand the necessary levels of accuracy and precision in measurement.
  ✔0806.4.3 Select or use the appropriate measurement instrument to determine or create a given length, area, volume, angle, weight, or mass.
  ✔0806.4.4 Understand how the precision of measurement influences accuracy of quantities derived from these measurements.

GLE 0806.4.4 Understand both metric and customary units of measurement.
  SPI 0806.4.4 Convert between and within the U.S. Customary System and the metric system.
  ✔0806.4.6 Make within-system and between-system conversions of derived quantities including distance, temperature, and money.

GLE 0806.4.5 Use visualization to describe or identify intersections, cross-sections, and various views of geometric figures.
  SPI 0806.4.5 Identify the intersection of two or more geometric figures in the plane.
  ✔0806.4.7 Visualize or describe the cross-section resulting from the intersection of a plane with a 3-dimensional figure.
  ✔0806.4.8 Build, draw, and work with 2- and 3-dimensional figures by means of orthogonal views, projective views, and/or nets.
Standard 5 – Data Analysis, Statistics, & Probability

GLE 0806.5.1 Explore probabilities for compound, independent and/or dependent events.

SPI 0806.5.1 Calculate probabilities of events for simple experiments with equally probable outcomes.
SPI 0806.5.2 Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models).

✓ 0806.5.1 Solve simple problems involving probability and relative frequency.
✓ 0806.5.2 Compare probabilities of two or more events and recognize when certain events are equally likely.

GLE 0806.5.2 Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures.

SPI 0806.5.3 Generalize the relationship between two sets of data using scatterplots and lines of best fit.

✓ 0806.5.4 Explain the benefits and the limitations of various representations (i.e., bar graphs, line graphs, circle graphs, histograms, stem-and-leaf plots, box plots, scatterplots) of data.
✓ 0806.5.5 Create and interpret box-and-whisker plots and scatterplots.
✓ 0806.5.6 Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken.
✓ 0806.5.7 Estimate lines of best fit to make and test conjectures.

GLE 0806.5.3 Evaluate the use of statistics in media reports.

SPI 0806.5.4 Recognize misrepresentations of published data in the media.

✓ 0806.5.3 Recognize common misconceptions associated with dependent and independent events.
✓ 0806.5.8 Consider the source, design, analysis, and display of data to evaluate statistics reported in the media.
Standard – Processes or Content Strand

CLE – Course Level Expectation

SPI – State Performance Indicator

✓ – Check for Understanding

Standard 1 – Mathematical Processes

CLE 3102.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

SPI 3102.1.1 Interpret patterns found in sequences, tables, and other forms of quantitative information using variables or function notation.

✓ 3102.1.1 Develop meaning for mathematical vocabulary.

✓ 3102.1.2 Use the terminology of mathematics correctly.

✓ 3102.1.3 Understand and use mathematical symbols, notation, and common mathematical abbreviations correctly.

✓ 3102.1.4 Write a rule with variables that expresses a pattern.

CLE 3102.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.

SPI 3102.1.2 Write an equation symbolically to express a contextual problem.

✓ 3102.1.5 Use formulas, equations, and inequalities to solve real-world problems including time/rate/distance, percent increase/decrease, ratio/proportion, and mixture problems.

✓ 3102.1.6 Use a variety of strategies to estimate and compute solutions, including real-world problems.

✓ 3102.1.7 Identify missing or irrelevant information in problems.

✓ 3102.1.8 Recognize and perform multiple steps in problem solving when necessary.

CLE 3102.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.

SPI 3102.1.3 Apply properties to evaluate expressions, simplify expressions, and justify solutions to problems.

✓ 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure, reflexive, symmetric, transitive, operation properties of equality).

✓ 3102.1.10 Use algebraic properties to develop a valid mathematical argument.

CLE 3102.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.

SPI 3102.1.4 Translate between representations of functions that depict real-world situations.

SPI 3102.1.5 Recognize and express the effect of changing constants and/or coefficients in problem solving.

✓ 3102.1.11 Use manipulatives to model algebraic concepts.

✓ 3102.1.12 Create and work flexibly among representations of relations (including verbal, equations, tables, mappings, graphs).

✓ 3102.1.13 Change from one representation of a relation to another representation, for example, change from a verbal description to a graph.

✓ 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients and constants in functions.
CLE 3102.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.

SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems.
- 3102.1.15 Apply arithmetic concepts in algebraic contexts.
- 3102.1.16 Understand and express the meaning of the slope and y-intercept of linear functions in real-world contexts.

CLE 3102.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
- 3102.1.17 Connect the study of algebra to the historical development of algebra.

CLE 3102.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.
- 3102.1.18 Translate syntax of technology to appropriate mathematical notation.
- 3102.1.19 Recognize and practice appropriate use of technology in representations and in problem solving.
- 3102.1.20 Estimate solutions to evaluate the reasonableness of results and to check technological computation.

Standard 2 – Number & Operations
CLE 3102.2.1 Understand computational results and operations involving real numbers in multiple representations.
- 3102.2.1 Recognize and use like terms to simplify expressions.
- 3102.2.2 Apply the order of operations to simplify and evaluate algebraic expressions.

SPI 3102.2.1 Operate (add, subtract, multiply, divide, simplify, powers) with radicals and radical expressions including radicands involving rational numbers and algebraic expressions.
- 3102.2.3 Operate with and simplify radicals (index 2, 3, n) and radical expressions including rational numbers and variables in the radicand.
- 3102.2.4 Operate efficiently with both rational and irrational numbers.

SPI 3102.2.2 Multiply, divide, and square numbers expressed in scientific notation.
- 3102.2.5 Perform operations with numbers in scientific notation (multiply, divide, powers).
- 3102.2.6 Use appropriate technologies to apply scientific notation to real-world problems.

CLE 3102.2.2 Understand properties of and relationships between subsets and elements of the real number system.

SPI 3102.2.3 Describe and/or order a given set of real numbers including both rational and irrational numbers.
- 3102.2.7 Identify the subsets in the real number system and understand their relationships.
- 3102.2.8 Use multiple strategies to approximate the value of an irrational number including irrational square roots and including location on the real number line.

Standard 3 – Algebra
CLE 3102.3.1 Use algebraic thinking to analyze and generalize patterns.

SPI 3102.3.1 Express a generalization of a pattern in various representations including algebraic and function notation.
- 3102.3.1 Recognize and extend arithmetic and geometric sequences.
- 3102.3.2 Explore patterns including Pascal’s Triangle and the Fibonacci sequence.
CLE 3102.3.2 Understand and apply properties in order to perform operations with, evaluate, simplify, and factor expressions and polynomials.

SPI 3102.3.2 Operate with polynomials and simplify results.

✓ 3102.3.3 Justify correct results of algebraic procedures using extension of properties of real numbers to algebraic expressions.
✓ 3102.3.5 Add, subtract, and multiply polynomials including squaring a binomial.
✓ 3102.3.6 Find the quotient of a polynomial and a monomial.
✓ 3102.3.7 Use various models (including area models) to represent products of polynomials.

SPI 3102.3.3 Factor polynomials.

✓ 3102.3.8 Find the GCF of the terms in a polynomial.
✓ 3102.3.9 Find two binomial factors of a quadratic expression.

CLE 3102.3.3 Understand and apply operations with rational expressions and equations.

SPI 3102.3.4 Operate with, evaluate, and simplify rational expressions including determining restrictions on the domain of the variables

✓ 3102.3.4 Simplify expressions using exponent rules including negative exponents and zero exponents
✓ 3102.3.10 Add, subtract, multiply, and divide rational expressions and simplify results

CLE 3102.3.4 Solve problems involving linear equations and linear inequalities.

SPI 3102.3.5 Write and/or solve linear equations, inequalities, and compound inequalities including those containing absolute value.

✓ 3102.3.11 Solve multi-step linear equations with one variable.
✓ 3102.3.12 Recognize and articulate when an equation has no solution, a single solution, or all real numbers as solutions.
✓ 3102.3.13 Solve multi-step linear inequalities with one variable and graph the solution on a number line.
✓ 3102.3.14 Solve absolute value equations and inequalities (including compound inequalities) with one variable and graph their solutions on a number line.
✓ 3102.3.15 Determine domain and range of a relation and articulate restrictions imposed either by the operations or by the real life situation that the function represents.
✓ 3102.3.25 Find function values using f(x) notation or graphs.
✓ 3102.3.26 Graph linear inequalities on the coordinate plane and identify regions of the graph containing ordered pairs in the solution

CLE 3102.3.5 Manipulate formulas and solve literal equations.

CLE 3102.3.6 Understand and use relations and functions in various representations to solve contextual problems.

SPI 3102.3.6 Interpret various relations in multiple representations.

SPI 3102.3.7 Determine domain and range of a relation, determine whether a relation is a function and/or evaluate a function at a specified rational value.

✓ 3102.3.16 Determine if a relation is a function from its graph or from a set of ordered pairs.

SPI 3102.3.8 Determine the equation of a line and/or graph a linear equation.

✓ 3102.3.18 Analyze the characteristics of graphs of basic linear relations and linear functions including constant function, direct variation, identity function, vertical lines, absolute value of linear functions. Use technology where appropriate.
✓ 3102.3.20 Understand that a linear equation has a constant rate of change called slope and represent slope in various forms.
✓ 3102.3.21 Determine the equation of a line using given information including a point and slope, two points, a point and a line parallel or perpendicular, graph, intercepts.
✓ 3102.3.22 Express the equation of a line in standard form, slope-intercept, and point-slope form.
✓ 3102.3.23 Determine the graph of a linear equation including those that depict contextual situations.
✓ 3102.3.24 Interpret the changes in the slope-intercept form and graph of a linear equation by looking at different parameters, m and b in the slope-intercept form.
CLE 3102.3.7 Construct and solve systems of linear equations and inequalities in two variables by various methods.

SPI 3102.3.9 Solve systems of linear equation/inequalities in two variables.
- 3102.3.27 Determine the number of solutions for a system of linear equations (0, 1, or infinitely many solutions).
- 3102.3.28 Solve systems of linear equations graphically, algebraically, and with technology.
- 3102.3.29 Solve contextual problems involving systems of linear equations or inequalities and interpret solutions in context

CLE 3102.3.8 Solve and understand solutions of quadratic equations with real roots.

SPI 3102.3.10 Find the solution of a quadratic equation and/or zeros of a quadratic function.
- 3102.3.30 Solve quadratic equations using multiple methods: factoring, graphing, quadratic formula, or square root principle.
- 3102.3.31 Determine the number of real solutions for a quadratic equation including using the discriminant and its graph.
- 3102.3.32 Recognize the connection among factors, solutions (roots), zeros of related functions, and x-intercepts in equations that arise from quadratic functions.

CLE 3102.3.9 Understand and use exponential functions to solve contextual problems.

SPI 3102.3.11 Analyze nonlinear graphs including quadratic and exponential functions that model a contextual situation.
- 3102.3.17 Recognize “families” of functions.
- 3102.3.19 Explore the characteristics of graphs of various nonlinear relations and functions including inverse variation, quadratic, and square root function. Use technology where appropriate.
- 3102.3.33 Recognize data that can be modeled by an exponential function.
- 3102.3.34 Graph exponential functions in the form \( y = a(b^x) \) where \( b \neq 0 \).
- 3102.3.35 Apply growth/decay and simple/compound interest formulas to solve contextual problems.

Standard 4 – Geometry & Measurement

CLE 3102.4.1 Use algebraic reasoning in applications involving geometric formulas and contextual problems.

SPI 3102.4.1 Develop and apply strategies to estimate the area of any shape on a plane grid.
- 3102.4.1 Using algebraic expressions solve for measures in geometric figures as well as for perimeter, area, and volume.

SPI 3102.4.2 Solve contextual problems using the Pythagorean Theorem.
- 3102.4.2 Use the Pythagorean Theorem to find the missing measure in a right triangle including those from contextual situations.

SPI 3102.4.3 Solve problems involving the distance between points or midpoint of a segment.
- 3102.4.3 Understand horizontal/vertical distance in a coordinate system as absolute value of the difference between coordinates; develop the distance formula for a coordinate plane using the Pythagorean Theorem.
- 3102.4.4 Develop the midpoint formula for segments on a number line or in the coordinate plane.

CLE 3102.4.2 Apply appropriate units of measure and convert measures in problem solving situations.

SPI 3102.4.4 Convert rates and measurements.
- 3102.4.5 Use dimensional analysis to convert rates and measurements both within a system and between systems and check the appropriateness of the solution.
Standard 5 – Data Analysis, Statistics, & Probability

CLE 3102.5.1 Describe and interpret quantitative information.

SPI 3102.5.1 Interpret displays of data to answer questions about the data set(s) (e.g., identify pattern, trends, and/or outliers in a data set).

✓ 3102.5.1 Identify patterns or trends in data.
✓ 3102.5.2 Develop a meaning for and identify outliers in a data set and verify.
✓ 3102.5.5 Construct and interpret various forms of data representations, (including line graphs, bar graphs, circle graphs, histograms, scatter-plots, box-and-whiskers, stem-and-leaf, and frequency tables).
✓ 3102.5.6 Draw qualitative graphs of functions and describe a general trend or shape.
✓ 3102.5.7 Compare two data sets using graphs and descriptive statistics.

CLE 3102.5.2 Use statistical thinking to draw conclusions and make predictions.

SPI 3102.5.2 Identify the effect on mean, median, mode, and range when values in the data set are changed.

✓ 3102.5.3 When a set of data is changed, identify effects on measures of central tendency, range, and inter-quartile range.
✓ 3102.5.4 Explore quartiles, deciles, and percentiles of a distribution.

SPI 3102.5.3 Using a scatter-plot, determine if a linear relationship exists and describe the association between variables.

SPI 3102.5.4 Generate the equation of a line that fits linear data and use it to make a prediction.

✓ 3102.5.8 Examine real-world graphical relationship (including scatter-plots) to determine type of relationship (linear or nonlinear) and any association (positive, negative or none) between the variables of the data set.
✓ 3102.5.9 Determine an equation for a line that fits real-world linear data; interpret the meaning of the slope and y-intercept in context of the data.
✓ 3102.5.10 Using technology with a set of contextual linear data to examine the line of best fit; determine and interpret the correlation coefficient.
✓ 3102.5.11 Use an equation that fits data to make a prediction.

CLE 3102.5.3 Understand basic counting procedures and concepts of probability.

SPI 3102.5.5 Determine theoretical and/or experimental probability of an event and/or its complement including using relative frequency.

✓ 3102.5.12 Use techniques (Venn Diagrams, tree diagrams, or counting procedures) to identify the possible outcomes of an experiment or sample space and compute the probability of an event.
✓ 3102.5.13 Determine the complement of an event and the probability of that complement.
✓ 3102.5.14 Determine if two events are independent or dependent.
✓ 3102.5.15 Explore joint and conditional probability.
✓ 3102.5.16 Identify situations for which the Law of Large Numbers applies.
✓ 3102.5.17 Perform simulations to estimate probabilities.
✓ 3102.5.18 Make informed decisions about practical situations using probability concepts.
Standard – Processes or Content Strand

CLE – Course Level Expectation

SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes

CLE 3108.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

SPI 3108.1.1 Give precise mathematical descriptions or definitions of geometric shapes in the plane and space.
✓ 3108.1.4 Recognize that a definition depends on undefined terms and on previous definitions.

CLE 3108.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.

SPI 3108.1.4 Use definitions, basic postulates, and theorems about points, lines, angles, and planes to write/complete proofs and/or to solve problems.
SPI 3108.1.2 Determine areas of planar figures by decomposing them into simpler figures without a grid.
✓ 3108.1.1 Check solutions after making reasonable estimates in appropriate units of quantities encountered in contextual situations.
✓ 3108.1.9 Expand analysis of units of measure to include area and volume.

CLE 3108.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.

SPI 3108.1.4 Use definitions, basic postulates, and theorems about points, lines, angles, and planes to write/complete proofs and/or to solve problems.
✓ 3108.1.6 Use inductive reasoning to write conjectures and/or conditional statements.
✓ 3108.1.13 Use proofs to further develop and deepen the understanding of the study of geometry (e.g. two-column, paragraph, flow, indirect, coordinate).
✓ 3108.1.14 Identify and explain the necessity of postulates, theorems, and corollaries in a mathematical system.

CLE 3108.1.4 Move flexibly between multiple representations (contextual, physical written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.

SPI 3108.1.3 Use geometric understanding and spatial visualization of geometric solids to solve problems and/or create drawings.
✓ 3108.1.2 Determine position using spatial sense with two and three-dimensional coordinate systems.
✓ 3108.1.10 Use visualization, spatial reasoning, and geometric modeling to solve problems.
✓ 3108.1.11 Identify and sketch solids formed by revolving two-dimensional figures around lines.

CLE 3108.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.
✓ 3108.1.3 Comprehend the concept of length on the number line.

CLE 3108.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
✓ 3108.1.8 Understand how the similarity of right triangles allows the trigonometric functions sine, cosine, and tangent to be defined as ratio of sides.
✓ 3108.1.12 Connect the study of geometry to the historical development of geometry.
CLE 3108.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.
  ✓3108.1.5 Use technology, hands-on activities, and manipulatives to develop the language and the concepts of geometry, including specialized vocabulary (e.g. graphing calculators, interactive geometry software such as Geometer’s Sketchpad and Cabri, algebra tiles, pattern blocks, tessellation tiles, MIRAs, mirrors, spinners, geoboards, conic section models, volume demonstration kits, Polydrons, measurement tools, compasses, PentaBlocks, pentominoes, cubes, tangrams).
  ✓3108.1.7 Recognize the capabilities and the limitations of calculators and computers in solving problems.

Standard 2 – Number & Operations
CLE3108.2.1 Establish the relationships between the real numbers and geometry; explore the importance of irrational numbers to geometry.

SPI 3108.2.1 Analyze, apply, or interpret the relationships between basic number concepts and geometry (e.g. rounding and pattern identification in measurement, the relationship of pi to other rational and irrational numbers)
  ✓3108.2.1 Analyze properties and aspects of pi (e.g. classical methods of approximating pi, irrational numbers, Buffon’s needle, use of dynamic geometry software).
  ✓3108.2.2 Approximate pi from a table of values for the circumference and diameter of circles using various methods (e.g. line of best fit).
  ✓3108.2.6 Analyze precision, accuracy, and approximate error in measurement situations.

CLE3108.2.2 Explore vectors as a numeric system, focusing on graphic representations and the properties of the operation.

SPI 3108.2.2 Perform operations on vectors in various representations.
  ✓3108.2.3 Recognize and apply real number properties to vector operations and geometric proofs (e.g. reflexive, symmetric, transitive, addition, subtraction, multiplication, division, distributive, and substitution properties).
  ✓3108.2.4 Add vectors graphically and algebraically.
  ✓3108.2.5 Multiply a vector by a scalar graphically and algebraically.

CLE3108.2.3 Establish an ability to estimate, select appropriate units, evaluate accuracy of calculations and approximate error in measurement in geometric settings.

Standard 3 – Algebra
CLE 3108.3.1 Use analytic geometry tools to explore geometric problems involving parallel and perpendicular lines, circles, and special points of polygons.

SPI 3108.3.1 Use algebra and coordinate geometry to analyze and solve problems about geometric figures (including circles).

SPI 3108.3.2 Use coordinate geometry to prove characteristics of polygonal figures.
  ✓3108.3.1 Prove two lines are parallel, perpendicular, or oblique using coordinate geometry.
  ✓3108.3.2 Connect coordinate geometry to geometric figures in the plane (e.g. midpoints, distance formula, slope, and polygons).
  ✓3108.3.3 Find the equation of a circle given its center and radius and vice versa.
  ✓3108.3.4 Apply the midpoint and distance formulas to points and segments to find midpoints, distances, and missing information in two and three dimensions.

CLE 3108.3.2 Explore the effect of transformations on geometric figures and shapes in the coordinate plane.

SPI 3108.3.3 Describe algebraically the effect of a single transformation (reflections in the x- or y-axis, rotations, translations, and dilations) on two-dimensional geometric shapes in the coordinate plane.
Standard 4 – Geometry & Measurement
CLE 3108.4.1 Develop the structures of geometry, such as lines, angles, planes, and planar figures, and explore their properties and relationships.

SPI 3108.4.1 Differentiate between Euclidean and non-Euclidean geometries.

- 3108.4.1 Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true and discuss unique properties of each.

SPI 3108.4.2 Define, identify, describe, and/or model plane figures using appropriate mathematical symbols (including collinear and non-collinear points, lines, segments, rays, angles, triangles, quadrilaterals, and other polygons).

- 3108.4.3 Solve problems involving betweenness of points and distance between points (including segment addition).
- 3108.4.4 Describe and recognize minimal conditions necessary to define geometric objects.
- 3108.4.5 Use vertical, adjacent, complementary, and supplementary angle pairs to solve problems and write proofs.
- 3108.4.6 Describe the intersection of lines (in the plane and in space), a line and a plane, or of two planes.
- 3108.4.7 Identify perpendicular planes, parallel planes, a line parallel to a plane, skew lines, and a line perpendicular to a plane.
- 3108.4.8 Apply properties and theorems about angles associated with parallel and perpendicular lines to solve problems.
- 3108.4.21 Use properties of and theorems about parallel lines, perpendicular lines, and angles to prove basic theorems in Euclidean geometry (e.g., two lines parallel to a third line are parallel to each other, the perpendicular bisectors of line segments are the set of all points equidistant from the endpoints, and two lines are parallel when the alternate interior angles they make with a transversal are congruent).
- 3108.4.22 Perform basic geometric constructions using a straight edge and a compass, paper folding, graphing calculator programs, and computer software packages (i.e., bisect and trisect segments, congruent angles, congruent segments, a line parallel to a given line through a point not on the line, angle bisector, and perpendicular bisector).

CLE 3108.4.2 Describe the properties of regular polygons, including comparative classification of them and special points and segments.

SPI 3108.4.3 Identify, describe and/or apply the relationships and theorems involving different types of triangles, quadrilaterals and other polygons.

- 3108.4.9 Classify triangles, quadrilaterals, and polygons (regular, non-regular, convex and concave) using their properties.
- 3108.4.10 Identify and apply properties and relationships of special figures (e.g., isosceles and equilateral triangles, family of quadrilaterals, polygons, and solids).
- 3108.4.11 Use the triangle inequality theorems (e.g., Exterior Angle Inequality Theorem, Hinge Theorem, SSS Inequality Theorem, Triangle Inequality Theorem) to solve problems.
- 3108.4.12 Apply the Angle Sum Theorem for polygons to find interior and exterior angle measures given the number of sides, to find the number of sides given angle measures, and to solve contextual problems.
- 3108.4.14 Identify and use medians, midsegments, altitudes, angle bisectors, and perpendicular bisectors of triangles to solve problems (e.g., find segment lengths, angle measures, points of concurrency).
CLE 3108.4.3 Develop an understanding of the tools of logic and proof, including aspects of formal logic as well as construction of proofs.

SPI 3108.4.4 Analyze different types and formats of proofs.
- 3108.4.2 Compare and contrast inductive reasoning and deductive reasoning for making predictions and valid conclusions based on contextual situations.
- 3108.4.15 Identify, write, and interpret conditional and bi-conditional statements along with the converse, inverse, and contra-positive of a conditional statement.
- 3108.4.16 Analyze and create truth tables to evaluate conjunctions, disjunctions, conditionals, inverses, contra-positives, and bi-conditional statements.
- 3108.4.17 Use the Law of Detachment, Law of Syllogism, conditional statements, and bi-conditional statements to draw conclusions.
- 3108.4.18 Use counterexamples, when appropriate, to disprove a statement.
- 3108.4.19 Use coordinate geometry to prove properties of plane figures.
- 3108.4.20 Prove key basic theorems in geometry (i.e., Pythagorean Theorem, the sum of the angles of a triangle is 180 degrees, characteristics of quadrilaterals, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length).

CLE 3108.4.4 Develop geometric intuition and visualization through performing geometric constructions with straightedge/compass and with technology.

CLE 3108.4.5 Extend the study of planar figures to three-dimensions, including the classical solid figures, and develop analysis through cross-sections.

SPI 3108.4.5 Describe solids and/or surfaces in three-dimensional space when given two-dimensional representations for the surfaces of three-dimensional objects.
- 3108.4.13 Locate, describe, and draw a locus in a plane or space (e.g., fixed distance from a point on a plane, fixed distance from a point in space, fixed distance from a line, equidistant from two points, equidistant from two parallel lines, and equidistant from two intersecting lines).
- 3108.4.23 Describe the polyhedron or solid that can be made from a given net including the Platonic Solids.
- 3108.4.24 Develop and use special formulas relating to polyhedra (e.g., Euler’s Formula).
- 3108.4.25 Use properties of prisms, pyramids, cylinders, cones, spheres, and hemispheres to solve problems.

CLE 3108.4.6 Generate formulas for perimeter, area, and volume, including their use, dimensional analysis, and applications.

SPI 3108.4.6 Use various area of triangle formulas to solve contextual problems (e.g., Heron’s formula, the area formula for an equilateral triangle and \( A = \frac{1}{2} ab \sin C \)).

SPI 3108.4.7 Compute the area and/or perimeter of triangles, quadrilaterals and other polygons when one or more additional steps are required (e.g. find missing dimensions given area or perimeter of the figure, using trigonometry).

SPI 3108.4.8 Solve problems involving area, circumference, area of a sector, and/or arclength of a circle.
- 3108.4.28 Derive and use the formulas for the area and perimeter of a regular polygon. \((A=1/2 \text{ap})\)

CLE 3108.4.7 Apply the major concepts of transformation geometry to analyzing geometric objects and symmetry.

SPI 3108.4.10 Identify, describe, and/or apply transformations on two and three dimensional geometric shapes
- 3108.4.31 Use properties of single transformations and compositions of transformations to determine their effect on geometric figures (e.g. reflections across lines of symmetry, rotations, translations, glide reflections, and dilations).
- 3108.4.32 Recognize, identify and apply types of symmetries (point, line, rotational) of two- and three- dimensional figures.
✓ 3108.4.33 Use transformations to create and analyze tessellations and investigate the use of tessellations in architecture, mosaics, and artwork.
✓ 3108.4.34 Create and analyze geometric designs using rigid motions (compositions of reflections, translations, and rotations).

CLE 3108.4.8 Establish processes for determining congruence and similarity of figures, especially as related to scale factor, contextual applications, and transformations.

SPI 3108.4.11 Use basic theorems about similar and congruent triangles to solve problems.
✓ 3108.4.35 Prove that two triangles are congruent by applying the SSS, SAS, ASA, AAS, and HL congruence statements.
✓ 3108.4.36 Use several methods, including AA, SSS, and SAS, to prove that two triangles are similar.
✓ 3108.4.37 Identify similar figures and use ratios and proportions to solve mathematical and real-world problems (e.g., Golden Ratio).
✓ 3108.4.38 Use the principle that corresponding parts of congruent triangles are congruent to solve problems.

SPI 3108.4.12 Solve problems involving congruence, similarity, proportional reasoning and/or scale factor of two similar figures or solids.
✓ 3108.4.29 Extend the effect of a scale factor $k$ in similar objects to include the impact on volume calculations and transformations.

CLE 3108.4.9 Develop the role of circles in geometry, including angle measurement, properties as a geometric figure, and aspects relating to the coordinate plane.

SPI 3108.4.13 Identify, analyze and/or use basic properties and theorems of circles to solve problems (including those relating right triangles and circles).
✓ 3108.4.39 Identify lines and line segments associated with circles.
✓ 3108.4.40 Find angle measures, intercepted arc measures, and segment lengths formed by radii, chords, secants, and tangents intersecting inside and outside circles.
✓ 3108.4.41 Use inscribed and circumscribed polygons to solve problems concerning segment length and angle measures.

CLE 3108.4.10 Develop the tools of right triangle trigonometry in the contextual applications, including the Pythagorean Theorem, Law of Sines and Law of Cosines

SPI 3108.4.9 Use right triangle trigonometry and cross-sections to solve problems involving surface areas and/or volumes of solids.
✓ 3108.4.26 Describe and draw cross-sections (including the conic sections) of prisms, cylinders, pyramids, spheres, and cones.
✓ 3108.4.27 Use right triangle trigonometry to find the area and perimeter of quadrilaterals (e.g. square, rectangle, rhombus, parallelogram, trapezoid, and kite).
✓ 3108.4.30 Use right triangle trigonometry to find the lateral area (if possible), surface area, and volume of prisms, cylinders, cones, pyramids, spheres, and hemispheres.

SPI 3108.4.14 Use properties of right triangles to solve problems (such as involving the relationship formed when the altitude to the hypotenuse of a right triangle is drawn).
✓ 3108.4.42 Use geometric mean to solve problems involving relationships that exist when the altitude is drawn to the hypotenuse of a right triangle.
✓ 3108.4.43 Apply the Pythagorean Theorem and its converse to triangles to solve mathematical and contextual problems in two- or three-dimensional situations.
✓ 3108.4.44 Identify and use Pythagorean triples in right triangles to find lengths of an unknown side in two- or three-dimensional situations.
✓ 3108.4.45 Use the converse of the Pythagorean Theorem to classify a triangle by its angles (right, acute, or obtuse).
✓ 3108.4.46 Apply properties of $30^\circ$ - $60^\circ$ - $90^\circ$ and $45^\circ$ - $45^\circ$ - $90^\circ$ to determine side lengths of triangles.
SPI 3108.4.15 Determine and use the appropriate trigonometric ratio for a right triangle to solve a contextual problem.

- 3108.4.47 Find the sine, cosine and tangent ratios of an acute angle of a right triangle given the side lengths.
- 3108.4.48 Define, illustrate, and apply angles of elevation and angles of depression in real-world situations.
- 3108.4.49 Use the Law of Sines (excluding the ambiguous case) and the Law of Cosines to find missing side lengths and/or angle measures in non-right triangles.

Standard 5 – Data Analysis, Statistics, & Probability

CLE 3108.5.1 Analyze, interpret, employ and construct accurate statistical graphs.

SPI 3108.5.1 Use area to solve problems involving geometric probability (e.g. dartboard problem, shaded sector of a circle, shaded region of a geometric figure).

- 3108.5.3 Estimate or calculate simple geometric probabilities (e.g., number line, area model, using length, circles).
- 3108.5.1 Determine the area of each sector and the degree measure of each intercepted arc in a pie chart.
- 3108.5.2 Translate from one representation of data to another (e.g., bar graph to pie graph, pie graph to bar graph, table to pie graph, pie graph to chart) accurately using the area of a sector.

CLE 3108.5.2 Develop the basic principles of geometric probability.
Standard – Processes or Content Strand
CLE – Course Level Expectation
SPI – State Performance Indicator
✓ – Check for Understanding

Standard 1 – Mathematical Processes
CLE 3103.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

SPI 3103.1.4 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely to effectively communicate reasoning in the process of solving problems via mathematical modeling with both linear and non-linear functions.
✓3103.1.5 Determine the accuracy and reliability of a mathematical model.
✓3103.1.9 Translate the syntax of technology to appropriate mathematical notation for non-linear and transcendental functions.
✓3103.1.10 Interpret the results of mathematical modeling in various contexts to answer questions.

CLE 3103.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.

SPI 3103.1.4 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely to effectively communicate reasoning in the process of solving problems via mathematical modeling with both linear and non-linear functions.

CLE 3103.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.

SPI 3103.1.4 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely to effectively communicate reasoning in the process of solving problems via mathematical modeling with both linear and non-linear functions.

CLE 3103.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.

SPI 3103.1.1 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic) of non-linear and transcendental functions to solve problems, to model mathematical ideas, and to communicate solution strategies.
✓3103.1.6 Use graphical representations to perform operations on complex numbers.
✓3103.1.7 Use the unit circle to determine the exact value of trigonometric functions for commonly used angles (0°, 30°, 45°, 60°…).
✓3103.1.8 Understand and describe the inverse relationship between exponential and logarithmic functions.
✓3103.1.1 Create and analyze scatter-plots of non-linear and transcendental functions.

CLE 3103.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.

SPI 3103.1.2 Recognize and describe errors in data collection and analysis as well as identifying representations of data as being accurate or misleading.
✓3103.1.2 Compare and contrast sampling techniques and identify the best technique for a given situation.
CLE 3103.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.

CLE 3103.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

SPI 3103.1.3 Use technology tools to identify and describe patterns in data using non-linear and transcendental functions that approximate data as well as using those functions to solve contextual problems.

- 3103.1.4 Identify the weaknesses of calculators and other technologies in representing non-linear data, such as graphs approaching vertical asymptotes, and use alternative techniques to identify these issues and correctly solve problems.
- 3103.1.3 Use calculators to identify regression equations for nonlinear data.
- 3103.1.5 Determine the accuracy and reliability of a mathematical model.
- 3103.1.9 Translate the syntax of technology to appropriate mathematical notation for non-linear and transcendental functions.

Standard 2 – Number & Operations

CLE 3103.2.1 Understand the hierarchy of the complex number system and relationships between the elements, properties and operations.

SPI 3103.2.1 Describe any number in the complex number system.
- 3103.2.1 Understand that to solve certain problems and equations, the real number system needs to be extended from real numbers to complex numbers.
- 3103.2.2 Define and give examples of each of the types of numbers in the complex number system.
- 3103.2.10 Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers over complex numbers.

CLE 3103.2.2 Connect numeric, analytic, graphical and verbal representations of both real and complex numbers.

- 3103.2.7 Graph complex numbers in the complex plane and recognize differences and similarities with the graphical representations of real numbers graphed on the number line.
- 3103.2.9 Find and describe geometrically the absolute value of a complex number.

SPI 3103.2.2 Compute with all real and complex numbers.

- 3103.2.3 Identify and apply properties of complex numbers (including simplification and standard form).
- 3103.2.4 Add and subtract complex numbers.
- 3103.2.5 Multiply complex numbers.
- 3103.2.6 Define and utilize the complex conjugates to write the quotient of two complex numbers in standard form.

SPI 3103.2.3 Use the number system, from real to complex, to solve equations and contextual problems.

- 3103.2.8 Solve quadratic equations over the complex number system.
- 3103.2.12 Select and use appropriate methods to make estimations without technology when solving contextual problems.
- 3103.2.13 Analyze and evaluate contextual situations involving any type of number from the complex number system.

CLE 3103.2.3 Use appropriate technology (including graphing calculators and computer spreadsheets) to solve problems, recognize patterns and collect and analyze data.
CLE 3103.2.4 Understand the capabilities and limitations of technology when performing operations, graphing, and solving equations involving complex numbers.
   ✔ 3103.2.11 Understand the capabilities and limitations of technology. Make estimations without a calculator to detect potential errors.

Standard 3 – Algebra

CLE 3103.3.1 Understand and apply properties of rational exponents and perform basic operations to simplify algebraic expressions.
   SPI 3103.3.1 Add, subtract and multiply polynomials; divide a polynomial by a lower degree polynomial.
      ✔ 3103.3.1 Perform operations on algebraic expressions and justify the procedures.
      ✔ 3103.3.21 Factor polynomials using a variety of methods including the factor theorem, synthetic division, long division, sums and differences of cubes, and grouping.
   SPI 3103.3.3 Add, subtract, multiply, divide and simplify rational expressions including those with rational and negative exponents.
      ✔ 3103.3.15 Find the sum of a geometric series whose common ratio, r, is in the interval (-1,1).

CLE 3103.3.2 Understand, analyze, transform and generalize mathematical patterns, relations and functions using properties and various representations.
   SPI 3103.3.5 Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the contextual situations which the functions represent.
   SPI 3103.3.6 Combine functions (such as polynomial, rational, radical and absolute value expressions) by addition, subtraction, multiplication, division, or by composition and evaluate at specified values of their variables.
   SPI 3103.3.7 Identify whether a function has an inverse, whether two functions are inverses of each other, and/or explain why their graphs are reflections over the line y = x.
      ✔ 3103.3.3 Determine and graph the inverse of a function with and without technology.
   SPI 3103.3.10 Identify and/or graph a variety of functions and their translations.
      ✔ 3103.3.4 Analyze the effect of changing various parameters on functions and their graphs.
      ✔ 3103.3.5 Graph piece-wise and step functions.
      ✔ 3103.3.11 Describe and articulate the characteristics and parameters of a parent function.

CLE 3103.3.3 Analyze and apply various methods to solve equations, absolute values, inequalities, and systems of equations over complex numbers.
   SPI 3103.3.2 Solve quadratic equations and systems, and determine roots of a higher order polynomial.
      ✔ 3103.3.7 Solve quadratic equations by factoring, graphing, completing the square, extracting square roots and using the quadratic formula.
      ✔ 3103.3.10 Given a quadratic equation use the discriminant to determine the nature of the roots.
      ✔ 3103.3.22 Determine the number and possible types of zeros for a polynomial function and find the rational roots.
      ✔ 3103.3.23 Understand the connection between the roots, zeros, x-intercepts, factors of polynomials, and solutions of polynomial equations.
   SPI 3103.3.4 Use the formulas for the general term and summation of finite arithmetic and both finite and infinite geometric series.
      ✔ 3103.3.2 Determine the domain of a function represented in either symbolic or graphical form.
      ✔ 3103.3.14 Define and use arithmetic and geometric sequences and series including using sigma and pi notation.
   SPI 3103.3.8 Solve systems of three linear equations in three variables.
      ✔ 3103.3.8 Solve a three by three system of linear equations algebraically and by using inverse matrices and determinants with and without technology.
SPI 3103.3.9 Graph the solution set of two or three linear or quadratic inequalities.

SPI 3103.3.18 Solve compound inequalities involving disjunction and conjunction and linear inequalities containing absolute values.

SPI 3103.3.19 Solve linear programming problems.

CLE 3103.3.4 Graph and compare equations and inequalities in two variables. Identify and understand the relationships between the algebraic and geometric properties of the graph.

SPI 3103.3.11 Graph conic sections (circles, parabolas, ellipses and hyperbolas) and understand the relationship between the standard form and the key characteristics of the graph.

SPI 3103.3.9 Find an equation for a parabola when given its graph or when given its roots.

SPI 3103.3.12 Understand the relationship between real zeros of a function and the x-intercepts of its graph.

SPI 3103.3.20 Understand the relationships between the equations of conic sections and their graphs.

CLE 3103.3.5 Use mathematical models involving equations and systems of equations to represent, interpret and analyze quantitative relationships, change in various contexts, and other real-world phenomena.

SPI 3103.3.12 Interpret graphs that depict real-world phenomena.

SPI 3103.3.13 Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.

SPI 3103.3.12 Simplify expressions and solve equations containing radicals.

SPI 3103.3.13 Solve problems using exponential functions requiring the use of logarithms for their solutions.

SPI 3103.3.16 Prove basic properties of logarithms using properties of exponents and apply those properties to solve problems.

SPI 3103.3.17 Know that the logarithm and exponential functions are inverses and use this information to solve real-world problems.

SPI 3103.3.14 Solve problems involving the binomial theorem and its connection to Pascal’s Triangle, combinatorics, and probability.

Standard 4 – Geometry & Measurement

CLE 3103.4.1 Understand the trigonometric functions and their relationship to the unit circle.

SPI 3103.4.1 Exhibit knowledge of unit circle trigonometry.

SPI 3103.4.3 Extend the trigonometric functions to periodic functions on the real line by defining them as functions on the unit circle.

SPI 3103.4.1 Convert between radians and degrees and vice versa.

SPI 3103.4.4 Understand the relationship between the radius, the central angle, and radian measure.

CLE 3103.4.2 Know and use the basic identities of sine, cosine, and tangent as well as their reciprocals.

SPI 3103.4.6 Know and be able to use the fundamental trigonometric identities, including the Pythagorean identities, reciprocal identities, sum of sine and cosine, and odd and even identities.

CLE 3103.4.3 Graph all six trigonometric functions and identify their key characteristics.

SPI 3103.4.2 Match graphs of basic trigonometric functions with their equations.

SPI 3103.4.2 Determine the period and the amplitude of a periodic function.

SPI 3103.4.5 Determine the domain and range of the six trigonometric functions given a graph.

CLE 3103.4.4 Know and use the Law of Sines to find missing sides and angles of a triangle, including the ambiguous case.

CLE 3103.4.5 Use trigonometric concepts, properties and graphs to solve problems.

SPI 3103.4.3 Describe and articulate the characteristics and parameters of parent trigonometric functions to solve contextual problems.
Standard 5 – Data Analysis, Statistics, & Probability

CLE 3103.5.1 Describe, interpret, and apply quantitative data.

SPI 3103.5.1 Compute, compare and explain summary statistics for distributions of data including measures of center and spread.

SPI 3103.5.2 Compare data sets using graphs and summary statistics.

✓ 3103.5.5 Calculate measures of central tendency and spread (variance and standard deviation).

CLE 3103.5.2 Evaluate and critique various ways of collecting data and using information based on data published in the media.

SPI 3103.5.5 Determine differences between randomized experiments and observational studies.

✓ 3103.5.4 Understand the impact of various sampling methods and use them to draw valid conclusions.

✓ 3103.5.10 Design simple experiments to collect data to answer questions of interest.

✓ 3103.5.11 Evaluate published data by considering the source, the design of the study and the analysis and representation (or misrepresentation) of the data.

✓ 3103.5.12 Investigate bias and the phrasing of questions during data acquisition to formulate reasonable conclusions.

CLE 3103.5.3 Use data and statistical thinking to draw inferences, make predictions, justify conclusions and identify and explain misleading uses of data.

SPI 3103.5.3 Analyze patterns in a scatter-plot and describe relationships in both linear and non-linear data.

✓ 3103.5.1 Collect, represent and describe both linear and non-linear data developed from contextual situations.

✓ 3103.5.2 Organize and display data using appropriate methods (including spreadsheets and technology tools) to detect patterns and departures from patterns.

✓ 3103.5.3 Read and interpret data from a two-way table.

✓ 3103.5.9 Use data to detect patterns.

SPI 3103.5.6 Find the regression curve that best fits both linear and non-linear data (using technology such as a graphing calculator) and use it to make predictions.

✓ 3103.5.6 Use technology to find the appropriate regression equation for both linear and non-linear data.

SPI 3103.5.7 Determine/recognize when the correlation coefficient measures goodness of fit.

✓ 3103.5.7 Recognize when the correlation coefficient measures goodness of fit and does not imply causation.

CLE 3103.5.4 Develop an understanding of probability concepts in order to make informed decisions.

SPI 3103.5.4 Apply the characteristics of the normal distribution.

✓ 3103.5.8 Know the Empirical Rule for one, two and three standard deviations for a normal distribution.

SPI 3103.5.8 Apply probability concepts such as conditional probability and independent events to calculate simple probability.

✓ 3103.5.13 Apply both theoretical and experimental probability to analyze the likelihood of an event.
# APPENDIX C

Webb’s Depth of knowledge Levels  
for the K-12 Tennessee Mathematics Framework

<table>
<thead>
<tr>
<th>Standards</th>
<th>Kindergarten Mathematics</th>
</tr>
</thead>
</table>
| Level 1   | GLE 0006.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.  
            GLE 0006.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely. |
| Level 2   | GLE 0006.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.  
            GLE 0006.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts. |
| Level 3   | GLE 0006.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.  
            GLE 0006.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.  
            GLE 0006.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world. |
<p>| Level 4   | GLE 0006.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution. |</p>
<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 2: Number and Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GLE 0006.2.1 Count objects in a set and use numbers, including written numerals to 25.</td>
</tr>
</tbody>
</table>
| 2     | GLE 0006.2.2 Create, represent and recognize a set with a given number of objects.  
GLE 0006.2.3 Recognize, compare and order sets of numerals by using both cardinal and ordinal meanings.  
GLE 0006.2.4 Understand addition as “putting together” and subtraction as “breaking apart.”  
GLE 0006.2.5 Model the numbers 1 through 10 as sums or differences of different sets of whole numbers (composing and decomposing numbers). |
| 3     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
| 4     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 3: Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
</tbody>
</table>
| 2     | GLE 0006.3.1 Identify, duplicate, and extend simple number patterns and sequential and growing patterns.  
GLE 0006.3.2 Recognize attributes (such as color, shape, size) and patterns (such as repeated pairs, bilateral symmetry).  
GLE 0006.3.3 Describe qualitative change. |
| 3     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
| 4     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
### Standard 4: Geometry and Measurement

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GLE 0006.4.1 Interpret and describe the physical world with geometric ideas and vocabulary.</td>
</tr>
</tbody>
</table>
| 2     | GLE 0006.4.2 Use positional terms to specify locations with simple relationships.  
       | GLE 0006.4.3 Compare and order measurable attributes of objects directly (by comparing them with each other) and indirectly (by comparing both with a third object). |
| 3     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
| 4     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

### Standard 5: Data, Probability, and Statistics

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
</tbody>
</table>
| 2     | GLE 0006.5.1 Sort objects and use one or more attributes to solve problems.  
       | GLE 0006.5.2 Re-sort objects using new attributes. |
| 3     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
| 4     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
## Grade One Mathematics

<table>
<thead>
<tr>
<th>Standard 1: Mathematical Processes</th>
<th></th>
<th>GLE 0106.1.1</th>
<th>Use mathematical language, symbols, and definitions while developing mathematical reasoning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Level 2</td>
<td>GLE 0106.1.6</td>
<td>Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.</td>
</tr>
<tr>
<td></td>
<td>Level 2</td>
<td>GLE 0106.1.4</td>
<td>Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.</td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>GLE 0106.1.8</td>
<td>Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.</td>
</tr>
<tr>
<td></td>
<td>Level 4</td>
<td>GLE 0106.1.3</td>
<td>Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.</td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>GLE 0106.1.5</td>
<td>Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.</td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>GLE 0106.1.7</td>
<td>Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.</td>
</tr>
<tr>
<td></td>
<td>Level 4</td>
<td>GLE 0106.1.2</td>
<td>Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard 2: Number and Operations</th>
<th></th>
<th>GLE 0106.2.1</th>
<th>Understand and use number notation and place value to 100.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Level 2</td>
<td>GLE 0106.2.3</td>
<td>Develop strategies for learning basic addition facts and related subtraction facts.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Level 2</td>
<td>GLE 0106.2.2</td>
<td>Compare and order whole numbers to 100.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Level 2</td>
<td>GLE 0106.2.4</td>
<td>Use multiple representations (including groups of ten) to model two-digit addition and subtraction.</td>
</tr>
<tr>
<td>Level 4</td>
<td>Level 3</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>Level 4</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>Standard: Algebra</td>
<td>Level 3: Algebra</td>
<td></td>
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<tr>
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</tr>
<tr>
<td>Level 1</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0106.3.1 Identify, describe, and extend simple number patterns to develop strategies for adding and subtracting whole numbers.</td>
<td>GLE 0106.3.2 Understand that addition and subtraction are inverse operations.</td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0106.3.3 Extend the strategies for basic facts to include other properties of number and operations.</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Standard: Geometry and Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0106.4.1 Recognize, describe, and draw geometric figures.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0106.4.3 Use non-standard units in linear measurement.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0106.4.2 Compose and decompose geometric shapes.</td>
</tr>
</tbody>
</table>
Standard 5 : Data, Probability, and Statistics

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0106.5.1 Use various representations to display and compare data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>Level 2</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>Level 3</td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
</tbody>
</table>

Standards Grade Two Mathematics

Standard 1 : Mathematical Processes

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0206.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0206.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0206.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0206.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0206.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0206.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0206.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0206.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.</td>
</tr>
</tbody>
</table>
| Standard 2: Number and Operations | Level | GLE 0206.2.1 Understand and use place value concepts to 1000.  
| GLE 0206.2.2 Understand and use the base-ten numeration system. |
| Level 2 | GLE 0206.2.3 Use efficient and accurate strategies to develop fluency with multi-digit addition and subtraction. |
| Level 3 | GLE 0206.2.4 Develop an initial understanding of multiplication. |
| 4 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

| Standard 3: Algebra | Level 1 | GLE 0206.3.4 Describe quantitative change. |
| Level 2 | GLE 0206.3.2 Extend knowledge of the properties of numbers and operations to multiplication. |
| Level 3 | GLE 0206.3.1 Develop pattern recognition.  
| GLE 0206.3.3 Solve simple arithmetic problems using various methods. |
| 4 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

| Standard 4: Geometry and Measurement | Level 1 | GLE 0206.4.3 Add, subtract, compare, compute and estimate linear measurements. |
| Level 2 | GLE 0206.4.1 Recognize, classify, and transform 2- and 3-dimensional geometric figures.  
| GLE 0206.4.2 Understand the meaning and process of linear measurement.  
<p>| GLE 0206.4.4 Compose and decompose polygons to make other polygons. |
| 3 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
| 4 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |</p>
<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 5: Data, Probability, and Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GLE 0206.5.2 Determine whether an event is likely or unlikely.</td>
</tr>
<tr>
<td>2</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
</tr>
<tr>
<td>3</td>
<td>GLE 0206.5.1 Use and understand various representations to depict and analyze data measurements.</td>
</tr>
<tr>
<td>4</td>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
</tr>
</tbody>
</table>

**Grade Three Mathematics**

<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 1: Mathematical Processes</th>
</tr>
</thead>
</table>
| 1     | GLE 0306.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.  
GLE 0306.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely. |
| 2     | GLE 0306.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.  
GLE 0306.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts. |
| 3     | GLE 0306.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.  
GLE 0306.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.  
GLE 0306.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world. |
| 4     | GLE 0306.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution. |
### Standard 2: Number and Operations

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0306.2.7</th>
<th>Add and subtract fractions with like denominators using various models.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0306.2.1</td>
<td>Understand the place value of whole numbers to ten-thousands place including expanded notation for all arithmetic operations.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0306.2.3</td>
<td>Relate multiplication and division as inverse operations.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0306.2.6</td>
<td>Use various strategies and models to compare and order fractions and identify equivalent fractions.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0306.2.2</td>
<td>Develop understanding of multiplication and related division facts through multiple strategies and representations.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0306.2.4</td>
<td>Solve multiplication and division problems using various representations.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0306.2.5</td>
<td>Understand the meaning and uses of fractions.</td>
</tr>
</tbody>
</table>

**THIS LEVEL IS NOT REPRESENTED AT THIS GRADE**

### Standard 3: Algebra

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0306.3.2</th>
<th>Develop understanding that a letter or a symbol can represent an unknown quantity in a simple mathematical expression/equation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0306.3.1</td>
<td>Develop meaning for and apply the commutative, associative, and distributive properties using various representations.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0306.3.3</td>
<td>Describe and analyze patterns and relationships in contexts.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0306.3.4</td>
<td>Create and represent patterns using words, tables, graphs, and symbols.</td>
</tr>
</tbody>
</table>

**THIS LEVEL IS NOT REPRESENTED AT THIS GRADE**

### Standard 4: Geometry and Measurement

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0306.4.1</th>
<th>Describe, compare, and analyze properties of polygons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0306.4.2</td>
<td>Understand and apply the concepts of congruence and symmetry.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0306.4.3</td>
<td>Understand and use attributes of 2- and 3-dimensional figures to solve problems.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0306.4.4</td>
<td>Use appropriate units, strategies and tools to solve problems involving perimeter.</td>
</tr>
<tr>
<td>Level 4</td>
<td>GLE 0306.4.5</td>
<td>Solve measurement problems involving fractional parts of linear units and capacity units.</td>
</tr>
</tbody>
</table>

**THIS LEVEL IS NOT REPRESENTED AT THIS GRADE**
Standard 5: Data, Probability, and Statistics

<table>
<thead>
<tr>
<th>Level</th>
<th>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>2</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>3</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>4</td>
<td>GLE 0306.5.1 Organize, display, and analyze data using various representations to solve problems.</td>
</tr>
</tbody>
</table>

**Standards**

**Grade Four Mathematics**

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0406.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GLE 0406.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.</td>
</tr>
<tr>
<td>2</td>
<td>GLE 0406.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.</td>
</tr>
<tr>
<td></td>
<td>GLE 0406.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.</td>
</tr>
<tr>
<td>3</td>
<td>GLE 0406.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.</td>
</tr>
<tr>
<td></td>
<td>GLE 0406.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.</td>
</tr>
<tr>
<td>4</td>
<td>GLE 0406.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.</td>
</tr>
<tr>
<td>Level</td>
<td>Standard 2: Number and Operations</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
| 1     | GLE 0406.2.1 Understand place value of numbers from hundredths to the hundred-thousands place.  
       | GLE 0406.2.2 Develop fluency with multiplication and single-digit division.  
       | GLE 0406.2.3 Identify prime and composite numbers.  
       | GLE 0406.2.5 Add and subtract fractions with like and unlike denominators. |
| 2     | GLE 0406.2.4 Understand and use the connections between fractions and decimals. |
| 3     | GLE 0406.2.6 Solve problems involving whole numbers, fractions, and/or decimals using all four arithmetic operations. |
| 4     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 3: Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GLE 0406.3.1 Extend understanding of a variable to equations involving whole numbers, fractions, decimals, and/or mixed numbers.</td>
</tr>
<tr>
<td>2</td>
<td>GLE 0406.3.3 Translate between different forms of representations of whole number relationships.</td>
</tr>
<tr>
<td>3</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>4</td>
<td>GLE 0406.3.2 Use mathematical language and modeling to develop descriptions, rules and extensions of patterns.</td>
</tr>
<tr>
<td>Level</td>
<td>Standard 4: Geometry and Measurement</td>
</tr>
<tr>
<td>-------</td>
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</tr>
</tbody>
</table>
| 1     | GLE 0406.4.1 Understand and use the properties of lines, segments, angles, polygons, and circles.  
       | GLE 0406.4.2 Understand and use measures of length, area, capacity, and weight. |
| 2     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
| 3     | GLE 0406.4.3 Solve problems that involve estimating and measuring length, area, capacity and weight.  
       | GLE 0406.4.4 Understand the representation of location and movement within the first quadrant of a coordinate system. |
| 4     | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 5: Data, Probability, and Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>2</td>
<td>GLE 0406.5.2 Use probability to describe chance events.</td>
</tr>
<tr>
<td>3</td>
<td>GLE 0406.5.1 Collect, record, arrange, present, and interpret data using tables and various representations.</td>
</tr>
<tr>
<td>4</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>Standard 1: Mathematical Processes</td>
<td>Level 1</td>
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<td>Level 2</td>
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<td>Level 3</td>
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<td>Level 4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard 2: Number and Operations</th>
<th>Level 1</th>
<th>GLE 0506.2.1 Extend the understanding of place value through millions and millionths in various contexts and representations.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 2</td>
<td>GLE 0506.2.2 Write natural numbers (to 50) as a product of prime factors and understand that this is unique (apart from order).</td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>GLE 0506.2.3 Develop fluency with division of whole numbers. Understand the relationship of divisor, dividend, and quotient in terms of multiplication and division.</td>
</tr>
<tr>
<td></td>
<td>Level 4</td>
<td>GLE 0506.2.4 Develop fluency with addition and subtraction of proper and improper fractions and mixed numbers; explain and model the algorithm.</td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>GLE 0506.2.5 Develop fluency in solving multi-step problems using whole numbers, fractions, mixed numbers, and decimals.</td>
</tr>
<tr>
<td>Level 4</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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</tr>
<tr>
<td>Standard 3 : Algebra</td>
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<tr>
<td><strong>Level 1</strong></td>
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</tr>
<tr>
<td>GLE 0506.3.1 Understand and use order of operations.</td>
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<tr>
<td>GLE 0506.3.2 Develop and apply the concept of variable.</td>
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<tr>
<td>GLE 0506.3.3 Understand and apply the substitution property.</td>
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<tr>
<td><strong>Level 2</strong></td>
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</tr>
<tr>
<td>GLE 0506.3.4 Solve single-step linear equations and inequalities.</td>
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<td><strong>Level 3</strong></td>
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<tr>
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<tr>
<th>Standard 4 : Geometry and Measurement</th>
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<tbody>
<tr>
<td><strong>Level 1</strong></td>
</tr>
<tr>
<td>GLE 0506.4.3 Describe length/distance relationships using the first quadrant of the coordinate system.</td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
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<tr>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
</tr>
<tr>
<td>GLE 0506.4.1 Use basic formulas and visualization to find the area of geometric figures.</td>
</tr>
<tr>
<td>GLE 0506.4.2 Describe polyhedral solids and analyze their properties, including volume and surface area.</td>
</tr>
<tr>
<td><strong>Level 4</strong></td>
</tr>
<tr>
<td>GLE 0506.4.4 Solve problems that require attention to both approximation and precision of measurement.</td>
</tr>
</tbody>
</table>

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<thead>
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<th>Standard 5 : Data, Probability, and Statistics</th>
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<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
</tr>
<tr>
<td>GLE 0506.5.1 Make, record, display and interpret data and graphs that include whole numbers, decimals, and fractions.</td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
</tr>
<tr>
<td>GLE 0506.5.2 Describe the shape and important features of a set of data using the measures of central tendency.</td>
</tr>
<tr>
<td><strong>Level 4</strong></td>
</tr>
<tr>
<td><strong>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</strong></td>
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</tbody>
</table>
## Standards | Grade Six Mathematics

| Standard 1: Mathematical Processes | Level 1 | GLE 0606.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.  
| | Level 2 | GLE 0606.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.  
| | Level 3 | GLE 0606.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.  
| | | GLE 0606.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.  
| | Level 4 | GLE 0606.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.  

| Standard 2: Number and Operations | Level 1 | GLE 0606.2.3 Understand and use ratios, rates and percents.  
| | Level 2 | GLE 0606.2.4 Understand and convert between fraction, decimal, and percent forms of rational numbers.  
| | | GLE 0606.2.5 Develop meaning for integers; represent and compare quantities with integers.  
| | Level 3 | GLE 0606.2.1 Understand and explain the procedures for multiplication and division of fractions, mixed numbers, and decimals.  
| | | GLE 0606.2.2 Solve multi-step mathematical, contextual and verbal problems using fractions, mixed numbers, and decimals.  
| | 4 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |
### Standard 3: Algebra

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0606.3.2 Interpret and represent algebraic relationships with variables in expressions, simple equations and inequalities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>GLE 0606.3.3 Extend order of operations to include grouping symbols and exponents.</td>
</tr>
<tr>
<td>Level</td>
<td>GLE 0606.3.6 Understand and use the Cartesian coordinate system.</td>
</tr>
</tbody>
</table>

This level is not represented at this grade.

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0606.3.1 Write and solve two-step equations and inequalities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>GLE 0606.3.4 Use expressions, equations and formulas to solve problems.</td>
</tr>
</tbody>
</table>

| Level | GLE 0606.3.5 Use multiple representations including symbolic algebra to model and/or solve contextual problems that involve linear relationships. |

This level is not represented at this grade.

### Standard 4: Geometry and Measurement

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0606.4.1 Understand and use basic properties of triangles, quadrilaterals, and other polygons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>GLE 0606.4.2 Use the concepts of translation, rotation, reflection, and symmetry to understand congruence in the plane.</td>
</tr>
<tr>
<td>Level</td>
<td>GLE 0606.4.3 Develop and use formulas to determine the circumference and area of circles, and the area of trapezoids, and develop strategies to find the area of composite shapes.</td>
</tr>
<tr>
<td>Level</td>
<td>GLE 0606.4.4 Develop and use formulas for surface area and volume of 3-dimensional figures.</td>
</tr>
</tbody>
</table>

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<tr>
<td><strong>Level 2</strong></td>
</tr>
<tr>
<td>GLE 0606.5.1 Understand the meaning of probability and how it is expressed.</td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
</tr>
<tr>
<td>GLE 0606.5.2 Interpret representations of data from surveys and polls, and describe sample bias and how data representations can be misleading.</td>
</tr>
<tr>
<td><strong>Level 4</strong></td>
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**Standards**  
Grade Seven Mathematics

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<tr>
<th>Standard 1: Mathematical Processes</th>
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<tbody>
<tr>
<td><strong>Level 1</strong></td>
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</table>
| GLE 0706.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.  
GLE 0706.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely. |
| **Level 2** |
| GLE 0706.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.  
GLE 0706.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts. |
| **Level 3** |
| GLE 0706.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.  
GLE 0706.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.  
GLE 0706.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world. |
<p>| <strong>Level 4</strong> |
| GLE 0706.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution. |</p>
<table>
<thead>
<tr>
<th>Standard 2: Number and Operations</th>
<th>Level</th>
<th>GLE 0706.2.1</th>
<th>Extend understandings of addition, subtraction, multiplication and division to integers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0706.2.5</td>
<td>Understand and work with squares, cubes, square roots and cube roots.</td>
<td></td>
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<tr>
<td>Level 1</td>
<td>GLE 0706.2.6</td>
<td>Introduce the concept of negative exponents.</td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>GLE 0706.2.7</td>
<td>Understand and use scientific notation.</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0706.2.2</td>
<td>Understand and work with the properties of and operations on the system of rational numbers.</td>
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<tr>
<td>Level 3</td>
<td>GLE 0706.2.3</td>
<td>Develop an understanding of and apply proportionality.</td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0706.2.4</td>
<td>Use ratios, rates and percents to solve single- and multi-step problems in various contexts.</td>
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<td>Level 4</td>
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<thead>
<tr>
<th>Standard 3: Algebra</th>
<th>Level</th>
<th>GLE 0706.3.3</th>
<th>Understand the concept of function as a rule that assigns to a given input one and only one number (the output).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0706.3.4</td>
<td>Use function notation where ( f(x) ) represents the output that the function ( f ) assigns to the input ( x ).</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0706.3.1</td>
<td>Recognize and generate equivalent forms for simple algebraic expressions.</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0706.3.2</td>
<td>Understand and compare various representations of relations and functions.</td>
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<tr>
<td>Level 2</td>
<td>GLE 0706.3.8</td>
<td>Use a variety of strategies to efficiently solve linear equations and inequalities.</td>
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<tr>
<td>Level 3</td>
<td>GLE 0706.3.5</td>
<td>Understand and graph proportional relationships.</td>
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<tr>
<td>Level 3</td>
<td>GLE 0706.3.6</td>
<td>Conceptualize the meanings of slope using various interpretations, representations, and contexts.</td>
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<tr>
<td>Level 4</td>
<td>GLE 0706.3.7</td>
<td>Use mathematical models involving linear equations to analyze real-world phenomena.</td>
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</tr>
<tr>
<td>Standard 4 : Geometry and Measurement</td>
<td>Level</td>
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<tr>
<td></td>
<td>Level 2</td>
<td>GLE 0706.4.2 Apply proportionality to converting among different units of measurements to solve problems involving rates such as motion at a constant speed.</td>
<td></td>
</tr>
</tbody>
</table>
|                                      | Level 3 | GLE 0706.4.1 Understand the application of proportionality with similar triangles.  
|                                      |        | GLE 0706.4.3 Understand and use scale factor to describe the relationships between length, area, and volume.  
|                                      |        | GLE 0706.4.4 Understand and use ratios, derived quantities, and indirect measurements. |
|                                      | Level 4 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

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<thead>
<tr>
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</table>
|                                               | Level 2 | GLE 0706.5.2 Select, create, and use appropriate graphical representations of data.  
|                                               |        | GLE 0706.5.5 Understand and apply basic concepts of probability. |
|                                               | Level 3 | GLE 0706.5.1 Collect, organize, and analyze both single- and two-variable data.  
<p>|                                               |        | GLE 0706.5.4 Use descriptive statistics to summarize and compare data. |
|                                               | Level 4 | GLE 0706.5.3 Formulate questions and design studies to collect data about a characteristic shared by two populations, or different characteristics within one population. |</p>
<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0806.1.1</th>
<th>Use mathematical language, symbols, and definitions while developing mathematical reasoning.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>GLE 0806.1.6</td>
<td>Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0806.1.4</th>
<th>Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GLE 0806.1.8</td>
<td>Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>GLE 0806.1.3</th>
<th>Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GLE 0806.1.5</td>
<td>Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.</td>
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<td>GLE 0806.1.7</td>
<td>Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.</td>
</tr>
</tbody>
</table>

| Level | GLE 0806.1.2 | Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution. |

| Level | GLE 0806.2.4 | Understand and use the laws of exponents. |

| Level | GLE 0806.2.1 | Extend understanding of the real number system to include irrational numbers. |

| Level | GLE 0806.2.2 | Solve problems involving exponents and scientific notation using technology appropriately. |

<p>| Level | GLE 0806.2.3 | Solve real-world problems using rational and irrational numbers. |</p>
<table>
<thead>
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<th>Level</th>
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<tbody>
<tr>
<td>Level 1</td>
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</tbody>
</table>
| Level 2 | GLE 0806.3.1 Recognize and generate equivalent forms for algebraic expressions.  
GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions. |
| Level 3 | GLE 0806.3.2 Represent, analyze, and solve problems involving linear equations and inequalities in one and two variables.  
GLE 0806.3.3 Solve systems of linear equations in two variables.  
GLE 0806.3.5 Use slope to analyze situations and solve problems. |
| Level 4 | GLE 0806.3.6 Compare and contrast linear and nonlinear functions. |

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<tr>
<th>Level</th>
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<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0806.4.2 Understand the relationships among the angles formed by parallel lines cut by transversals.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0806.4.4 Understand both metric and customary units of measurement.</td>
</tr>
</tbody>
</table>
| Level 3 | GLE 0806.4.3 Understand the necessary levels of accuracy and precision in measurement.  
GLE 0806.4.1 Derive the Pythagorean theorem and understand its applications.  
GLE 0806.4.5 Use visualization to describe or identify intersections, cross-sections, and various views of geometric figures. |
| Level 4 | THIS LEVEL IS NOT REPRESENTED AT THIS GRADE |

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<tbody>
<tr>
<td>Level 1</td>
<td>GLE 0806.5.1 Explore probabilities for compound, independent and/or dependent events.</td>
</tr>
<tr>
<td>Level 2</td>
<td>GLE 0806.5.2 Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures.</td>
</tr>
<tr>
<td>Level 3</td>
<td>GLE 0806.5.3 Evaluate the use of statistics in media reports.</td>
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<td>Level</td>
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<tr>
<td>Level 1</td>
<td>CLE 3102.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.</td>
</tr>
<tr>
<td>Level 2</td>
<td>CLE 3102.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.</td>
</tr>
<tr>
<td>Level 3</td>
<td>CLE 3102.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.</td>
</tr>
<tr>
<td>Level 4</td>
<td>CLE 3102.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.</td>
</tr>
<tr>
<td></td>
<td>CLE 3102.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.</td>
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<tr>
<td></td>
<td>CLE 3102.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.</td>
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<tr>
<td></td>
<td>CLE 3102.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.</td>
</tr>
<tr>
<td>Level</td>
<td>Standard 2: Number and Operations</td>
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<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<tr>
<td>2</td>
<td>CLE 3102.2.2 Understand properties of and relationships between subsets and elements of the real number system.</td>
</tr>
<tr>
<td>3</td>
<td>CLE 3102.2.1 Understand computational results and operations involving real numbers in multiple representations.</td>
</tr>
<tr>
<td>4</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Level</th>
<th>Standard 3: Algebra</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CLE 3102.3.3 Understand and apply operations with rational expressions and equations.</td>
</tr>
</tbody>
</table>
| 2     | CLE 3102.3.1 Use algebraic thinking to analyze and generalize patterns.  
CLE 3102.3.5 Manipulate formulas and solve literal equations. |
| 3     | CLE 3102.3.2 Understand and apply properties in order to perform operations with, evaluate, simplify, and factor expressions and polynomials.  
CLE 3102.3.4 Solve problems involving linear equations and linear inequalities.  
CLE 3102.3.8 Solve and understand solutions of quadratic equations with real roots.  
CLE 3102.3.9 Understand and use exponential functions to solve contextual problems. |
| 4     | CLE 3102.3.6 Understand and use relations and functions in various representations to solve contextual problems.  
CLE 3102.3.7 Construct and solve systems of linear equations and inequalities in two variables by various methods. |
<table>
<thead>
<tr>
<th>Standard 4 : Geometry and Measurement</th>
<th>Level 1</th>
<th>CLE 3102.4.2 Apply appropriate units of measure and convert measures in problem solving situations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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</tr>
<tr>
<td>Level 3</td>
<td>CLE 3102.4.1 Use algebraic reasoning in applications involving geometric formulas and contextual problems.</td>
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<td>Level 4</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<thead>
<tr>
<th>Standard 5 : Data, Probability, and Statistics</th>
<th>Level 1</th>
<th>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</th>
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<tr>
<td>Level 2</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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</tr>
<tr>
<td>Level 3</td>
<td>CLE 3102.5.1 Describe and interpret quantitative information.</td>
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<tr>
<td>Level 4</td>
<td>CLE 3102.5.2 Use statistical thinking to draw conclusions and make predictions.</td>
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<tr>
<td></td>
<td>CLE 3102.5.3 Understand basic counting procedures and concepts of probability.</td>
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<td>Level</td>
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<tr>
<td><strong>Standard 1 : Mathematical Processes</strong></td>
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</tr>
<tr>
<td><strong>CLE 3108.1.1</strong></td>
<td>Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.</td>
<td></td>
</tr>
<tr>
<td><strong>CLE 3108.1.4</strong></td>
<td>Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.</td>
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<tr>
<td><strong>CLE 3108.1.5</strong></td>
<td>Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.</td>
<td></td>
</tr>
<tr>
<td><strong>CLE 3108.1.6</strong></td>
<td>Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.</td>
<td></td>
</tr>
<tr>
<td><strong>CLE 3108.1.2</strong></td>
<td>Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.</td>
<td></td>
</tr>
<tr>
<td><strong>CLE 3108.1.3</strong></td>
<td>Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.</td>
<td></td>
</tr>
<tr>
<td><strong>CLE 3108.1.7</strong></td>
<td>Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.</td>
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<tr>
<td>Level</td>
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<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<tr>
<td>2</td>
<td>CLE3108.2.2 Explore vectors as a numeric system, focusing on graphic representations and the properties of the operation.</td>
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<tr>
<td>3</td>
<td>CLE3108.2.1 Establish the relationships between the real numbers and geometry; explore the importance of irrational numbers to geometry.</td>
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<tr>
<td>4</td>
<td>CLE3108.2.3 Establish an ability to estimate, select appropriate units, evaluate accuracy of calculations and approximate error in measurement in geometric settings.</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Level</th>
<th>Standard 3: Algebra</th>
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<tbody>
<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<tr>
<td>2</td>
<td>CLE 3108.3.2 Explore the effect of transformations on geometric figures and shapes in the coordinate plane.</td>
</tr>
<tr>
<td>3</td>
<td>CLE 3108.3.1 Use analytic geometry tools to explore geometric problems involving parallel and perpendicular lines, circles, and special points of polygons.</td>
</tr>
<tr>
<td>4</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<tr>
<td>Level</td>
<td>Standard 4 : Geometry and Measurement</td>
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<td>2</td>
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</tbody>
</table>
| 3     | **CLE 3108.4.2** Describe the properties of regular polygons, including comparative classification of them and special points and segments.  
**CLE 3108.4.4** Develop geometric intuition and visualization through performing geometric constructions with straightedge/compass and with technology.  
**CLE 3108.4.7** Apply the major concepts of transformation geometry to analyzing geometric objects and symmetry.  
**CLE 3108.4.8** Establish processes for determining congruence and similarity of figures, especially as related to scale factor, contextual applications, and transformations. |
| 4     | **CLE 3108.4.1** Develop the structures of geometry, such as lines, angles, planes, and planar figures, and explore their properties and relationships.  
**CLE 3108.4.3** Develop an understanding of the tools of logic and proof, including aspects of formal logic as well as construction of proofs.  
**CLE 3108.4.5** Extend the study of planar figures to three-dimensions, including the classical solid figures, and develop analysis through cross-sections.  
**CLE 3108.4.6** Generate formulas for perimeter, area, and volume, including their use, dimensional analysis, and applications.  
**CLE 3108.4.9** Develop the role of circles in geometry, including angle measurement, properties as a geometric figure, and aspects relating to the coordinate plane.  
**CLE 3108.4.10** Develop the tools of right triangle trigonometry in the contextual applications, including the Pythagorean Theorem, Law of Sines and Law of Cosines |
### Standard 5: Data, Probability, and Statistics

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Level 1</td>
<td>CLE 3108.5.2 Develop the basic principles of geometric probability.</td>
</tr>
<tr>
<td>Level 2</td>
<td>CLE 3108.5.1 Analyze, interpret, employ and construct accurate statistical graphs.</td>
</tr>
<tr>
<td>Level 3</td>
<td>CLE 3108.5.2 Develop the basic principles of geometric probability.</td>
</tr>
<tr>
<td>Level 4</td>
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### Algebra II

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<tr>
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<tbody>
<tr>
<td>Level 1</td>
<td>CLE 3103.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.</td>
</tr>
<tr>
<td>Level 2</td>
<td>CLE 3103.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.</td>
</tr>
<tr>
<td>Level 3</td>
<td>CLE 3103.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.</td>
</tr>
<tr>
<td>Level 4</td>
<td>CLE 3103.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.</td>
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<td></td>
<td>CLE 3103.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.</td>
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<td></td>
<td>CLE 3103.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.</td>
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<td></td>
<td>CLE 3103.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.</td>
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<td>Level</td>
<td>Standard 2: Number and Operations</td>
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<tr>
<td>Level 1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
</tr>
<tr>
<td>Level 2</td>
<td>CLE 3103.2.1 Understand the hierarchy of the complex number system and relationships between the elements, properties and operations.</td>
</tr>
</tbody>
</table>
| Level 3 | CLE 3103.2.2 Connect numeric, analytic, graphical and verbal representations of both real and complex numbers.  
CLE 3103.2.4 Understand the capabilities and limitations of technology when performing operations, graphing, and solving equations involving complex numbers. |
| Level 4 | CLE 3103.2.3 Use appropriate technology (including graphing calculators and computer spreadsheets) to solve problems, recognize patterns and collect and analyze data. |

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Level 1</td>
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<tr>
<td>Level 2</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<tr>
<td>Level 3</td>
<td>CLE 3103.3.1 Understand and apply properties of rational exponents and perform basic operations to simplify algebraic expressions.</td>
</tr>
</tbody>
</table>
| Level 4 | CLE 3103.3.2 Understand, analyze, transform and generalize mathematical patterns, relations and functions using properties and various representations.  
CLE 3103.3.3 Analyze and apply various methods to solve equations, absolute values, inequalities, and systems of equations over complex numbers.  
CLE 3103.3.4 Graph and compare equations and inequalities in two variables. Identify and understand the relationships between the algebraic and geometric properties of the graph.  
CLE 3103.3.5 Use mathematical models involving equations and systems of equations to represent, interpret and analyze quantitative relationships, change in various contexts, and other real-world phenomena. |
### Standard 4: Geometry and Measurement

<table>
<thead>
<tr>
<th>Level</th>
<th>CLE 3103.4.2</th>
<th>CLE 3103.4.3</th>
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<tbody>
<tr>
<td>1</td>
<td>THIS LEVEL IS NOT REPRESENTED AT THIS GRADE</td>
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<tr>
<td>2</td>
<td>Know and use the basic identities of sine, cosine, and tangent as well as their reciprocals.</td>
<td>Graph all six trigonometric functions and identify their key characteristics.</td>
</tr>
<tr>
<td>3</td>
<td>Understand the trigonometric functions and their relationship to the unit circle.</td>
<td>Know and use the Law of Sines to find missing sides and angles of a triangle, including the ambiguous case.</td>
</tr>
</tbody>
</table>
| 4     | CLE 3103.4.5 Use trigonometric concepts, properties and graphs to solve problems. | }

### Standard 5: Data, Probability, and Statistics

<table>
<thead>
<tr>
<th>Level</th>
<th>CLE 3103.5.1</th>
<th>CLE 3103.5.2</th>
<th>CLE 3103.5.3</th>
<th>CLE 3103.5.4</th>
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<tr>
<td>3</td>
<td>CLE 3103.5.1 Describe, interpret, and apply quantitative data.</td>
<td>CLE 3103.5.2 Evaluate and critique various ways of collecting data and using information based on data published in the media.</td>
<td>CLE 3103.5.3 Use data and statistical thinking to draw inferences, make predictions, justify conclusions and identify and explain misleading uses of data.</td>
<td>CLE 3103.5.4 Develop an understanding of probability concepts in order to make informed decisions.</td>
</tr>
</tbody>
</table>
APPENDIX D
Mathematics Framework Alignment with
ACT College Readiness Standards and NAEP Content Standards
<table>
<thead>
<tr>
<th>TN DOE unique identifier</th>
<th>SPI</th>
<th>ACT content area</th>
<th>Range</th>
<th>ACT College Readiness Standard</th>
<th>NAEP content area</th>
<th>Grade</th>
<th>NAEP 2009 Math Content Area Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra II SPI 3103.1.1</td>
<td></td>
<td>Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic) of non-linear and transcendental functions to solve problems, to model mathematical ideas, and to communicate solution strategies.</td>
<td>GR</td>
<td>28-32 Match number line graphs with solution sets of linear inequalities</td>
<td>ALG 12</td>
<td>1e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or *trigonometric functions from tables, graphs, or equations.</td>
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<td>Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)†</td>
<td></td>
<td>1f) Recognize and analyze the general forms of linear, quadratic, rational, exponential, or *trigonometric functions.</td>
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<td>Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$</td>
<td></td>
<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or *trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>Write expressions that require planning and/or manipulating to accurately model a situation</td>
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<td>2f) Given a real-world situation, determine if a linear, quadratic, rational, exponential, logarithmic, or *trigonometric function fits the situation.</td>
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<td></td>
<td>Write equations and inequalities that require planning, manipulating, and/or solving</td>
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<tr>
<td>Algebra II SPI 3103.1.2</td>
<td></td>
<td>Recognize and describe errors in data collection and analysis as well as identifying representations of data as being accurate or misleading.</td>
<td>PSDA</td>
<td>24-27 Manipulate data from tables and graphs</td>
<td>DASP 12</td>
<td>1d) Solve problems involving univariate or bivariate data.</td>
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<td>Interpret and use information from figures, tables, and graphs</td>
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<td>3a) Identify possible sources of bias in sample surveys, and describe how such bias can be controlled and reduced.</td>
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<tr>
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<td>Analyze and draw conclusions based on information from figures, tables, and graphs</td>
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<td>3d) Identify or evaluate the characteristics of a good survey or of a well-designed experiment</td>
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<td>Pattern in sets of data with specified conditions or based on a general equation such as $y = ax^2 + c$</td>
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<td>5a) Identify misleading uses of data in real-world settings and critique different ways of presenting and using information.</td>
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<td>Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or *trigonometric functions from tables, graphs, or equations.</td>
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<td>5c) Recognize, use, and distinguish between the processes of mathematical (deterministic) and statistical modeling.</td>
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<td>Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)†</td>
<td></td>
<td>5d) Recognize when arguments based on data confuse correlation with causation.</td>
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<tr>
<td>Algebra II SPI 3103.1.3</td>
<td></td>
<td>Use technology tools to identify and</td>
<td>F</td>
<td>33-36 Match graphs of basic trigonometric functions</td>
<td>ALG 12</td>
<td>2b) Analyze or interpret relationships expressed in symbols, graphs, tables, diagrams</td>
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<tr>
<td>Algebra II SPI 3103.1.4</td>
<td>F</td>
<td>28-32</td>
<td>Evaluate composite functions at integer values†</td>
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<td>GR</td>
<td>33-36</td>
<td>Write an expression for the composite of two simple functions†</td>
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<td></td>
<td>28-32</td>
<td>Write an expression for the composite of two simple functions†</td>
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<tr>
<td></td>
<td></td>
<td>33-36</td>
<td>Match number line graphs with solution sets of simple quadratic inequalities</td>
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</table>

**ACT College Readiness Standard**

- **Range**: Describe patterns in data using non-linear and transcendental functions that approximate data as well as using those functions to solve contextual problems.

- **ACT College Readiness Standard**: Functions with their equations†

- **NAEP content area**: (including Venn diagrams), or written descriptions and evaluate the relative advantages or disadvantages of different representations to answer specific questions.

**Grade**: 2e) Make inferences or predictions using an algebraic model of a situation.

**NAEP 2009 Math Content Area Standard**

- 2f) Given a real-world situation, determine if a linear, quadratic, rational, exponential, logarithmic, or *trigonometric function fits the situation.

- 2g) Solve problems involving exponential growth and decay.

- 2h) Analyze properties of exponential, logarithmic, and rational functions.

- 4c) Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.

**ALG 12**

- 1e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or *trigonometric functions from tables, graphs, or equations.

- 5a) Use algebraic properties to develop a valid mathematical argument.

- 5b) Determine the role of hypotheses, logical implications, and conclusions in algebraic argument.

- 5c) Explain the use of relational conjunctions (and, or) in algebraic arguments.
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<td></td>
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<td></td>
<td>Analyze and draw conclusions based on information from graphs in the coordinate plane</td>
<td>DASP</td>
<td>12</td>
<td>2e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to make predictions.</td>
</tr>
<tr>
<td>Algebra II SPI 3103.2.1</td>
<td>NCP</td>
<td>24-27</td>
<td></td>
<td>Exhibit some knowledge of the complex numbers†</td>
<td>NPO</td>
<td>12</td>
<td>6a) Give a mathematical argument to establish the validity of a simple numerical property or relationship.</td>
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<td>Multiply two complex numbers</td>
<td>NPO</td>
<td>12</td>
<td>6b) Analyze or interpret a proof by mathematical induction of a simple numerical relationship.</td>
</tr>
<tr>
<td>Algebra II SPI 3103.2.2</td>
<td>NCP</td>
<td>29-32</td>
<td></td>
<td>Apply properties of complex numbers</td>
<td>NPO</td>
<td>12</td>
<td>5f) Recognize properties of the number system—whole numbers, integers, rational numbers, real numbers, and complex numbers—recognize how they are related to each other, and identify examples of each type of number.</td>
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<td>30-36</td>
<td></td>
<td>Solve real-world problems using first-degree equations Identify solutions to simple quadratic equations</td>
<td>ALG</td>
<td>12</td>
<td>5e) Apply basic properties of operations, including conventions about the order of operation</td>
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<tr>
<td>Algebra II SPI 3103.2.3</td>
<td>EEI</td>
<td>24-27</td>
<td></td>
<td>Solve real-world problems using first-degree equations Identify solutions to simple quadratic equations</td>
<td>ALG</td>
<td>12</td>
<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>2g) Solve problems involving exponential growth and decay.</td>
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<td>3b) Write algebraic expressions, equations, or inequalities to represent a situation.</td>
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<td>4a) Solve linear, rational or quadratic equations or inequalities, including those involving absolute value.</td>
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<td>4c) Analyze situations, develop mathematical models, or solve problems using linear,</td>
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<td>quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.</td>
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<td>4e) Solve problems involving special formulas such as: ( A = P(t + r)^t ), ( A = Pe^{rt} ).</td>
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<td>4g) Solve quadratic equations with complex roots.</td>
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<td>Algebra II</td>
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<td></td>
<td>3c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions.</td>
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<tr>
<td>SPI 3103.3.1</td>
<td></td>
<td>Add, subtract and multiply polynomials; divide a polynomial by a lower degree polynomial.</td>
<td>EEI 20-23</td>
<td>Multiply two binomials</td>
<td>ALG 12</td>
<td></td>
<td>4a) Solve linear, rational or quadratic equations or inequalities, including those involving absolute value.</td>
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<td></td>
<td>Add, subtract, and multiply polynomials</td>
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<td>4d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.</td>
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<td>4g) Solve quadratic equations with complex roots.</td>
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<td>Algebra II</td>
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<td>Solve quadratic equations and systems, and determine roots of a higher order polynomial.</td>
<td>EEI 28-32</td>
<td>Solve quadratic equations</td>
<td>ALG 12</td>
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<td>4d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.</td>
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<td>SPI 3103.3.2</td>
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<td>4g) Solve quadratic equations with complex roots.</td>
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<td>Algebra II</td>
<td></td>
<td>Add, subtract, multiply, divide and simplify rational expressions including those with rational and negative exponents.</td>
<td>NCO 24-27</td>
<td>Determine when an expression is undefined*</td>
<td>ALG 12</td>
<td></td>
<td>3c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions.</td>
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<td>SPI 3103.3.3</td>
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<td></td>
<td>Apply rules of exponents</td>
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<td>Algebra II</td>
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<td>Use the formulas for the general term and summation of finite arithmetic and both finite and infinite geometric series.</td>
<td>NCO 28-32</td>
<td>Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers</td>
<td>ALG 12</td>
<td></td>
<td>1a) Recognize, describe, or extend numerical patterns, including arithmetic and geometric progressions.</td>
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<td>SPI 3103.3.4</td>
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<td>3g) Determine the sum of finite and infinite arithmetic and geometric series.</td>
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<td>Algebra II SPI 3103.5</td>
<td>Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the contextual situations which the functions represent.</td>
<td>NCP 24-27</td>
<td>Determine when an expression is undefined</td>
<td>ALG 12</td>
<td>1) Determine the domain and range of functions given in various forms and contexts.</td>
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<td>Algebra II SPI 3103.6</td>
<td>Combine functions (such as polynomial, rational, radical and absolute value expressions) by addition, subtraction, multiplication, division, or by composition and evaluate at specified values of their variables.</td>
<td>FN 20-23</td>
<td>Evaluate quadratic functions, expressed in function notation, at integer values</td>
<td>ALG 12</td>
<td>3f) Use function notation to evaluate a function at a specified point in its domain and combine functions by addition, subtraction, multiplication, division, and composition.</td>
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<td>Evaluate polynomial functions, expressed in function notation, at integer values</td>
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<td>Evaluate composite functions at integer values</td>
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<td>Write an expression for the composite of two simple functions</td>
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<td>Algebra II SPI 3103.7</td>
<td>Identify whether a function has an inverse, whether two functions are inverses of each other, and/or explain why their graphs are reflections over the line y = x.</td>
<td>EEI 28-32</td>
<td>Find solutions to systems of linear equations</td>
<td>ALG 12</td>
<td>1j) Given a function, determine its inverse if it exists, and explain the contextual meaning of the inverse for a given situation.</td>
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<td>Algebra II SPI 3103.8</td>
<td>Solve systems of three linear equations in three variables.</td>
<td>EEI 28-32</td>
<td>Find solutions to systems of linear equations</td>
<td>ALG 12</td>
<td>4d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.</td>
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<tr>
<td>Algebra II SPI 3103.9</td>
<td>Graph the solution set of two or three linear or quadratic inequalities.</td>
<td>ALG 12</td>
<td>4d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.</td>
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<tr>
<td>Algebra II SPI 3103.10</td>
<td>Identify and/or graph a variety of functions and their translations.</td>
<td>ALG 12</td>
<td>2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions.</td>
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<td>Algebra II SPI 3103.3.11</td>
<td>GR</td>
<td>28-32</td>
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<td>Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)</td>
<td>ALG</td>
<td>12</td>
<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or *trigonometric) using symbols, graphs, tables, diagrams, or written descriptions. 2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions. 4c) Describe or identify conic sections and other cross sections of solids. 4f) Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius. 4g) *Graph ellipses and hyperbolas whose axes are parallel to the coordinate axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.</td>
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<tr>
<td>Algebra II SPI 3103.3.12</td>
<td>GR</td>
<td>33-36</td>
<td></td>
<td>Analyze and draw conclusions based on information from graphs in the coordinate plane</td>
<td>ALG</td>
<td>12</td>
<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or *trigonometric) using symbols, graphs, tables, diagrams, or written descriptions. 2b) Analyze or interpret relationships expressed in symbols, graphs, tables, diagrams (including Venn diagrams), or written descriptions and evaluate the relative advantages or disadvantages of different representations to answer specific questions. 2e) Make inferences or predictions using an algebraic model of a situation. 2f) Given a real-world situation, determine if a</td>
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<tr>
<td>Algebra II SPI 3103.3.13</td>
<td>EEI</td>
<td>Solve quadratic equations</td>
<td>ALG</td>
<td>12</td>
<td>Linear, quadratic, rational, exponential, logarithmic, or *trigonometric function fits the situation.</td>
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<tr>
<td>Algebra II SPI 3103.3.13</td>
<td>EEI</td>
<td>Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.</td>
<td>ALG</td>
<td>12</td>
<td>1b) Express linear and exponential functions in recursive and explicit form given a table, verbal description, or some terms of a sequence.</td>
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<tr>
<td>Algebra II SPI 3103.3.13</td>
<td>EEI</td>
<td>Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.</td>
<td>ALG</td>
<td>12</td>
<td>2f) Given a real-world situation, determine if a linear, quadratic, rational, exponential, logarithmic, or *trigonometric function fits the situation.</td>
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<tr>
<td>Algebra II SPI 3103.3.13</td>
<td>EEI</td>
<td>Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.</td>
<td>ALG</td>
<td>12</td>
<td>2g) Solve problems involving exponential growth and decay.</td>
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<td>Algebra II SPI 3103.3.13</td>
<td>EEI</td>
<td>Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.</td>
<td>ALG</td>
<td>12</td>
<td>4c) Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.</td>
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<tr>
<td>Algebra II SPI 3103.3.13</td>
<td>EEI</td>
<td>Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.</td>
<td>ALG</td>
<td>12</td>
<td>4e) Solve problems involving special formulas such as: $A = P(1 + r)^t$, $A = Pe^{rt}$.</td>
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<td>Algebra II SPI 3103.3.14</td>
<td>PSDA</td>
<td>Apply counting techniques</td>
<td>DASP</td>
<td>12</td>
<td>4k) Use the binomial theorem to solve problems</td>
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<tr>
<td>Algebra II SPI 3103.3.14</td>
<td>PSDA</td>
<td>Apply counting techniques</td>
<td>DASP</td>
<td>12</td>
<td>3e) Determine the radian measure of an angle and explain how radian measurement is related to a circle of radius 1.</td>
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<tr>
<td>Algebra II SPI 3103.4.1</td>
<td>FN</td>
<td>Exhibit knowledge of unit circle trigonometry</td>
<td>MEAS</td>
<td>12</td>
<td>1e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or *trigonometric functions from tables, graphs, or equations.</td>
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<tr>
<td>Algebra II SPI 3103.4.2</td>
<td>FN</td>
<td>Match graphs of basic trigonometric functions with their equations</td>
<td>ALG</td>
<td>12</td>
<td>1h) Recognize and analyze the general forms</td>
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<td>of linear, quadratic, rational, exponential, or *trigonometric functions.</td>
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<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or *trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions.</td>
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<tr>
<td>Algebra II</td>
<td>SPI 3103.4.3</td>
<td>Describe and articulate the characteristics and parameters of parent trigonometric functions to solve contextual problems.</td>
<td>FN 33-36</td>
<td>Use trigonometric concepts and basic identities to solve problems</td>
<td>ALG 12</td>
<td>1e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or *trigonometric functions from tables, graphs, or equations.</td>
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<td>1h) Recognize and analyze the general forms of linear, quadratic, rational, exponential, or *trigonometric functions.</td>
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<td>Algebra II</td>
<td>SPI 3103.5.1</td>
<td>Compute, compare and explain summary statistics for distributions of data including measures of center and spread.</td>
<td>PSDA 24-27</td>
<td>Calculate the average, given the frequency counts of all the data values</td>
<td>DASP 12</td>
<td>2a) Calculate, interpret, or use summary statistics for distributions of data including measures of typical value (mean, median), position (quartiles, percentiles), and spread (range, interquartile range, variance, standard deviation).</td>
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<td>2b) Recognize how linear transformations of one-variable data affect mean, median, mode, range, interquartile range, and standard deviation.</td>
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<td>33-36</td>
<td>Distinguish between mean, median, and mode for a list of numbers</td>
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<td>2c) Determine the effect of outliers on mean, median, mode, range, interquartile range, or standard deviation.</td>
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<td>Algebra II SPI 3103.5.2</td>
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<td>2d) Compare data sets using summary statistics (mean, median, mode, range, interquartile range, or standard deviation) describing the same characteristic for two different populations or subsets of the same population.</td>
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<td>33-36</td>
<td>Analyze and draw conclusions based on information from figures, tables, and graphs</td>
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<td>DASP 12</td>
<td>2d) Compare data sets using summary statistics (mean, median, mode, range, interquartile range, or standard deviation) describing the same characteristic for two different populations or subsets of the same population.</td>
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<td>Algebra II SPI 3103.5.3</td>
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<td>2e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to make predictions.</td>
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<td>2g) Know and interpret the key characteristics of a normal distribution such as shape, center (mean), and spread (standard deviation).</td>
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<td>Algebra II SPI 3103.5.4</td>
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<td>3e) Recognize the differences in design and in conclusions between randomized experiments and observational studies.</td>
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<td>Algebra II SPI 3103.5.5</td>
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<td>2e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to make predictions.</td>
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<td>5c) Recognize, use, and distinguish between the processes of mathematical (deterministic) and statistical modeling.</td>
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<td>2f) Recognize that the correlation coefficient is a number from –1 to +1 that measures the strength of the linear relationship between two variables; visually estimate the correlation coefficient (e.g., positive or negative, closer to 0, .5, or 1.0) of a scatterplot.</td>
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<td>5d) Recognize when arguments based on data confuse correlation with causation.</td>
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<td>Algebra II SPI 3103.5.7</td>
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<td>Determine/recognize when the correlation coefficient measures goodness of fit.</td>
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<td>DASP</td>
<td>12</td>
<td>4a) Recognize whether two events are independent or dependent.</td>
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<td>4b) Determine the theoretical probability of simple and compound events in familiar or unfamiliar contexts.</td>
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<td>4c) Given the results of an experiment or simulation, estimate the probability of simple or compound events in familiar or unfamiliar contexts.</td>
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<td>4h) Determine the probability of independent and dependent events.</td>
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<td>Algebra II SPI 3103.5.8</td>
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<td>Apply probability concepts such as conditional probability and independent events to calculate simple probability.</td>
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<td>20-23</td>
<td>Determine the probability of a simple event</td>
<td>DASP</td>
<td>12</td>
<td>4a) Recognize whether two events are independent or dependent.</td>
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<td>4b) Determine the theoretical probability of simple and compound events in familiar or unfamiliar contexts.</td>
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<td>4c) Given the results of an experiment or simulation, estimate the probability of simple or compound events in familiar or unfamiliar contexts.</td>
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<td>4h) Determine the probability of independent and dependent events.</td>
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<td>Algebra I SPI 3102.1.1</td>
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<td>Interpret patterns found in sequences, tables, and other forms of quantitative information using variables or function notation.</td>
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<td>20-23</td>
<td>Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor Evaluate quadratic functions, expressed in function notation, at integer values†</td>
<td>ALG</td>
<td>12</td>
<td>1a) Recognize, describe, or extend numerical patterns, including arithmetic and geometric progressions.</td>
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<td>1b) Express linear and exponential functions in recursive and explicit form given a table, verbal description, or some terms of a sequence.</td>
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<td>Algebra I SPI 3102.1.2</td>
<td>EEI</td>
<td>24-27</td>
<td>Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)</td>
<td>ALG</td>
<td>8</td>
<td>3b) Write algebraic expressions, equations, or inequalities to represent a situation.</td>
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<td>28-32</td>
<td>Write expressions, equations, and inequalities for common algebra settings</td>
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<td>Algebra I SPI 3102.1.3</td>
<td>EEI</td>
<td>16-19</td>
<td>Substitute whole numbers for unknown quantities to evaluate expressions</td>
<td>ALG</td>
<td>8</td>
<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and expanding).</td>
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<td>20-23</td>
<td>Evaluate algebraic expressions by substituting integers for unknown quantities</td>
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<td>3c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions.</td>
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<td>NPO</td>
<td>8</td>
<td>3d) Write equivalent forms of algebraic expressions, equations, or inequalities to represent and explain mathematical relationships.</td>
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<td>12</td>
<td>3e) Evaluate algebraic expressions, including polynomials and rational expressions.</td>
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<td>5e) Apply basic properties of operations.</td>
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<td>6b) Provide a mathematical argument to explain operations with two or more fractions.</td>
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<td>12</td>
<td>5e) Apply basic properties of operations, including conventions about the order of operations.</td>
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</table>
| Algebra I SPI 3102.1.4  | GR  | 24-27           |       | Match linear graphs with their equations | ALG               | 8     | 2a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.  
2b) Analyze or interpret linear relationships expressed in symbols, graphs, tables, diagrams, or written descriptions.  
2f) Identify or represent functional relationships in meaningful contexts including proportional, linear, and common nonlinear (e.g., compound interest, bacterial growth) in tables, graphs, words, or symbols.  
1g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function. |
|                        |     |                 |       |                               |                   |       | 4d) Interpret relationships between symbolic linear expressions and graphs of lines by identifying and computing slope and intercepts (e.g., know in $y = ax^2 + c$ that $a$ is the rate of change and $b$ is the vertical intercept of the graph).  
2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions.  
3d) Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a rational number by:  
• Zero, or  
• A number less than zero, or  
• A number between zero and one,  
• One, or a number greater than one. |
| Algebra I SPI 3102.1.5  | GR  | 33-36           |       | Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$ | ALG               | 8     | 4d) Interpret relationships between symbolic linear expressions and graphs of lines by identifying and computing slope and intercepts (e.g., know in $y = ax^2 + c$, that $a$ is the rate of change and $b$ is the vertical intercept of the graph).  
2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions.  
3d) Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a rational number by:  
• Zero, or  
• A number less than zero, or  
• A number between zero and one,  
• One, or a number greater than one. |
|                        |     |                 |       |                               | NPO               | 8     | 2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions.  
3d) Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a rational number by:  
• Zero, or  
• A number less than zero, or  
• A number between zero and one,  
• One, or a number greater than one. |
| Algebra I SPI 3102.1.6  | GR  | 24-27           |       | Determine the slope of a line from points or equations | ALG               | 8     | d) Interpret relationships between symbolic linear expressions and graphs of lines by |
|                        |     |                 |       |                               |                   |       | 2d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and *trigonometric functions.  
3d) Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a rational number by:  
• Zero, or  
• A number less than zero, or  
• A number between zero and one,  
• One, or a number greater than one. |
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<td>identifying and computing slope and intercepts (e.g., know in $y = ax + b$, that $a$ is the rate of change and $b$ is the vertical intercept of the graph).</td>
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<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and expanding).</td>
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<td>3c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions</td>
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<td>3b) Perform arithmetic operations with real numbers, including common irrational numbers.</td>
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<tr>
<td>Algebra I SPI 3102.1</td>
<td>NCP</td>
<td>24-27</td>
<td></td>
<td>Work with squares and square roots of numbers</td>
<td>ALG</td>
<td>8</td>
<td>1f) Express or interpret numbers using scientific notation from real-life contexts.</td>
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<td>Work with cubes and cube roots of numbers</td>
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<td></td>
<td>1i) Order or compare rational numbers including very large and small integers, and decimals and fractions close to zero.</td>
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<td>NPO</td>
<td>12</td>
<td>1f) Represent or interpret expressions involving very large or very small numbers in scientific notation.</td>
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<td>1i) Order or compare real numbers, including very large and very small real numbers.</td>
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<td>ALG</td>
<td>8</td>
<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and expanding).</td>
</tr>
<tr>
<td>Algebra I SPI 3102.2</td>
<td>NCP</td>
<td>24-27</td>
<td></td>
<td>Work with scientific notation</td>
<td>NPO</td>
<td>8</td>
<td>1f) Express or interpret numbers using scientific notation from real-life contexts.</td>
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<td>1i) Order or compare rational numbers including very large and small integers, and decimals and fractions close to zero.</td>
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<td>ALG</td>
<td>8</td>
<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and expanding).</td>
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| Algebra I SPI 3102.2.3   | NCP | 20-23           |       | Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor | NPO               | 8     | 1a) Use place value to model and describe integers and decimals.  
1d) Write or rename rational numbers.  
1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).  
1i) Order or compare rational numbers including very large and small integers, and decimals and fractions close to zero |
|                          |     |                 |       |                               |                   |       | 12  
1d) Represent, interpret or compare expressions for real numbers, including expressions utilizing exponents and logarithms.  
1i) Order or compare real numbers, including very large and very small real numbers. |
| Algebra I SPI 3102.3.1   | EEI | 33-36           |       | Write expressions that require planning and/or manipulating to accurately model a situation | ALG               | 8     | 1a) Recognize, describe, or extend numerical and geometric patterns using tables, graphs, words, or symbols.  
1b) Generalize a pattern appearing in a numerical sequence or table or graph using words or symbols.  
2a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions. |
|                          |     |                 |       |                               |                   |       | 12  
3c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions. |
| Algebra I SPI 3102.3.2   | EEI | 24-27           |       | Add, subtract, and multiply polynomials | ALG               | 12    |  

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<tr>
<td>Algebra I SPI 3102.3.3</td>
<td>EEI</td>
<td>Factor polynomials.</td>
<td>24-27</td>
<td>Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)</td>
<td>ALG</td>
<td>12</td>
<td>3d) Write equivalent forms of algebraic expressions, equations, or inequalities to represent and explain mathematical relationships.</td>
</tr>
<tr>
<td>Algebra I SPI 3102.3.4</td>
<td>NCP</td>
<td>Operate with, evaluate, and simplify rational expressions including determining restrictions on the domain of the variables.</td>
<td>24-27</td>
<td>Determine when an expression is undefined</td>
<td>ALG</td>
<td>12</td>
<td>3c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions.</td>
</tr>
<tr>
<td>Algebra I SPI 3102.3.5</td>
<td>EEI</td>
<td>Write and/or solve linear equations, inequalities, and compound inequalities including those containing absolute value.</td>
<td>24-27</td>
<td>Solve first-degree inequalities that do not require reversing the inequality sign</td>
<td>ALG</td>
<td>8</td>
<td>4a) Solve linear equations or inequalities (e.g., ax + b = c or ax + b = cx + d or ax + b &gt; c).</td>
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<td>28-32</td>
<td>Solve linear inequalities that require reversing the inequality sign</td>
<td>ALG</td>
<td>12</td>
<td>4c) Analyze situations or solve problems using linear equations and inequalities with rational coefficients symbolically or graphically (e.g., ax + b = c or ax + b = cx + d).</td>
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<td>33-36</td>
<td>Solve absolute value equations</td>
<td>ALG</td>
<td>12</td>
<td>4a) Solve linear, rational or quadratic equations or inequalities, including those involving absolute value.</td>
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<td>Write equations and inequalities that require planning, manipulating, and/or solving</td>
<td>ALG</td>
<td>12</td>
<td>4c) Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.</td>
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<td>Solve simple absolute value inequalities</td>
<td>ALG</td>
<td>12</td>
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<tr>
<td>Algebra I SPI 3102.3.6</td>
<td>GR</td>
<td>Interpret various relations in multiple representations.</td>
<td>28-32</td>
<td>Interpret and use information from graphs in the coordinate plane</td>
<td>ALG</td>
<td>8</td>
<td>2a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>28-32</td>
<td>Interpret and use information from figures, tables, and graphs</td>
<td>ALG</td>
<td>12</td>
<td>2b) Analyze or interpret linear relationships expressed in symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>ALG</td>
<td>12</td>
<td>1e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or trigonometric functions from tables, graphs, or equations.</td>
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<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or *trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>2b) Analyze or interpret relationships expressed in symbols, graphs, tables, diagrams (including Venn diagrams), or written descriptions and evaluate the relative advantages or disadvantages of different representations to answer specific questions.</td>
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<td>Algebra I SPI 3102.3.7</td>
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<td>20-23</td>
<td>ALG</td>
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<td>1g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.</td>
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<td>1i) Determine the domain and range of functions given in various forms and contexts.</td>
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<td>3f) Use function notation to evaluate a function at a specified point in its domain and combine functions by addition, subtraction, multiplication, division, and composition.</td>
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<td>Algebra I SPI 3102.3.8</td>
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<td>GR</td>
<td>24-27</td>
<td>ALG</td>
<td></td>
<td>2f) Identify or represent functional relationships in meaningful contexts including proportional, linear, and common nonlinear (e.g., compound interest, bacterial growth) in tables, graphs, words, or symbols.</td>
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<td>4d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.</td>
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<td>Algebra I SPI 3102.3.9</td>
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<td>EEI</td>
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<td>ALG</td>
<td></td>
<td>4g) Solve quadratic equations with complex roots.</td>
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<td>Algebra I SPI 3102.3.10</td>
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<td>EEI</td>
<td>28-32</td>
<td>ALG</td>
<td></td>
<td>24-27 Evaluate quadratic functions, expressed in function notation, at integer values.</td>
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<td>Evaluate polynomial functions, expressed in function notation, at integer values.</td>
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<td>24-27 Match linear graphs with their equations.</td>
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<td>Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.</td>
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<td>28-32 Find solutions to systems of linear equations.</td>
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<td>Solve quadratic equations.</td>
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<td>28-32 Find the solution of a quadratic equation and/or zeros of a quadratic equation.</td>
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<td>quadratic function</td>
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</table>
| Algebra I               | SPI 3102.3.11 | GR             | 33-36 | Analyze and draw conclusions based on information from graphs in the coordinate plane | ALG               | 12    | 2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or *trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.  
2f) Given a real-world situation, determine if a linear, quadratic, rational, exponential, logarithmic, or *trigonometric function fits the situation.  
2h) Analyze properties of exponential, logarithmic, and rational functions.  
4c) Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically. |
|                        |     |                 |       |                                |                   |       |                                     |
| Algebra I               | SPI 3102.4.1 | MEAS            | 33-36 | Analyze and draw conclusions based on information from graphs in the coordinate plane | MEAS             | 8     | 1c) Estimate the size of an object with respect to a given measurement attribute (e.g., area). |
|                        |     |                 |       |                                |                   |       |                                     |
| Algebra I               | SPI 3102.4.2 | PPF             | 28-32 | Use the Pythagorean theorem   | GEO              | 8     | 3d) Use the Pythagorean theorem to solve problems.  
3d) Use the Pythagorean theorem to solve problems in two- or three-dimensional situations. |
|                        |     |                 |       |                                |                   | 12    |                                     |
| Algebra I               | SPI 3102.4.3 | GR             | 20-23 | Comprehend the concept of length on the number line | GEO              | 8     | 3d) Use the Pythagorean theorem to solve problems.  
3d) Use the Pythagorean theorem to solve problems in two- or three-dimensional situations.  
4a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines. |
<p>|                        |     |                 | 24-27 | Find the midpoint of a line segment |                   | 12    |                                     |</p>
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</thead>
<tbody>
<tr>
<td>28-32 Use the distance formula</td>
<td>ALG 8</td>
<td>2d) Solve problems involving coordinate pairs on the rectangular coordinate system.</td>
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<tr>
<td>BOA 13-15</td>
<td></td>
<td>13-15 Perform common conversions (e.g., inches to feet or hours to minutes)</td>
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<tr>
<td>24-27</td>
<td></td>
<td>24-27 Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)</td>
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<td>Convert rates and measurements.</td>
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<tr>
<td>PSDA 28-32</td>
<td></td>
<td>1a) Read or interpret data, including interpolating or extrapolating from data.</td>
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<td>12</td>
<td>1a) Read or interpret graphical or tabular representations of data.</td>
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<td></td>
<td>d) Solve problems involving coordinate pairs</td>
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<tr>
<td>DASP 8</td>
<td></td>
<td>2c) Identify outliers and determine their effect on mean, median, mode, or range.</td>
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<td>12</td>
<td>2b) Recognize how linear transformations of one-variable data affect mean, median, mode, range, interquartile range, and standard deviation.</td>
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<td>2c) Determine the effect of outliers on mean, median, mode, range, interquartile range, or standard deviation.</td>
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<td>2e) Visually choose the line that best fits given a scatterplot and informally explain the meaning of the line. Use the line to make predictions.</td>
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<td>DASP 12</td>
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<td>2e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to</td>
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<td>make predictions.</td>
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<td>Algebra I SPI 3102.5.5</td>
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<td>Determine theoretical and/or experimental probability of an event and/or its complement including using relative frequency.</td>
<td>PSDA 16-19</td>
<td>Use the relationship between the probability of an event and the probability of its complement</td>
<td>DASP</td>
<td>8</td>
<td>4b) Determine the theoretical probability of simple and compound events in familiar contexts 4c) Estimate the probability of simple and compound events through experimentation or simulation.</td>
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<tr>
<td>Geometry SPI 3108.1.1</td>
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<td>GEO 12</td>
<td>1c) Give precise mathematical descriptions or definitions of geometric shapes in the plane and in three-dimensional space.</td>
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<td></td>
<td>Give precise mathematical descriptions or definitions of geometric shapes in the plane and space.</td>
<td>MEAS 33-36</td>
<td>Compute the area of composite geometric figures when planning or visualization is required</td>
<td>MEAS 8</td>
<td>1f) Solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures 1f) Solve problems involving perimeter or area of plane figures such as polygons, circles, or composite figures.</td>
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<td>Geometry SPI 3108.1.2</td>
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<td>GEO 12</td>
<td>1f) Demonstrate an understanding about the two- and three-dimensional shapes in our world through identifying, drawing, modeling, building, or taking apart.</td>
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<td>Determine areas of planar figures by decomposing them into simpler figures without a grid.</td>
<td>MEAS 33-36</td>
<td>Compute the area of composite geometric figures when planning or visualization is required</td>
<td>MEAS 8</td>
<td>1f) Solve problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures.</td>
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<td>Geometry SPI 3108.1.3</td>
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<td>GEO 8</td>
<td>1f) Solve problems involving perimeter or area of plane figures such as polygons, circles, or composite figures.</td>
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<td>Use geometric understanding and spatial visualization of geometric solids to solve problems and/or create drawings.</td>
<td>MEAS 33-36</td>
<td>Draw conclusions based on a set of conditions</td>
<td>GEO 12</td>
<td>5a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines. 5b) Describe the intersections of lines in the plane and in space, intersections of a line and a plane, or of two planes in space. 5c) Describe or identify conic sections and other cross sections of solids.</td>
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<td>Geometry SPI 3108.1.4</td>
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<td>GEO 12</td>
<td>5a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines. 5b) Describe the intersections of lines in the plane and in space, intersections of a line and a plane, or of two planes in space. 5c) Describe or identify conic sections and other cross sections of solids.</td>
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<tr>
<td>Geometry SPI 3108.2.1</td>
<td>Analyze, apply, or interpret the relationships between basic number concepts and geometry (e.g. rounding and pattern identification in measurement, the relationship of pi to other rational and irrational numbers)</td>
<td>MEAS</td>
<td>8</td>
<td>1e Select or use appropriate measurement instrument to determine or create a given length, area, volume, angle, weight, or mass.</td>
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<td>Geometry SPI 3108.2.2</td>
<td>Perform operations on vectors in various representations.</td>
<td>GEO</td>
<td>12</td>
<td>4e) Use vectors to represent velocity and direction; multiply a vector by a scalar and add vectors both algebraically and graphically.</td>
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<tr>
<td>Geometry SPI 3108.3.1</td>
<td>Use algebra and coordinate geometry to analyze and solve problems about geometric figures (including circles).</td>
<td>PPF</td>
<td>33-36</td>
<td>ALG</td>
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<td>2d) Solve problems involving coordinate pairs on the rectangular coordinate system.</td>
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<td>4a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines.</td>
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<td>4f) Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.</td>
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<tr>
<td>Geometry SPI 3108.3.2</td>
<td>Use coordinate geometry to prove characteristics of polygonal figures.</td>
<td>GR</td>
<td>33-36</td>
<td>GEO</td>
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<td>4d) Represent geometric figures using rectangular coordinates on a plane.</td>
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<td>4f) Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.</td>
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<td>Geometry SPI 3108.3.3</td>
<td>Describe algebraically the effect of a single</td>
<td>PPF</td>
<td>33-36</td>
<td>GEO</td>
<td>12</td>
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| | | | | | 2b) Give or recognize the precise mathematical relationship (e.g., congruence,
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<td>transformation (reflections in the x- or y-axis, rotations, translations, and dilations) on two-dimensional geometric shapes in the coordinate plane.</td>
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<td>similarity, orientation) between a figure and its image under a transformation.</td>
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<td>Geometry SPI 3108.4.1</td>
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<td>Differentiate between Euclidean and non-Euclidean geometries.</td>
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<td>Geometry SPI 3108.4.2</td>
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<td>Define, identify, describe, and/or model plane figures using appropriate mathematical symbols (including collinear and non-collinear points, lines, segments, rays, angles, triangles, quadrilaterals, and other polygons).</td>
<td>PPF</td>
<td>20-23</td>
<td>Find the measure of an angle using properties of parallel lines</td>
<td>GEO</td>
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<td>Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)</td>
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<td>1c) Identify, define, or describe geometric shapes in the plane and in three-dimensional space given a visual representation.</td>
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<td>3g) Describe or analyze properties and relationships of parallel or intersecting lines.</td>
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<td></td>
<td>3e) Recall and interpret definitions and basic properties of congruent and similar triangles, circles, quadrilaterals, polygons, parallel, perpendicular and intersecting lines, and associated angle relationships.</td>
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<td>3g) Analyze properties and relationships of parallel, perpendicular, or intersecting lines, including the angle relationships that arise in these cases.</td>
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<td>Geometry SPI 3108.4.3</td>
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<td>Identify, describe and/or apply the relationships and theorems involving different types of triangles, quadrilaterals and other polygons.</td>
<td>PPF</td>
<td>24-27</td>
<td>Use properties of isosceles triangles</td>
<td>GEO</td>
<td>12</td>
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<td>3e) 3e) Recall and interpret definitions and basic properties of congruent and similar triangles, circles, quadrilaterals, polygons, parallel, perpendicular and intersecting lines, and associated angle relationships.</td>
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<td>3f) Analyze properties or relationships of triangles, quadrilaterals, and other polygonal plane figures.</td>
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<tr>
<td>Geometry SPI 3108.4.4</td>
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<td>Analyze different types and formats of proofs.</td>
<td>PPF</td>
<td>33-36</td>
<td>Draw conclusions based on a set of conditions</td>
<td>GEO</td>
<td>12</td>
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<td>5a) Make, test, and validate geometric conjectures using a variety of methods including deductive reasoning and</td>
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<td>counterexamples.</td>
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<td>5b) Determine the role of hypotheses, logical implications, and conclusion, in proofs of geometric theorems.</td>
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<td>5c) Analyze or explain a geometric argument by contradiction</td>
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<td>Geometry SPI 3108.4.5</td>
<td></td>
<td>Describe solids and/or surfaces in three-dimensional space when given two-dimensional representations for the surfaces of three-dimensional objects.</td>
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<td>GEO</td>
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<td>1c) Identify, define, or describe geometric shapes in the plane and in three-dimensional space given a visual representation.</td>
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<td>1e) Represent or describe a three-dimensional situation in a two-dimensional drawing from different views.</td>
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<td>Geometry SPI 3108.4.6</td>
<td>MEAS</td>
<td>Use various area of triangle formulas to solve contextual problems (e.g., Heron's formula, the area formula for an equilateral triangle and ( A = \frac{1}{2} ab \sin C )).</td>
<td>20-23</td>
<td>Compute the area and perimeter of triangles and rectangles in simple problems ( A = \frac{1}{2} ab \sin C ).</td>
<td>MEAS</td>
<td>8</td>
<td>1f) Solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures.</td>
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<td>24-27</td>
<td>Use geometric formulas when all necessary information is given</td>
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<td>Compute the area of triangles and rectangles when one or more additional simple steps are required</td>
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<td>Geometry SPI 3108.4.7</td>
<td>MEAS</td>
<td>Compute the area and perimeter of triangles, quadrilaterals and other polygons when one or more additional steps are required (e.g. find missing dimensions given area or perimeter of the figure, using trigonometry).</td>
<td>24-27</td>
<td>Compute the area of triangles and rectangles when one or more additional simple steps are required</td>
<td>MEAS</td>
<td>12</td>
<td>1f) Solve problems involving perimeter or area of plane figures such as polygons, circles, or composite figures.</td>
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<td>33-36</td>
<td>Compute the perimeter of simple composite geometric figures with unknown side lengths</td>
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<td>Compute the area of composite geometric figures when planning or visualization is required</td>
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<td>Geometry SPI 3108.4.8</td>
<td>MEAS</td>
<td>24-27</td>
<td>Compute the area and circumference of circles after identifying necessary information</td>
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<td></td>
<td>ALG</td>
<td>38-32</td>
<td>Use relationships involving area, perimeter, and volume of geometric figures to compute another measure</td>
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<tr>
<td>Geometry SPI 3108.4.9</td>
<td>FN</td>
<td>28-32</td>
<td>Apply basic trigonometric ratios to solve right-triangle problems</td>
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<tr>
<td>Geometry SPI 3108.4.10</td>
<td>GEO</td>
<td>8</td>
<td>1f) Solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures.</td>
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<td>12</td>
<td>1f) Solve problems involving perimeter or area of plane figures such as polygons, circles, or composite figures.</td>
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<td>8</td>
<td>4e) Use and evaluate common formulas [e.g., relationship between a circle’s circumference and diameter (C = πd), distance and time under constant speed].</td>
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<td>12</td>
<td>3b) Solve problems using the fact that trigonometric ratios (sine, cosine, and tangent) stay constant in similar triangles.</td>
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<td>8</td>
<td>3c) Use the definitions of sine, cosine, and tangent as ratios of sides in a right triangle to solve problems about length of sides and measure of angles.</td>
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<td>12</td>
<td>3g) Use the law of cosines and the law of sines to find unknown sides and angles of a triangle.</td>
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<td>8</td>
<td>2c) Recognize or informally describe the effect of a transformation on two-dimensional geometric shapes (reflections across lines of symmetry, rota-tions, translations, magnifications, and contractions).</td>
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<td>12</td>
<td>2a) Recognize or identify types of symmetries (e.g., point, line, rotational, self-congruence) of two- and three-dimensional figures.</td>
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<td>2c) Perform or describe the effect of a single transformation on two- and three-dimensional geometric shapes (reflections across lines of symmetry, rotations, translations, and dilations).</td>
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<tr>
<td>Geometry SPI 3108.4.11</td>
<td>Use basic theorems about similar and congruent triangles to solve problems.</td>
<td>PPF</td>
<td>28-32</td>
<td>Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles</td>
<td>GEO</td>
<td>12</td>
<td>2e) Justify relationships of congruence and similarity, and apply these relationships using scaling and proportional reasoning.</td>
</tr>
<tr>
<td>Geometry SPI 3108.4.12</td>
<td>Solve problems involving congruence, similarity, proportional reasoning and/or scale factor of two similar figures or solids</td>
<td>MEAS</td>
<td>13-15</td>
<td>Estimate or calculate the length of a line segment based on other lengths given on a geometric figure</td>
<td>GEO</td>
<td>12</td>
<td>2e) Justify relationships of congruence and similarity, and apply these relationships using scaling and proportional reasoning.</td>
</tr>
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<td></td>
<td>28-32</td>
<td>Use relationships involving area, perimeter, and volume of geometric figures to compute another measure</td>
<td>GEO</td>
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<td></td>
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<td></td>
<td>33-36</td>
<td>Use scale factors to determine the magnitude of a size change</td>
<td>GEO</td>
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<tr>
<td>Geometry SPI 3108.4.13</td>
<td>Identify, analyze and/or use basic properties and theorems of circles to solve problems (including those relating right triangles and circles).</td>
<td>PPF</td>
<td>33-36</td>
<td>Use relationships among angles, arcs, and distances in a circle</td>
<td>GEO</td>
<td>12</td>
<td>3h) Analyze properties of circles and the intersections of lines and circles (inscribed angles, central angles, tangents, secants, chords). 5e) Prove basic theorems about congruent and similar triangles and circles.</td>
</tr>
<tr>
<td>Geometry SPI 3108.4.14</td>
<td>Use properties of right triangles to solve problems (such as involving the relationship formed when the altitude to the hypotenuse of a right triangle is drawn).</td>
<td>FN</td>
<td>28-32</td>
<td>Apply basic trigonometric ratios to solve right-triangle problems</td>
<td>GEO</td>
<td>12</td>
<td>3e) Recall and interpret definitions and basic properties of congruent and similar triangles, circles, quadrilaterals, polygons, parallel, perpendicular and intersecting lines, and associated angle relationships.</td>
</tr>
</tbody>
</table>
| Geometry SPI 3108.4.15   | Determine and use the appropriate | FN    | 28-32 | Apply basic trigonometric ratios to solve right-triangle problems | MEAS              | 12    | 3b) Solve problems using the fact that trigonometric ratios (sine, cosine, and tangent)
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<tr>
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<tbody>
<tr>
<td>Geometry SPI 3108.5.1</td>
<td></td>
<td>trigonometric ratio for a right triangle to solve a contextual problem.</td>
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<td>stay constant in similar triangles.</td>
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<td></td>
<td></td>
<td>Use area to solve problems involving geometric probability (e.g. dartboard problem, shaded sector of a circle, shaded region of a geometric figure).</td>
<td>BOA</td>
<td>33-36</td>
<td>Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)</td>
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</tbody>
</table>

### Grade 8

<p>| Grade 8 SPI 0806.1.1  | Solve problems involving rate/time/distance (i.e., ( d = rt )) | EEI   | 24-27 | Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions) | ALG   | 8    | 4c) Analyze situations or solve problems using linear equations and inequalities with rational coefficients symbolically or graphically (e.g., ( ax + b = c ) or ( ax + b = cx + d )). |
|                       |                                                   |       |       |                                                               |       |       | 4e) Use and evaluate common formulas [e.g., relationship between a circle’s circumference and diameter ( (C = \pi d) ), distance and time under constant speed]. |
| Grade 8 SPI 0806.1.2  | Interpret a qualitative graph representing a contextual situation | PSDA  | 16-19 | Read tables and graphs | DASP  | 8    | 1a) Read or interpret data, including interpolating or extrapolating from data. |
| Grade 8 SPI 0806.1.3  | Calculates rates involving cost per unit to determine the best buy. | BOA   | 28-32 | Solve word problems containing several rates, proportions, or percentages | NPO   | 8    | 4a) Use ratios to describe problem situations. |
|                       |                                                   |       |       |                                                               |       |       | 4b) Use fractions to represent and express ratios and proportions |
| Grade 8 SPI 0806.2.1  | Order and compare rational and irrational numbers and locate on the number line | NCP   | 20-23 | Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor | NPO   | 8    | 1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line). |
|                       |                                                   | 24-27 |       | Order fractions |       |       |                                                   |</p>
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<tr>
<td>Grade 8 SPI 0806.2.2</td>
<td>GR</td>
<td>13-15</td>
<td></td>
<td>Identify the location of a point with a positive coordinate on the number line</td>
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<td>2a) Establish or apply benchmarks for rational numbers and common irrational numbers (e.g., π) in contexts.</td>
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<td></td>
<td></td>
<td>16-19</td>
<td></td>
<td>Locate points on the number line and in the first quadrant</td>
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<tr>
<td>Grade 8 SPI 0806.2.3</td>
<td>NCP</td>
<td>24-27</td>
<td></td>
<td>Work problems involving positive integer exponents</td>
<td>NPO</td>
<td>8</td>
<td>1f) Express or interpret numbers using scientific notation from real-life contexts.</td>
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<td></td>
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<td></td>
<td>Work with squares and roots of numbers</td>
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<td></td>
<td>3b) Perform arithmetic operations with real numbers, including common irrational numbers.</td>
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<tr>
<td>Grade 8 SPI 0806.2.4</td>
<td>NCP</td>
<td>24-27</td>
<td></td>
<td>Work with scientific notation.</td>
<td>NPO</td>
<td>8</td>
<td>1f) Express or interpret numbers using scientific notation from real-life contexts.</td>
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<td></td>
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<td></td>
<td>Work with scientific notation.</td>
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<td></td>
<td>3b) Perform arithmetic operations with real numbers, including common irrational numbers.</td>
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<tr>
<td>Grade 8 SPI 0806.3.1</td>
<td>EEI</td>
<td>28-32</td>
<td></td>
<td>Find solutions to systems of linear equations</td>
<td>ALG</td>
<td>12</td>
<td>4d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.</td>
</tr>
<tr>
<td>Grade 8 SPI 0806.3.2</td>
<td>EEI</td>
<td>20-23</td>
<td></td>
<td>Solve routine first-degree equations</td>
<td>ALG</td>
<td>8</td>
<td>4a) Solve linear equations or inequalities (e.g., ( ax + b = c ) or ( ax + b = cx + d ) or ( ax + b &gt; c )).</td>
</tr>
<tr>
<td>Grade 8 SPI 0806.3.3</td>
<td>GR</td>
<td>28-32</td>
<td></td>
<td>Interpret and use information from graphs in the coordinate plane</td>
<td>ALG</td>
<td>12</td>
<td>2a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or trigonometric) using symbols, graphs, tables, diagrams, or</td>
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<td>written descriptions.</td>
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<td>Grade 8</td>
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<tr>
<td>SPI 0806.3.4</td>
<td>GR</td>
<td>24-27</td>
<td></td>
<td>Match linear graphs with their equations</td>
<td>ALG 8</td>
<td></td>
<td>2a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<tr>
<td>SPI 0806.3.5</td>
<td>GR</td>
<td>28-32</td>
<td></td>
<td>Interpret and use information from graphs in the coordinate plane</td>
<td>ALG 8</td>
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<td>2d) Solve problems involving coordinate pairs on the rectangular coordinate system.</td>
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<td>SPI 0806.3.6</td>
<td>GR</td>
<td>33-36</td>
<td></td>
<td>Identify characteristics of graphs based on a general equation such as $y = ax^2 + c$</td>
<td>ALG 8</td>
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<td>1f) Interpret the meaning of slope or intercepts in linear functions.</td>
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<td>Identify, compare and contrast functions as</td>
<td>GR</td>
<td>33-36</td>
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<td>Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$</td>
<td>ALG 8</td>
<td></td>
<td>1e) Identify functions as linear or nonlinear or contrast distinguishing properties of functions</td>
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<tr>
<td>SPI 0806.3.7</td>
<td>linear or nonlinear.</td>
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<td>general equation such as ( y = ax^2 + c )</td>
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<td>from tables, graphs, or equations.</td>
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<tr>
<td>Grade 8 SPI 0806.4.1</td>
<td>Use the Pythagorean Theorem to solve contextual problems.</td>
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<td>Use the Pythagorean theorem</td>
<td>GEO</td>
<td>8</td>
<td>3d) Use the Pythagorean theorem to solve problems.</td>
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<td>PPF 28-32</td>
<td></td>
<td>Solve problems integrating multiple algebraic and/or geometric concepts</td>
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<td>12</td>
<td>3d) Use the Pythagorean theorem to solve problems in two- or three-dimensional situations.</td>
</tr>
<tr>
<td>Grade 8 SPI 0806.4.2</td>
<td>Apply the Pythagorean theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra.</td>
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<td>Use the Pythagorean theorem</td>
<td>GEO</td>
<td>12</td>
<td>4a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines.</td>
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<td>PPF 28-32</td>
<td></td>
<td>Solve problems integrating multiple algebraic and/or geometric concepts</td>
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<td>33-36</td>
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<td></td>
<td></td>
<td>GR 28-32</td>
<td></td>
<td>Use the distance formula</td>
<td>GEO</td>
<td>12</td>
<td>4a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines.</td>
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<td>33-36</td>
<td></td>
<td>Solve problems integrating multiple algebraic and/or geometric concepts</td>
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<tr>
<td>Grade 8 SPI 0806.4.3</td>
<td>Find measures of the angles formed by parallel lines cut by a transversal.</td>
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<td>Exhibit some knowledge of the angles associated with parallel lines</td>
<td>GEO</td>
<td>12</td>
<td>3g) Analyze properties and relationships of parallel, perpendicular, or intersecting lines, including the angle relationships that arise in these cases.</td>
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<td>PPF 16-19</td>
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<td>Find the measure of an angle using properties of parallel lines</td>
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<td>20-23</td>
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<tr>
<td>Grade 8 SPI 0806.4.4</td>
<td>Convert between and within the U.S. Customary System and the metric system.</td>
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<td>Perform common conversions (e.g., inches to feet or hours to minutes)</td>
<td>MEAS</td>
<td>12</td>
<td>2b) Solve problems involving conversions within or between measurement systems, given the relationship between the units.</td>
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<td>BOA 13-15</td>
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<tr>
<td>Grade 8 SPI 0806.4.5</td>
<td>Identify the intersection of two or more geometric figures in the plane.</td>
<td></td>
<td></td>
<td>Determine the probability of a simple event</td>
<td>GEO</td>
<td>8</td>
<td>3g) Describe or analyze properties and relationships of parallel or intersecting lines.</td>
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<td></td>
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<td>PSDA 20-23</td>
<td></td>
<td>Compute straightforward probabilities for common situations</td>
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<td>21-27</td>
<td>4b) Describe the intersection of two or more geometric figures in the plane (e.g., intersection of a circle and a line).</td>
</tr>
<tr>
<td>Grade 8 SPI 0806.5.1</td>
<td>Calculate probabilities of events for simple experiments with equally probable outcomes.</td>
<td></td>
<td></td>
<td>Determine the probability of a simple event.</td>
<td>DASP</td>
<td>8</td>
<td>4b) Determine the theoretical probability of simple and compound events in familiar contexts.</td>
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<td>PSDA 20-23</td>
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<td>Exhibit knowledge of simple counting techniques.</td>
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<td>4c) Estimate the probability of simple and</td>
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<td>Compute a probability when the event and/or sample space are not given or obvious</td>
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<td>compound events through experimentation or simulation.</td>
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<td>Apply counting techniques.</td>
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<td>4d) Use theoretical probability to evaluate or predict experimental outcomes.</td>
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<td>4f) Use a sample space to determine the probability of the possible outcomes of an event.</td>
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<td>g) Represent probability of a given outcome using fractions, decimals, and percents.</td>
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<td>Grade 8</td>
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<tr>
<td>SPI 0806.5.2</td>
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<td>Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models).</td>
<td>PSDA</td>
<td>28-32</td>
<td>DASP 12 4e) Determine the number of ways an event can occur using tree diagrams, formulas for combinations and permutations, or other counting techniques</td>
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<td>Grade 8</td>
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<td>SPI 0806.5.3</td>
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<td>Generalize the relationship between two sets of data using scatterplots and lines of best fit.</td>
<td>PSDA</td>
<td>16-19</td>
<td>DASP 8 2e) Visually choose the line that best fits given a scatterplot and informally explain the meaning of the line. Use the line to make predictions.</td>
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<td>SPI 0806.5.4</td>
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<td>Recognize misrepresentations of published data in the media.</td>
<td>PSDA</td>
<td>33-36</td>
<td>DASP 8 2e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to make predictions.</td>
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<td>Use proportional</td>
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<td>Solve routine two-step or three-step</td>
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<td>4c) Use proportional reasoning to model and</td>
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<td>reasoning to solve mixture/concentration problems.</td>
<td>24-27</td>
<td>arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average. Solve multi-step arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).</td>
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<td>solve problems (including rates and scaling).</td>
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<td>Grade 7 SPI 0706.1.2</td>
<td></td>
<td>Generalize a variety of patterns to a symbolic rule from tables, graphs, or words.</td>
<td>20-23</td>
<td>Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.</td>
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<td>Grade 7 SPI 0706.1.3</td>
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<td>Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship.</td>
<td>33-36</td>
<td>Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.</td>
<td>ALG 8</td>
<td></td>
<td>2f) Identify or represent functional relationships in meaningful contexts including proportional, linear, and common nonlinear (e.g., compound interest, bacterial growth) in tables, graphs, words, or symbols.</td>
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<td>Grade 7 SPI 0706.1.4</td>
<td></td>
<td>Use scales to read maps.</td>
<td>24-27</td>
<td>Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).</td>
<td>NPO 8</td>
<td></td>
<td>4e) Use proportions to solve problems (including rates of change).</td>
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<tr>
<td>Grade 7 SPI 0706.2.1</td>
<td></td>
<td>Simplify numerical expressions involving rational numbers.</td>
<td>16-19</td>
<td>Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent. Solve some routine two-step arithmetic problems.</td>
<td>ALG 8</td>
<td></td>
<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and expanding).</td>
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<td>Grade 7 SPI 0706.2.2</td>
<td></td>
<td>Compare rational numbers using appropriate inequality symbols.</td>
<td>20-23</td>
<td>Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes,</td>
<td>NPO 8</td>
<td></td>
<td>1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).</td>
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<td>24-27</td>
<td>and greatest common factor</td>
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<td></td>
<td>Order fractions</td>
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<td>Grade 7 SPI 0706.2.3</td>
<td>NCO</td>
<td>Use rational numbers and roots of perfect squares/cubes to solve contextual problems.</td>
<td>24-27</td>
<td>Work with squares and square roots of numbers</td>
<td>NPO</td>
<td>8</td>
<td>1f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate.</td>
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<td>Work with cubes and cube roots of numbers</td>
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<td>3a) Perform computations with rational numbers.</td>
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<td></td>
<td>Solve word problems containing several rates, proportions, or percentages</td>
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<td>3e) Interpret rational number operations and the relationships between them.</td>
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<td>28-32</td>
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<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate.</td>
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<td>Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)</td>
<td>ALG</td>
<td>8</td>
<td>3b) Perform arithmetic operations with real numbers, including common irrational numbers.</td>
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<td>33-36</td>
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<td>3f) Solve application problems involving numbers, including rational and common irrationals</td>
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<td>NCO</td>
<td>Determine the approximate location of square/cube roots on a number line.</td>
<td>24-27</td>
<td>Work with squares and square roots of numbers</td>
<td>NPO</td>
<td>8</td>
<td>1d) Estimate square or cube roots of numbers less than 1,000 between two whole numbers.</td>
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<td>Work with cubes and cube roots of numbers</td>
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<td>1i) Order or compare rational numbers including very large and small integers, and decimals and fractions close to zero.</td>
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<td>3a) Perform computations with rational numbers.</td>
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<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate.</td>
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<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate.</td>
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<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate.</td>
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<td>20-23</td>
<td>Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average</td>
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<td>4b) Use fractions to represent and express ratios and proportions.</td>
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<td>Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)</td>
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<td>EEI</td>
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<td>16-19</td>
<td>Substitute whole numbers for unknown quantities to evaluate expressions</td>
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<td>4c) Use proportions to solve problems (including rates of change).</td>
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<td>20-23</td>
<td>Evaluate algebraic expressions by substituting integers for unknown quantities</td>
<td>NPO</td>
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<td>4c) Use proportions to solve problems (including rates of change).</td>
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<td>ALG</td>
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<td>3e) Evaluate algebraic expressions, including polynomials and rational expressions.</td>
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<td>1g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.</td>
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<td>1g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.</td>
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<td>1g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.</td>
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<td>1g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.</td>
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<td>Grade 7 SPI 0706.3.3</td>
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<td>Given a table of inputs $x$ and outputs $f(x)$, identify the function rule and continue the pattern.</td>
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<td>ALG</td>
<td>8</td>
<td>1a) Recognize, describe, or extend numerical and geometric patterns using tables, graphs, words, or symbols. 1b) Generalize a pattern appearing in a numerical sequence or table or graph using words or symbols.</td>
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<td>Grade 7 SPI 0706.3.4</td>
<td></td>
<td>Interpret the slope of a line as a unit rate given the graph of a proportional relationship.</td>
<td>28-32</td>
<td>Exhibiting knowledge of slope</td>
<td>ALG</td>
<td>8</td>
<td>1f) Interpret the meaning of slope or intercepts in linear functions.</td>
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<td>Grade 7 SPI 0706.3.5</td>
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<td>Represent proportional relationships with equations, tables and graphs.</td>
<td>24-27</td>
<td>Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)</td>
<td>ALG</td>
<td>8</td>
<td>2f) Identify or represent functional relationships in meaningful contexts including proportional, linear, and common nonlinear (e.g., compound interest, bacterial growth) in tables, graphs, words, or symbols.</td>
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<td>Grade 7 SPI 0706.3.6</td>
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<td>Solve linear equations with rational coefficients symbolically or graphically.</td>
<td>20-23</td>
<td>Solve routine first-degree equations</td>
<td>ALG</td>
<td>8</td>
<td>2d) Solve problems involving coordinate pairs on the rectangular coordinate system. 4a) Solve linear equations or inequalities (e.g., $ax + b = c$ or $ax + b = cx + d$ or $ax + b &gt; c$). 3c) Analyze situations or solve problems using linear equations and inequalities with rational coefficients symbolically or graphically (e.g., $ax + b = c$ or $ax + b = cx + d$).</td>
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<td>Grade 7 SPI 0706.3.7</td>
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<td>Translate between verbal and symbolic representations of real-world phenomena involving</td>
<td>24-27</td>
<td>Solve real-world problems using first-degree equations</td>
<td>ALG</td>
<td>8</td>
<td>2a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>linear equations.</td>
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<td>24-27</td>
<td>Match linear graphs with their equations*</td>
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<td>Solve contextual problems involving two-step linear equations.</td>
<td>EEI</td>
<td>24-27</td>
<td>Solve real-world problems using first-degree equations</td>
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<td>Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)</td>
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<td>ALG</td>
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<td>4c) Analyze situations or solve problems using linear equations and inequalities with rational coefficients symbolically or graphically (e.g., $ax + b = c$ or $ax + b = cx + d$).</td>
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<td>SPI 0706.3.8</td>
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<td>4a) Solve linear equations or inequalities (e.g., $ax + b = c$ or $ax + b = cx + d$ or $ax + b &gt; c$).</td>
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<td>Solve linear inequalities in one variable with rational coefficients symbolically or graphically.</td>
<td>EEI</td>
<td>24-27</td>
<td>Solve first-degree inequalities that do not require reversing the inequality sign</td>
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<td>Solve linear inequalities that require reversing the inequality sign</td>
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<td>Identify the graph of a linear inequality on the number line</td>
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<td>Match number line graphs with solution sets of linear inequalities</td>
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<td>ALG</td>
<td>8</td>
<td>4c) Analyze situations or solve problems using linear equations and inequalities with rational coefficients symbolically or graphically (e.g., $ax + b = c$ or $ax + b = cx + d$).</td>
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<td>SPI 0706.3.9</td>
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<td></td>
<td>a) Solve linear equations or inequalities (e.g., $ax + b = c$ or $ax + b = cx + d$ or $ax + b &gt; c$).</td>
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<td>c) Analyze situations or solve problems using linear equations and inequalities with rational coefficients symbolically or graphically (e.g., $ax + b = c$ or $ax + b = cx + d$).</td>
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<tr>
<td>Solve contextual problems involving similar triangles.</td>
<td>PPF</td>
<td>28-32</td>
<td>Apply properties of $30^\circ$-$60^\circ$-$90^\circ$, $45^\circ$-$45^\circ$-$90^\circ$, similar, and congruent triangles</td>
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<td>GEO</td>
<td>8</td>
<td>2 e) Justify relationships of congruence and similarity, and apply these relationships using scaling and proportional reasoning.</td>
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<td>2f) For similar figures, identify and use the relationships of conservation of angle and of proportionality of side length and perimeter.</td>
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<td>Use SSS, SAS, and AA to determine if two triangles are similar.</td>
<td>GEO</td>
<td>8</td>
<td>2e) Justify relationships of congruence and similarity, and apply these relationships using scaling and proportional reasoning.</td>
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<tr>
<td>SPI 0706.4.3</td>
<td>MEAS</td>
<td>Apply scale factor to solve problems involving area and volume</td>
<td>28-32</td>
<td>Use relationships involving area, perimeter, and volume of geometric figures to compute another measure</td>
<td>MEAS</td>
<td>12</td>
<td>1c) Estimate, or compare perimeters or areas of two-dimensional geometric figures.</td>
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<td>Use scale factors to determine the magnitude of a size change</td>
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<td>33-36</td>
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<tr>
<td>SPI 0706.5.1</td>
<td>PSDA</td>
<td>Interpret and employ various graphs and charts to represent data.</td>
<td>13-15</td>
<td>Perform a single computation using information from a table or chart</td>
<td>DASP</td>
<td>8</td>
<td>1a) Read or interpret data, including interpolating or extrapolating from data.</td>
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<td>Perform computations on data from tables and graphs</td>
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<tr>
<td>SPI 0706.5.2</td>
<td>PSDA</td>
<td>Select suitable graph types (such as bar graphs, histograms, line graphs, circle graphs, box-and-whisker plots, and stem-and-leaf plots) and use them to create accurate representations of given data.</td>
<td>20-23</td>
<td>Translate from one representation of data to another (e.g., a bar graph to a circle graph)</td>
<td>DASP</td>
<td>8</td>
<td>1a) Read or interpret data, including interpolating or extrapolating from data.</td>
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<td>1b) For a given set of data, complete a graph and then solve a problem using the data in the graph (histograms, line graphs, scatterplots, circle graphs, and bar graphs).</td>
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<td></td>
<td>1e) Compare and contrast the effectiveness of different representations of the same data.</td>
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<tr>
<td>SPI 0706.5.3</td>
<td>PSDA</td>
<td>Calculate and interpret the mean, median, upper-quartile, lower-quartile, and interquartile range of a set of data.</td>
<td>13-15</td>
<td>Calculate the average of a list of positive whole numbers</td>
<td>DASP</td>
<td>12</td>
<td>2a) Calculate, interpret, or use summary statistics for distributions of data including measures of typical value (mean, median), position (quartiles, percentiles), and spread (range, interquartile range, variance, standard deviation).</td>
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<td>Calculate the average of a list of numbers</td>
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<td>33-36</td>
<td>Distinguish between mean, median, and mode for a list of numbers</td>
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<tr>
<td>SPI 0706.5.4</td>
<td>DASP</td>
<td>Use theoretical probability to make predictions</td>
<td>13-15</td>
<td></td>
<td>DASP</td>
<td>8</td>
<td>4 d) Use theoretical probability to evaluate or predict experimental outcomes.</td>
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<tr>
<td>Grade 6 SPI 0606.1.1</td>
<td>Make conjectures and predictions based on data.</td>
<td>PSDA</td>
<td>16-19</td>
<td>Read tables and graphs</td>
<td>DASP</td>
<td>8</td>
<td>1c) Solve problems by estimating and computing with data from a single set or across sets of data.</td>
</tr>
<tr>
<td>Grade 6 SPI 0606.1.2</td>
<td>Judge the reasonableness of the results of rational number estimates and/or computations.</td>
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<td>28-32</td>
<td>Interpret and use information from figures, tables, and graphs</td>
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<td>b) Make estimates appropriate to a given situation by:</td>
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<tr>
<td>Grade 6 SPI 0606.1.3</td>
<td>Use concrete, pictorial, and symbolic representation for integers.</td>
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<td>NPO</td>
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<td>Grade 6 SPI 0606.1.4</td>
<td>Select the representation that models one of the arithmetic properties (commutative, associative, or distributive).</td>
<td>NCP</td>
<td>28-32</td>
<td>Apply number properties involving positive/negative numbers</td>
<td>NPO</td>
<td>8</td>
<td>1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).</td>
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<td>Grade 6 SPI 0606.1.5</td>
<td>Model algebraic expressions using algebra tiles.</td>
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<td>ALG</td>
<td>8</td>
<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and expanding).</td>
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<td><strong>Grade 6</strong>&lt;br&gt;SPI 0606.2.1</td>
<td>BOA</td>
<td>Solve problems involving the multiplication and division of fractions.</td>
<td>16-19</td>
<td>Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent</td>
<td>NPO 8</td>
<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate. &lt;br&gt;4d) Solve problems involving percentages (including percent increase and decrease, interest rates, tax, discount, tips, or part/whole relationships).</td>
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<tr>
<td><strong>Grade 6</strong>&lt;br&gt;SPI 0606.2.2</td>
<td>BOA</td>
<td>Solve problems involving the addition, subtraction, multiplication, and division of mixed numbers.</td>
<td>16-19</td>
<td>Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent</td>
<td>NPO 8</td>
<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate. &lt;br&gt;4d) Solve problems involving percentages (including percent increase and decrease, interest rates, tax, discount, tips, or part/whole relationships).</td>
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<tr>
<td><strong>Grade 6</strong>&lt;br&gt;SPI 0606.2.3</td>
<td>BOA</td>
<td>Solve problems involving the addition, subtraction, multiplication, and division of decimals.</td>
<td>16-19</td>
<td>Solve some routine two-step arithmetic problems</td>
<td>NPO 8</td>
<td>3f) Solve application problems involving rational numbers and operations using exact answers or estimates as appropriate. &lt;br&gt;4d) Solve problems involving percentages (including percent increase and decrease, interest rates, tax, discount, tips, or part/whole relationships).</td>
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<tr>
<td><strong>Grade 6</strong>&lt;br&gt;SPI 0606.2.4</td>
<td>BOA</td>
<td>Solve multi-step arithmetic problems using fractions,</td>
<td>20-23</td>
<td>Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average</td>
<td>NPO 8</td>
<td>4d) Solve problems involving percentages (including percent increase and decrease, interest rates, tax, discount, tips, or part/whole relationships).</td>
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<td>mixed numbers, and decimals.</td>
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<td>tax added, percentage off, and computing with a given average</td>
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<td>24-27</td>
<td>Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)</td>
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<td>28-32</td>
<td>Solve word problems containing several rates, proportions, or percentages</td>
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<td>33-36</td>
<td>Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)</td>
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</table>
| Grade 6 SPI 0606.2.5    | NCP | Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers). | 13-15 | Recognize equivalent fractions and fractions in lowest terms | NPO   | 8     | 1e) Recognize, translate between, or apply multiple representations of rational numbers (fractions, decimals, and percents) in meaningful contexts.  
4a) Use place value to model and describe integers and decimals. |
<p>|                         | BOA | Solve problems involving ratios, rates and percents. | 20-23 | Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average | NPO   | 8     | 4d) Solve problems involving percentages (including percent increase and decrease, interest rates, tax, discount, tips, or part/whole relationships). |
|                         |     |                  | 28-32 | Solve word problems containing several rates, proportions, or percentages |       |       |                                     |
|                         |     |                  | 33-36 | Solve complex arithmetic problems involving percent of increase or |       |       |                                     |</p>
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<td>decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings) Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)</td>
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<td>Grade 6</td>
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<td>NPO</td>
<td>8</td>
<td>1b) Model or describe rational numbers or numerical relationships using number lines and diagrams. 1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).</td>
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<tr>
<td>SPI 0606.2.7</td>
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<td>Locate positive rational numbers on the number line.</td>
<td>13-15</td>
<td>Identify the location of a point with a positive coordinate on the number line Locate points on the number line and in the first quadrant</td>
<td>NPO</td>
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<td>NPO</td>
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<td>1b) Model or describe rational numbers or numerical relationships using number lines and diagrams. 1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).</td>
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<tr>
<td>Grade 6</td>
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<td>Locate integers on the number line.</td>
<td>16-19</td>
<td>Locate points on the number line and in the first quadrant</td>
<td>NPO</td>
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<td>SPI 0606.2.8</td>
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<td>NPO</td>
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<td>1b) Model or describe rational numbers or numerical relationships using number lines and diagrams. 1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).</td>
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<td>Identify the graph of a linear inequality on the number line Match number line graphs with solution sets of linear inequalities</td>
<td>ALG</td>
<td>8</td>
<td>3b) Write algebraic expressions, equations, or inequalities to represent a situation.</td>
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<td>Grade 6</td>
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<td>Represent on a number line the solution of a linear inequality.</td>
<td>24-27</td>
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<td>ALG</td>
<td>8</td>
<td>3c) Perform basic operations, using appropriate tools, on linear algebraic expressions (including grouping and order of multiple operations involving basic operations, exponents, roots, simplifying, and</td>
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<td>ALG</td>
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<td>Use order of operations and parentheses to simplify expressions and solve problems.</td>
<td>20-23</td>
<td>Evaluate algebraic expressions by substituting integers for unknown quantities</td>
<td>ALG</td>
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<td>3b) Write algebraic expressions, equations, or inequalities to represent a situation.</td>
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<td>Grade 6</td>
<td>EEI</td>
<td>Write equations that correspond to given situations or represent a given mathematical relationship.</td>
<td>13-15</td>
<td>Exhibit knowledge of basic expressions (e.g., identify an expression for a total as ( b + g ))</td>
<td>ALG</td>
<td>8</td>
<td>3b) Write algebraic expressions, equations, or inequalities to represent a situation.</td>
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<td>2 a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>2b) Analyze or interpret linear relationships expressed in symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>EEI</td>
<td>Rewrite expressions to represent quantities in different ways.</td>
<td>16-19</td>
<td>Combine like terms (e.g., ( 2x + 5x ))</td>
<td>ALG</td>
<td>8</td>
<td>2 a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>2b) Analyze or interpret linear relationships expressed in symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>EEI</td>
<td>Translate between verbal expressions or sentences and algebraic expressions or equations.</td>
<td>13-15</td>
<td>Exhibit knowledge of basic expressions (e.g., identify an expression for a total as ( b + g ))</td>
<td>ALG</td>
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<td>2 a) Translate between different representations of linear expressions using symbols, graphs, tables, diagrams, or written descriptions.</td>
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<td>3b) Write algebraic expressions, equations, or inequalities to represent a situation.</td>
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<td></td>
<td>EEI</td>
<td>Solve two-step linear equations using number sense, properties, and</td>
<td>20-23</td>
<td>Solve routine first-degree equations</td>
<td>ALG</td>
<td>8</td>
<td>4a) Solve linear equations or inequalities (e.g., ( ax + b = c ) or ( ax + b = cx + d ) or ( ax + b &gt; c )).</td>
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<td>Grade 6 SPI 0606.3.7</td>
<td>NCP</td>
<td>28-32</td>
<td></td>
<td>Apply number properties involving prime factorization</td>
<td>ALG</td>
<td>8</td>
<td>1a) Recognize, describe, or extend numerical and geometric patterns using tables, graphs, words, or symbols.</td>
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<td>Apply number properties involving even/odd numbers and factors/multiples</td>
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<tr>
<td>Grade 6 SPI 0606.3.8</td>
<td>GR</td>
<td>33-36</td>
<td></td>
<td>Analyze and draw conclusions based on information from graphs in the coordinate plane</td>
<td>ALG</td>
<td>8</td>
<td>f) Identify or represent functional relationships in meaningful contexts including proportional, linear, and common nonlinear (e.g., compound interest, bacterial growth) in tables, graphs, words, or symbols.</td>
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<td>Grade 6 SPI 0606.3.9</td>
<td>GR</td>
<td>20-23</td>
<td></td>
<td>Locate points in the coordinate plane</td>
<td>ALG</td>
<td>8</td>
<td>2c) Graph or interpret points that are represented by ordered pairs of numbers on a rectangular coordinate system.</td>
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<tr>
<td>Grade 6 SPI 0606.4.1</td>
<td>PPF</td>
<td>33-36</td>
<td></td>
<td>Draw conclusions based on a set of conditions</td>
<td>GEO</td>
<td>8</td>
<td>1b) Identify a geometric object given a written description of its properties.</td>
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<td>1d) Draw or sketch from a written description polygons, circles, or semicircles.</td>
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<tr>
<td>Grade 6 SPI 0606.4.2</td>
<td>PPF</td>
<td>20-23</td>
<td></td>
<td>Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)</td>
<td>GEO</td>
<td>8</td>
<td>3 b) Apply geometric properties and relationships in solving simple problems in two and three dimensions.</td>
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<td>24-27</td>
<td></td>
<td>Use several angle properties to find an unknown angle measure</td>
<td>MEAS</td>
<td>12</td>
<td>1 d) Solve problems of angle measure, including those involving triangles or other polygons or parallel lines cut by a transversal.</td>
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<tr>
<td>Grade 6 SPI 0606.4.3</td>
<td>MEAS</td>
<td>13-15</td>
<td></td>
<td>Estimate or calculate the length of a line segment based on other lengths given on a geometric figure</td>
<td>GEO</td>
<td>8</td>
<td>3b) Apply geometric properties and relationships in solving simple problems in two and three dimensions.</td>
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<tr>
<td>Grade 6 SPI 0606.4.4</td>
<td>MEAS</td>
<td>24-27</td>
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<td>Compute the area and circumference of circles after identifying necessary information</td>
<td>ALG</td>
<td>8</td>
<td>4e) Use and evaluate common formulas [e.g., relationship between a circle’s circumference and diameter (C = πd), distance and time</td>
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</table>

1 f) Solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures.

1h) Solve problems involving volume or surface area of rectangular solids, cylinders, prisms, or composite shapes.

h) Solve problems by determining, estimating, or comparing volumes or surface areas of three-dimensional figures.

4b) Determine the theoretical probability of simple and compound events in familiar contexts.

5a) Identify misleading uses of data in real-world settings and critique different ways of presenting and using information.

3a) Given a sample, identify possible sources of bias in sampling.
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<td>figure described.</td>
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<tr>
<td>Grade 5</td>
<td>SPI 0506.1.2</td>
<td>Estimate fraction and decimal sums or differences.</td>
<td>BOA</td>
<td>13-15</td>
<td>Perform one-operation computation with whole numbers and decimals</td>
<td>NPO</td>
<td>8</td>
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<tr>
<td>Grade 5</td>
<td>SPI 0506.1.3</td>
<td>Recognize the unit associated with the remainder in a division problem or the meaning of the fractional part of a whole given in either decimal or fraction form.</td>
<td>BOA</td>
<td>13-15</td>
<td>Identify a digit's place value</td>
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<td>• Identifying when estimation is appropriate,</td>
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<td>• Selecting the appropriate method of estimation, or</td>
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<td>• Analyzing the effect of an estimation method on the accuracy of results.</td>
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<td>Grade 5</td>
<td>SPI 0506.1.4</td>
<td>Identify missing information and/or too much information in contextual problems.</td>
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<td>NPO</td>
<td>8</td>
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<tr>
<td>Grade 5</td>
<td>SPI 0506.2.1</td>
<td>Read and write numbers from millions to millionths in various contexts.</td>
<td>NCP</td>
<td>16-19</td>
<td>Identify a digit's place value</td>
<td>NPO</td>
<td>8</td>
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<td>Grade 5</td>
<td>SPI 0506.2.2</td>
<td>Write the prime factorization of numbers through 50 using both exponential and standard notation.</td>
<td>NCP</td>
<td>16-19</td>
<td>Recognize one-digit factors of a number</td>
<td>NPO</td>
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<td>5c) Recognize or use prime and composite numbers to solve problems.</td>
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<td>6 a) Explain or justify a mathematical concept or relationship (e.g., explain why 17 is prime).</td>
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<td>1 d) Represent, interpret or compare</td>
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<td>2c) Verify solutions or determine</td>
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<td>5d) Use divisibility or remainders</td>
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<td>Select a reasonable solution</td>
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<td>3 c) Divide whole numbers:</td>
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<td>to a real-world division</td>
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<td>• Up to five-digits by two-digits</td>
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<td>Solve problems involving the</td>
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<td>3f) Solve application problems</td>
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<td>Solve addition and subtraction</td>
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<td>3 a) Add and subtract:</td>
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<td>problems involving both</td>
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<td>fractions and decimals.</td>
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<td>• Fractions with like denominators,</td>
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<td>• Decimals through hundredths.</td>
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<td>Add and subtract proper and</td>
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<td>1c) Recognize, translate between,</td>
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<td>improper fractions as well as</td>
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<td>Grade 5 SPI 0506.2.8</td>
<td>NCP</td>
<td>Write terminating decimals in the form of fractions or mixed numbers.</td>
<td>13-15</td>
<td>Recognize equivalent fractions and fractions in lowest terms</td>
<td>NPO</td>
<td>8</td>
<td>1e) Recognize, translate between, or apply multiple representations of rational numbers (fractions, decimals, and percents) in meaningful contexts.</td>
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<tr>
<td>Grade 5 SPI 0506.2.9</td>
<td>NCP</td>
<td>Compare whole numbers, decimals and fractions using the symbols &lt;, &gt;, and =.</td>
<td>20-23</td>
<td>Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor</td>
<td>NPO</td>
<td>8</td>
<td>1h) Order or compare rational numbers (fractions, decimals, percents, or integers) using various models and representations (e.g., number line).</td>
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<tr>
<td>Grade 5 SPI 0506.3.1</td>
<td>ALG</td>
<td>Evaluate algebraic expressions involving decimals and fractions using order of operations.</td>
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<td>12</td>
<td>e) Evaluate algebraic expressions, including polynomials and rational expressions.</td>
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<tr>
<td>Grade 5 SPI 0506.3.2</td>
<td>ALG</td>
<td>Evaluate multi-step numerical expressions involving fractions using order of operations.</td>
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<td>12</td>
<td>e) Evaluate algebraic expressions, including polynomials and rational expressions.</td>
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<td>Grade 5 SPI 0506.3.3</td>
<td>ALG</td>
<td>Find the unknown in single-step equations involving fractions and mixed numbers.</td>
<td>16-19</td>
<td>Solve one-step equations having integer or decimal answers</td>
<td>ALG</td>
<td>8</td>
<td>4a) Solve linear equations or inequalities (e.g., $ax + b = c$ or $ax + b = cx + d$ or $ax + b &gt; c$).</td>
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<td>Grade 5 SPI 0506.3.4</td>
<td>EEI</td>
<td>Given a set of values, identify those that make an inequality a true statement</td>
<td>24-27</td>
<td>Solve first-degree inequalities that do not require reversing the inequality sign</td>
<td>ALG</td>
<td>8</td>
<td>4b) Interpret &quot;=&quot; as an equivalence between two expressions and use this interpretation to solve problems.</td>
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<td>Grade 5 SPI 0506.4.1</td>
<td>MEAS</td>
<td>Solve contextual problems that require calculating the area of triangles and parallelograms.</td>
<td>16-19</td>
<td>Compute the area of rectangles when whole number dimensions are given</td>
<td>MEAS</td>
<td>8</td>
<td>1f) Solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures.</td>
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<td>Grade 5 SPI 0506.4.2</td>
<td>Decompose irregular shapes to find perimeter and area.</td>
<td>MEAS</td>
<td>24-27</td>
<td>Compute the perimeter of simple composite geometric figures with unknown side lengths</td>
<td>GEO</td>
<td>8</td>
<td>2d) Predict results of combining, subdividing, and changing shapes of plane figures and solids (e.g., paper folding, tiling, and cutting up and rearranging pieces).</td>
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<td>Compute the area of composite geometric figures when planning or visualization is required</td>
<td>MEAS</td>
<td>8</td>
<td>1f) Solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles, rectangles, circles, or composite figures.</td>
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<td>Grade 5 SPI 0506.4.3</td>
<td>Identify a three-dimensional object from two-dimensional representations of that object and vice versa.</td>
<td>GEO</td>
<td>33-36</td>
<td></td>
<td>8</td>
<td>8</td>
<td>e) Represent or describe a three-dimensional situation in a two-dimensional drawing from different views.</td>
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<td>12</td>
<td>d) Draw or sketch from a written description plane figures and planar images of three-dimensional figures.</td>
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<td></td>
<td>e) Use two-dimensional representations of three-dimensional objects to visualize and solve problems.</td>
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<tr>
<td>Grade 5 SPI 0506.4.4</td>
<td>Solve problems involving surface area and volume of rectangular prisms and polyhedral solids.</td>
<td>MEAS</td>
<td>20-23</td>
<td>Use geometric formulas when all necessary information is given</td>
<td>MEAS</td>
<td>8</td>
<td>1h) Solve problems involving volume or surface area of rectangular solids, cylinders, prisms, or composite shapes.</td>
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<td></td>
<td>Use relationships involving area, perimeter, and volume of geometric figures to compute another measure</td>
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<tr>
<td>Grade 5 SPI 0506.4.5</td>
<td>Find the length of vertical or horizontal line segments in the first quadrant of the coordinate system, including problems that require the use of fractions and decimals.</td>
<td>GR</td>
<td>20-23</td>
<td>Comprehend the concept of length on the number line*</td>
<td>MEAS</td>
<td>4</td>
<td>1c) Estimate the size of an object with respect to a given measurement attribute (e.g., length, perimeter, or area using a grid).</td>
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<tr>
<td>Grade 5 SPI 0506.4.6</td>
<td>Record measurements in context to reasonable degree of accuracy using decimals and/or fractions</td>
<td>MEAS</td>
<td></td>
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<td>8</td>
<td>2e) Determine appropriate accuracy of measurement in problem situations (e.g., the accuracy of each of several lengths needed to obtain a specified accuracy of a total length) and find the measure to that degree of accuracy.</td>
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<td>Grade 5 SPI 0506.5.1</td>
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<td>Depict data using various representations, including decimal and/or fractional data.</td>
<td>DASP</td>
<td>8</td>
<td>1b) For a given set of data, complete a graph and then solve a problem using the data in the graph (histograms, line graphs, scatterplots, circle graphs, and bar graphs).</td>
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<tr>
<td>Grade 5 SPI 0506.5.2</td>
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<td>Make predictions based on various data representations, including double bar and line graphs.</td>
<td>DASP</td>
<td>8</td>
<td>2e) Visually choose the line that best fits given a scatterplot and informally explain the meaning of the line. Use the line to make predictions.</td>
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<tr>
<td>Grade 5 SPI 0506.5.3</td>
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<td>Calculate measures of central tendency to analyze data</td>
<td>DASP</td>
<td>8</td>
<td>2a) Calculate, use, or interpret mean, median, mode, or range. 2b) Describe how mean, median, mode, range, or interquartile ranges relate to the shape of the distribution.</td>
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<tr>
<td>Grade 4 SPI 0406.1.1</td>
<td>NCP</td>
<td></td>
<td>28-32</td>
<td>Apply number properties involving positive/negative number</td>
<td>NPO</td>
<td>4</td>
<td>5e) Apply basic properties of operations.</td>
</tr>
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<td>33-36</td>
<td>Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers</td>
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<tr>
<td>Grade 4 SPI 0406.1.2</td>
<td>NCP</td>
<td></td>
<td>20-23</td>
<td>Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor</td>
<td>NPO</td>
<td>4</td>
<td>1e) Connect model, number word, or number using various models and representations for whole numbers, fractions, and decimals.</td>
</tr>
</tbody>
</table>
| Grade 4 SPI 0406.1.3    | BOA |                  | 16-19 | Solve some routine two-step arithmetic problems | NPO               | 4     | 3a) Add and subtract:  
  - Whole numbers, or  
  - Fractions with like denominators, or  
  - Decimals through hundredths. |
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<td>Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average</td>
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<td></td>
<td>1c) Estimate the size of an object with respect to a given measurement attribute (e.g., length, perimeter, or area using a grid).</td>
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<td>Grade 4</td>
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<td>SPI 0406.1.4</td>
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<td>Compare objects with respect to a given geometric or physical attribute and select appropriate measurement instrument</td>
<td>20-23</td>
<td></td>
<td>MEAS</td>
<td>4</td>
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<td>Grade 4</td>
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<tr>
<td>SPI 0406.2.1</td>
<td></td>
<td>Read and write numbers from hundredths to hundred-thousands in numerals and in words.</td>
<td>16-19</td>
<td>Identify a digit's place value</td>
<td>NPO</td>
<td>4</td>
<td>1c) Compose or decompose whole quantities by place value (e.g., write whole numbers in expanded notation using place value: 342 = 300 + 40 + 2).</td>
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<td>Grade 4</td>
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<td>Locate and place mixed numbers on the number line.</td>
<td>13-15</td>
<td>Identify the location of a point with a positive coordinate on the number line</td>
<td>NPO</td>
<td>4</td>
<td>b) Represent numbers using models such as base 10 representations, number lines, and two-dimensional models.</td>
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<td>Locate points on the number line and in the first quadrant</td>
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<tr>
<td>Grade 4</td>
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<td>Identify the place value of a specified digit in a number and the quantity it represents.</td>
<td>16-19</td>
<td>Identify a digit's place value</td>
<td>NPO</td>
<td>4</td>
<td>1a) Identify the place value and actual value of digits in whole numbers.</td>
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<tr>
<td>Grade 4</td>
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<td>Find factors, common factors, multiples, and common multiples of two numbers.</td>
<td>13-15</td>
<td>Recognize one-digit factors of a number</td>
<td>NPO</td>
<td>4</td>
<td>5b) Identify factors of whole numbers.</td>
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<td>Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor</td>
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<td>Work with numerical factors</td>
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</table>
| Grade 4                  |     |                  |       | Generate equivalent forms of common fractions and decimals and use them to compare size. | NCP               | 13-15 | Recognize equivalent fractions and fractions in lowest terms | NPO | 4 | 1e) Connect model, number word, or number using various models and representations for whole numbers, fractions, and decimals.  
1i) Order or compare whole numbers, decimals, or fractions.  
e) Recognize, translate between, or apply multiple representations of rational numbers (fractions, decimals, and percents) in meaningful contexts. |
| SPI 0406.2.5             |     |                  |       | Use the symbols <, > and = to compare common fractions and decimals in both increasing and decreasing order. | NCP               | 13-15 | Recognize equivalent fractions and fractions in lowest terms | NPO | 4 | 1i) Order or compare whole numbers, decimals, or fractions. |
|                          |     |                  |       | Convert improper fractions into mixed numbers and/or decimals. | BOA               | 16-19 | Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent  
Solve some routine two-step arithmetic problems | NPO | 4 | 2a) Use benchmarks (well-known numbers used as meaningful points for comparison) for whole numbers, decimals, or fractions in contexts (e.g., 1/2 and .5 may be used as benchmarks for fractions and decimals between 0 and 1.00). |
|                          |     |                  |       | Add and subtract proper fractions with like and unlike denominators and simplify the answer. | BOA               | 16-19 | Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent | NPO | 4 | 3a) Add and subtract:  
• Whole numbers, or  
• Fractions with like denominators, or  
• Decimals through hundredths. |
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</table>
| Grade 4 SPI 0406.2.9     | BOA | Add and subtract decimals through hundredths. | 13-15 | Perform one-operation computation with whole numbers and decimals | NPO | 4 | 3a) Add and subtract:  
• Whole numbers, or  
• Fractions with like denominators, or  
• Decimals through hundredths. |
|                          |     |                  |       | Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent |                  |       |                                   |
|                          | BOA |                  | 16-19 | Solve problems in one or two steps using whole numbers | NPO | 4 | 3f) Solve application problems involving numbers and operations. |
|                          |     |                  |       | Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent |                  |       |                                   |
|                          |     |                  | 20-23 | Solve some routine two-step arithmetic problems |                  |       |                                   |
|                          |     |                  |       | Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average |                  |       |                                   |
| Grade 4 SPI 0406.2.10    | BOA | Solve contextual problems using whole numbers, fractions, and decimals. | 13-15 | Perform one-operation computation with whole numbers and decimals | NPO | 4 | 3b) Multiply whole numbers:  
• No larger than two-digit by two-digit with paper and pencil computation, or  
• Larger numbers with use of calculator. |
|                          |     |                  |       | Solve problems in one or two steps using whole numbers |                  |       |                                   |
| Grade 4 SPI 0406.2.11    | BOA | Solve problems using whole number multi-digit multiplication. | 13-15 | Perform one-operation computation with whole numbers and decimals | NPO | 4 | 3c) Divide whole numbers:  
• Up to three-digits by one-digit with paper and pencil computation, or  
• Up to five-digits by two-digits with use of calculator. |
<p>|                          |     |                  |       | Solve problems in one or two steps using whole numbers |                  |       |                                   |
| Grade 4 SPI 0406.2.12    | BOA | Solve problems using whole number division with one- or two-digit divisors | 13-15 | Perform one-operation computation with whole numbers and decimals | NPO | 4 |                                   |
|                          |     |                  |       | Solve problems in one or two steps using whole numbers |                  |       |                                   |</p>
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<td>Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent</td>
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</table>
| Grade 4 SPI 0406.3.1    | EEI | 13-15           |       | Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$) | ALG 4              | 3a) Use letters and symbols to represent an unknown quantity in a simple mathematical expression.  
3b) Express simple mathematical relationships using number sentences. |
| Grade 4 SPI 0406.3.2    | NCP | 20-23           |       | Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor | ALG 4              | 1a) Recognize, describe, or extend numerical patterns.  
1d) Create a different representation of a pattern or sequence given a verbal description. |
| Grade 4 SPI 0406.3.3    |     |                 |       |                                      | GEO 4              | 3a) Analyze or describe patterns of geometric figures by increasing number of sides, changing size or orientation (e.g., polygons with more and more sides).  
4a) Describe relative positions of points and lines using the geometric ideas of parallelism or perpendicularity. |
| Grade 4 SPI 0406.4.1    |     |                 |       | Identify the location of a point with a positive coordinate on the number line  
Locate points on the number line and in the first quadrant | ALG 4              | 2c) Graph or interpret points with whole number or letter coordinates on grids or in the first quadrant of the coordinate plane. |
| Grade 4 SPI 0406.4.2    | GR  | 13-15           |       | Identify the location of a point with a positive coordinate on the number line  
Locate points on the number line and in the first quadrant | ALG 4              | 1e) Identify or draw angles and other geometric figures in the plane. |
<p>| Grade 4 SPI 0406.4.3    |     |                 |       |                                      | GEO 4              | 1c) Identify, define, or describe geometric shapes in the plane and in three-dimensional |
| Grade 4 SPI 0406.4.4    | PPF | 20-23           |       | Exhibit knowledge of basic angle properties and special sums of angle | GEO 8              | 1c) Identify, define, or describe geometric shapes in the plane and in three-dimensional |</p>
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<td>dimensional shapes.</td>
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<td>measures (e.g., 90°, 180°, and 360°)</td>
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<td>space given a visual representation.</td>
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<tr>
<td>Grade 4 SPI 0406.4.5</td>
<td>Identify attributes of simple and compound figures composed of 2- and 3-dimensional shapes.</td>
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<td>GEO 4</td>
<td>3 f) Describe and compare properties of simple and compound figures composed of triangles, squares, and rectangles.</td>
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<tr>
<td>Grade 4 SPI 0406.4.6</td>
<td>Determine situations in which a highly accurate measurement is important.</td>
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<td>MEAS 4</td>
<td>2c) Determine situations in which a highly accurate measurement is important.</td>
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<td>Grade 4 SPI 0406.4.7</td>
<td>Determine appropriate size of unit of measurement in problem situations involving length, capacity or weight.</td>
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<td>MEAS 4</td>
<td>2d) Determine appropriate size of unit of measurement in problem situation involving such attributes as length, time, capacity, or weight.</td>
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<tr>
<td>Grade 4 SPI 0406.4.8</td>
<td>Convert measurements within a single system that are common in daily life (e.g., hours and minutes, inches and feet, centimeters and meters, quarts and gallons, liters and milliliters).</td>
<td>BOA 13-15</td>
<td>Perform common conversions (e.g., inches to feet or hours to minutes)</td>
<td>MEAS 4</td>
<td>2b) Solve problems involving conversions within the same measurement system such as conversions involving inches and feet or hours and minute.</td>
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<tr>
<td>Grade 4 SPI 0406.4.9</td>
<td>Solve problems involving area and/or perimeter of rectangular figures.</td>
<td>MEAS 16-19</td>
<td>Compute the perimeter of polygons when all side lengths are given</td>
<td>MEAS 4</td>
<td>1c) Estimate the size of an object with respect to a given measurement attribute (e.g., length, perimeter, or area using a grid).</td>
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<tr>
<td>Grade 4 SPI 0406.4.10</td>
<td>Identify images resulting from reflections, translations, or rotations</td>
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<td>GEO 4</td>
<td>2c) Identify the images resulting from flips (reflections), slides (translations), or turns (rotations).</td>
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<td>Grade 4</td>
<td>Depict data using</td>
<td>PSDA 20-23</td>
<td>Translate from one representation of</td>
<td>DASP 4</td>
<td>1a) Read or interpret a single set of data.</td>
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<td>SPI 0406.5.1</td>
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<td>various representations (e.g., tables, pictographs, line graphs, bar graphs)</td>
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<td>data to another (e.g., a bar graph to a circle graph)</td>
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<tr>
<td>Grade 4 SPI 0406.5.2</td>
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<td>Solve problems using estimation and comparison within a single set of data.</td>
<td>PSDA 33-36</td>
<td>DASP 4</td>
<td>1c) Solve problems by estimating and computing within a single set of data.</td>
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<td>Analyze and draw conclusions based on information from figures, tables, and graphs</td>
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<tr>
<td>Grade 4 SPI 0406.5.3</td>
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<td>Given a set of data or a graph, describe the distribution of the data using median, range, or mode.</td>
<td>PSDA 33-36</td>
<td>DASP 4</td>
<td>2b) Given a set of data or a graph, describe the distribution of the data using median, range, or mode.</td>
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<td>Distinguish between mean, median, and mode for a list of numbers</td>
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<td>Analyze and draw conclusions based on information from figures, tables, and graphs</td>
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<td>Grade 4 SPI 0406.5.4</td>
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<td>List all possible outcomes of a given situation or event</td>
<td>DASP 4</td>
<td></td>
<td>4e) List all possible outcomes of a given situation or event.</td>
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</tbody>
</table>

### Grade 3

| Grade 3 SPI 0306.1.1     |     |                 |       | Solve problems using a calendar. | MEAS 4 |       | 2a) Select or use appropriate type of unit for the attribute being measured such as length, time, or temperature. |
| Grade 3 SPI 0306.1.2     |     |                 |       | Solve problems involving elapsed time. | MEAS 4 |       | 2a) Select or use appropriate type of unit for the attribute being measured such as length, time, or temperature. |
| Grade 3 SPI 0306.1.3     |     |                 | 16-19 | Determine the correct change from a transaction less than a dollar. | BOA    | NPO 4 | 3a) Add and subtract:  
  - Whole numbers, or  
  - Fractions with like denominators, or  
  - Decimals through hundredths. |
<p>| Grade 3 SPI 0306.1.4     |     |                 |       | Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten. | NPO    |       | 1e) Connect model, number word, or number using various models and representations for whole numbers, fractions, and decimals. |
| Grade 3 SPI 0306.1.5     |     |                 | 24-27 | Represent problems mathematically using diagrams, numbers, | PSDA   | ALG 4 | 1d) Create a different representation of a pattern or sequence given a verbal description. |
|                         |     |                 |       | Use Venn diagrams in counting |                   |       |                                     |</p>
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<td>and symbolic expressions.</td>
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<td></td>
<td>2a) Translate between the different forms of representations (symbolic, numerical, verbal, or pictorial) of whole number relationships (such as from a written description to an equation or from a function table to a written description).</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.1.6</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.</td>
<td></td>
<td></td>
<td></td>
<td>GEO</td>
<td>4</td>
<td></td>
<td>1b) Identify or describe (informally) real-world objects using simple plane figures (e.g., triangles, rectangles, squares, and circles) and simple solid figures (e.g., cubes, spheres, and cylinders).</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.1.7</td>
<td></td>
<td></td>
<td></td>
<td>DASP</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select appropriate units and tools to solve problems involving measures.</td>
<td></td>
<td></td>
<td></td>
<td>MEAS</td>
<td>4</td>
<td></td>
<td>1e) Select or use appropriate measurement instruments such as ruler, meter stick, clock, thermometer, or other scaled instruments.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.1.8</td>
<td></td>
<td></td>
<td></td>
<td>DASP</td>
<td>4</td>
<td></td>
<td>2e) Determine situations in which a highly accurate measurement is important.</td>
</tr>
<tr>
<td>Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate</td>
<td></td>
<td></td>
<td></td>
<td>MEAS</td>
<td>4</td>
<td></td>
<td>2a) Select or use appropriate type of unit for the attribute being measured such as length, time, or temperature.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.1</td>
<td></td>
<td></td>
<td></td>
<td>NCP</td>
<td>16-19</td>
<td></td>
<td>1b) For a given set of data, complete a graph (limits of time make it difficult to construct graphs completely).</td>
</tr>
<tr>
<td>Read and write numbers up to 10,000 in numerals and up to 1,000 in words.</td>
<td>16-19</td>
<td>Identify a digit's place value</td>
<td></td>
<td>NCP</td>
<td>16-19</td>
<td></td>
<td>2a) Select or use appropriate type of unit for the attribute being measured such as length, time, or temperature.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.2</td>
<td></td>
<td></td>
<td></td>
<td>NCP</td>
<td>16-19</td>
<td></td>
<td>1a) Identify the place value and actual value of digits in whole numbers.</td>
</tr>
<tr>
<td>Identify the place value of numbers in the ten-thousands, thousands, hundreds, tens, and ones</td>
<td>16-19</td>
<td>Identify a digit's place value</td>
<td></td>
<td>NCP</td>
<td>16-19</td>
<td></td>
<td>1b) Represent numbers using models such as base 10 representations, number lines, and two-dimensional models.</td>
</tr>
<tr>
<td>TN DOE unique identifier</td>
<td>SPI</td>
<td>ACT content area</td>
<td>Range</td>
<td>ACT College Readiness Standard</td>
<td>NAEP content area</td>
<td>Grade</td>
<td>NAEP 2009 Math Content Area Standard</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NPO</td>
<td>4</td>
<td>1e) Compose or decompose whole quantities by place value (e.g., write whole numbers in expanded notation using place value: $342 = 300 + 40 + 2$).</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NPO</td>
<td>4</td>
<td>1) Order or compare whole numbers, decimals, or fractions.</td>
</tr>
</tbody>
</table>
| Grade 3 SPI 0306.2.4    |     |                  |       |                               | NPO              | 4     | 3b) Multiply whole numbers:  
|                         |     |                  |       |                               |                  |       | • No larger than two-digit by two-digit  
|                         |     |                  |       |                               |                  |       |   with paper and pencil computation, or  
|                         |     |                  |       |                               |                  |       | • Larger numbers with use of calculator. |
| Grade 3 SPI 0306.2.5    |     |                  |       |                               | NPO              | 4     | 3b) Multiply whole numbers:  
|                         |     |                  |       |                               |                  |       | • No larger than two-digit by two-digit  
|                         |     |                  |       |                               |                  |       |   with paper and pencil computation, or  
|                         |     |                  |       |                               |                  |       | • Larger numbers with use of calculator. |
| Grade 3 SPI 0306.2.6    |     |                  |       |                               | NPO              | 4     | 3e) Interpret whole number operations and the relationships between them. |
| Grade 3 SPI 0306.2.7    |     |                  |       |                               | NPO              | 4     | 3f) Solve application problems involving numbers and operations. |
| Grade 3 SPI 0306.2.8    |     |                  |       |                               | NPO              | 4     | 1e) Connect model, number word, or number using various models and representations for whole numbers, fractions, and decimals.  
<p>|                         |     |                  |       |                               |                  |       | 2) Use benchmarks (well-known numbers |</p>
<table>
<thead>
<tr>
<th>TN DOE unique identifier</th>
<th>SPI</th>
<th>ACT content area</th>
<th>Range</th>
<th>ACT College Readiness Standard</th>
<th>NAEP content area</th>
<th>Grade</th>
<th>NAEP 2009 Math Content Area Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>of two- and three digit whole numbers.</td>
<td></td>
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<td></td>
<td></td>
<td>used as meaningful points for comparison) for whole numbers, decimals, or fractions in contexts (e.g., 1/2 and .5 may be used as benchmarks for fractions and decimals between 0 and 1.00).</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.10 Identify equivalent fractions given by various representations.</td>
<td>NCP</td>
<td>13-15</td>
<td>Recognize equivalent fractions and fractions in lowest terms</td>
<td>NPO</td>
<td>4</td>
<td>1e) Connect model, number word, or number using various models and representations for whole numbers, fractions, and decimals.</td>
<td></td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.11 Recognize and use different interpretations of fractions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NPO</td>
<td>8</td>
<td>1b) Model or describe rational numbers or numerical relationships using number lines and diagrams.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.12 Name fractions in various contexts that are less than, equal to, or greater than one.</td>
<td>NCP</td>
<td>24-27</td>
<td>Order fractions</td>
<td>NPO</td>
<td>4</td>
<td>1i) Order or compare whole numbers, decimals, or fractions.</td>
<td></td>
</tr>
<tr>
<td>Grade 3 SPI 0306.2.13 Recognize, compare, and order fractions (benchmark fractions, common numerators, or common denominators).</td>
<td>NCP</td>
<td>13-15</td>
<td>Recognize equivalent fractions and fractions in lowest terms</td>
<td>NPO</td>
<td>4</td>
<td>1i) Order or compare whole numbers, decimals, or fractions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>24-27</td>
<td>Order fractions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Grade 3 SPI 0306.2.14 Add and subtract fractions with like denominators | BOA | 16-19 | Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent | NPO | 4 | 3a) Add and subtract:  
• Whole numbers, or  
• Fractions with like denominators, or  
• Decimals through hundredths. |
<p>| | NCP | 13-15 | Recognize equivalent fractions and fractions in lowest terms | | | | |
| | | 24-27 | Order fractions | | | | |
| Grade 3 SPI 0306.3.1 Verify a conclusion using algebraic properties. | NCP | 33-36 | Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers | ALG | 4 | 5a) Verify a conclusion using algebraic properties. |</p>
<table>
<thead>
<tr>
<th>TN DOE unique identifier</th>
<th>SPI</th>
<th>ACT content area</th>
<th>Range</th>
<th>ACT College Readiness Standard</th>
<th>NAEP content area</th>
<th>Grade</th>
<th>NAEP 2009 Math Content Area Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 3 SPI 0306.3.2</td>
<td>EEI</td>
<td>Express mathematical relationships using number sentences/equations.</td>
<td>13-15</td>
<td>Exhibit knowledge of basic expressions (e.g., identify an expression for a total as ( b + g ))</td>
<td>ALG</td>
<td>4</td>
<td>3b) Express simple mathematical relationships using number sentences.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.3.3</td>
<td>EEI</td>
<td>Find the missing values in simple multiplication and division equations.</td>
<td>13-15</td>
<td>Solve equations in the form ( x + a = b ), where ( a ) and ( b ) are whole numbers or decimals. Solve one-step equations having integer or decimal answers.</td>
<td>ALG</td>
<td>4</td>
<td>4a) Find the value of the unknown in a whole number sentence.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.3.4</td>
<td>ALG</td>
<td>Describe or extend (including finding missing terms) geometric and numeric patterns</td>
<td>16-19</td>
<td></td>
<td>ALG</td>
<td>4</td>
<td>1a) Recognize, describe, or extend numerical patterns.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.4.1</td>
<td>GEO</td>
<td>Recognize polygons and be able to identify examples based on geometric definitions.</td>
<td></td>
<td></td>
<td>GEO</td>
<td>4</td>
<td>1b) Identify or describe (informally) real-world objects using simple plane figures (e.g., triangles, rectangles, squares, and circles) and simple solid figures (e.g., cubes, spheres, and cylinders).</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.4.2</td>
<td>GEO</td>
<td>Determine if two figures are congruent based on size and shape.</td>
<td></td>
<td></td>
<td>GEO</td>
<td>4</td>
<td>2e) Match or draw congruent figures in a given collection.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.4.3</td>
<td>GEO</td>
<td>Identify the line of symmetry in a two-dimensional design or shape.</td>
<td></td>
<td></td>
<td>GEO</td>
<td>4</td>
<td>2a) Identify whether a figure is symmetrical, or draw lines of symmetry.</td>
</tr>
<tr>
<td>Grade 3 SPI 0306.4.4</td>
<td>MEAS</td>
<td>Calculate the perimeter of shapes made from polygons.</td>
<td>16-19</td>
<td>Compute the perimeter of polygons when all side lengths are given.</td>
<td>MEAS</td>
<td>4</td>
<td>1f) Solve problems involving perimeter of plane figures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20-23</td>
<td>Compute the perimeter of polygons when all side lengths are given.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>33-36</td>
<td>Compute the area of composite geometric figures when planning or visualization is required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3 SPI 0306.4.5</td>
<td>MEAS</td>
<td>Choose reasonable units of measure, estimate common</td>
<td></td>
<td></td>
<td>MEAS</td>
<td>4</td>
<td>1e) Select or use appropriate measurement instruments such as ruler, meter stick, clock, thermometer, or other scaled instruments.</td>
</tr>
<tr>
<td>TN DOE unique identifier</td>
<td>SPI</td>
<td>ACT content area</td>
<td>Range</td>
<td>ACT College Readiness Standard</td>
<td>NAEP content area</td>
<td>Grade</td>
<td>NAEP 2009 Math Content Area Standard</td>
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<td></td>
<td></td>
<td>measurements using benchmarks, and use appropriate tools to make measurements.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2a) Select or use appropriate type of unit for the attribute being measured such as length, time, or temperature</td>
</tr>
<tr>
<td>Grade 3</td>
<td>SPI 0306.4.6</td>
<td>Measure length to the nearest centimeter or half inch.</td>
<td></td>
<td></td>
<td>MEAS 4</td>
<td></td>
<td>1e) Select or use appropriate measurement instruments such as ruler, meter stick, clock, thermometer, or other scaled instruments. 2a) Select or use appropriate type of unit for the attribute being measured such as length, time, or temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solve problems requiring the addition and subtraction of lengths</td>
<td>16-19</td>
<td>Compute the perimeter of polygons when all side lengths are given</td>
<td>MEAS 4</td>
<td></td>
<td>1f) Solve problems involving perimeter of plane figures.</td>
</tr>
<tr>
<td>Grade 3</td>
<td>SPI 0306.4.7</td>
<td></td>
<td>20-23</td>
<td>Compute the area and perimeter of triangles and rectangles in simple problems</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Interpret a frequency table, bar graph, pictograph, or line plot.</td>
<td>16-19</td>
<td>Read tables and graphs</td>
<td>DASP 4</td>
<td></td>
<td>1 a) Read or interpret a single set of data.</td>
</tr>
<tr>
<td>Grade 3</td>
<td>SPI 0306.5.1</td>
<td></td>
<td>28-32</td>
<td>Interpret and use information from figures, tables, and graphs</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Solve problems in which data is represented in tables or graph.</td>
<td>13-15</td>
<td>Perform a single computation using information from a table or chart</td>
<td>DASP 8</td>
<td></td>
<td>1 b) For a given set of data, complete a graph and then solve a problem using the data in the graph (histograms, line graphs, scatterplots, circle graphs, and bar graphs).</td>
</tr>
<tr>
<td>Grade 3</td>
<td>SPI 0306.5.2</td>
<td></td>
<td>24-27</td>
<td>Manipulate data from tables and graphs</td>
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<tr>
<td></td>
<td></td>
<td>Make predictions based on various representations of data</td>
<td></td>
<td></td>
<td>DASP 4</td>
<td></td>
<td>1c) Solve problems by estimating and computing within a single set of data.</td>
</tr>
</tbody>
</table>
APPENDIX E
COMPARISON OF FORMER AND NEW STANDARDS

Explanation of COMPARISON tables

The COMPARISON documents are provided to assist teachers in planning effectively to implement the new standards in the two critical school years (2008-2009 and 2009-2010) in order to avoid gaps in mathematical understanding and concept development.

Strand 1: Mathematical Processes are the same for grades K-8 and for 9-12. These are outlined at the beginning of each grade/course. If the SPI’s are related to a specific content area, then they are appropriately listed in that strand.

The Learner Expectations from the former standards are listed next to the Grade/Course Level Expectations for the new standards at the beginning of each grade’s content area (Strand 2: Number and Operation, Strand 3: Algebra, Strand 4: Geometry and Measurement, Strand 5: Data, Probability, and Statistics).

The horizontal rows follow a concept from the old to the new standards as well as from the previous grade to the current grade. The four columns are described in detail below.

FORMER Standards – Prior Grade
This column lists Standards (K-2) or Student Performance Indicators (grades 3 and above) for the former Math Standards from the previous grade/course. These skills/concepts are those on which your students were assessed (TCAP, Gateway) during the previous school year. Teachers may consider these concepts review material.

NEW Standards – Prior Grade
This column lists Standards/Student Performance Indicators (SPI) and Checks for Understanding from the NEW Math Standards from the grade level prior to this year. These are skills/concepts that your students must master this year to be prepared to transition to the new curriculum. Because of the “no redundancy” format, concepts are only placed in more than one grade if instruction at the latter grades is to provide greater depth of understanding or wider scope of application. The standards for each year will provide the foundation material for the following year. Teachers should consider incorporating these standards to avoid gaps in learning during the transition period (fall of 2008-spring 2010.)

FORMER Standards – Current Grade
This column lists Blueprint objectives (A-assessed, D-developing, M-Mastery, I-Introduced) from the former Math Standards for the current grade. These are skills/concepts on which your students will be assessed Spring 2009. Teachers must address these standards to prepare students for the TCAP/Gateway of 2009.

NEW Standards – Current Grade
This column lists Checks for Understanding (grades K – 2 ) or State Performance Indicators (SPI) with associated Checks for Understanding (grades 3 and above) from the new Math Standards from the current grade level. These are skills/concepts that prepare students to continue in the new curriculum for the next grade. Because of the “no redundancy” format, concepts are only placed in more than one grade if instruction at the latter grades is to provide greater depth of understanding or wider scope of application. The standards for each year will provide the foundation material for the following year. Teachers should consider incorporating these standards to avoid gaps in learning during the transition period fall of 2008-spring 2010.
Kindergarten Transition to New TN Mathematics Standards
Kindergarten – Mathematical Processes

New Grade Level Expectations

GLE 0006.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0006.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0006.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0006.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0006.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0006.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0006.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0006.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)

✓ 0006.1.1 Model addition and subtraction (e.g., using a number chart, number line and/or concrete objects).
✓ 0006.1.2 Begin to develop the concept of estimation using concrete objects.
✓ 0006.1.3 Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, tomorrow).
✓ 0006.1.4 Tell time to the hour.
✓ 0006.1.5 Recognize a calendar as a way of measuring time.
✓ 0006.1.6 Name and identify coins and their values.
✓ 0006.1.7 Use words to describe temperature (e.g., hot, warm, cool, cold).
✓ 0006.1.8 Recognize a thermometer as a way of measuring temperature.
✓ 0006.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
### Kindergarten – Number and Operations

#### Former Learning Expectations
1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand meanings of operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

#### New Grade Level Expectations
GLE 0006.2.1 Count objects in a set and use numbers, including written numerals to 25.
GLE 0006.2.2 Create, represent and recognize a set with a given number of objects.
GLE 0006.2.3 Recognize, compare and order sets of numerals by using both cardinal and ordinal meanings.
GLE 0006.2.4 Understand addition as “putting together” and subtraction as “breaking apart.”
GLE 0006.2.5 Model the numbers 1 through 10 as sums or differences of different sets of whole numbers (composing and decomposing numbers).

<table>
<thead>
<tr>
<th>No prior grade for Kindergarten</th>
<th>No prior grade for Kindergarten</th>
<th>Former Blueprint Standards Kindergarten</th>
<th>New Standards kindergarten</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>▪ Count how many objects are in a set (1-20). Count to 50 by 1’s and 10’s. ▪ Match quantities up to 20 with numerals.</td>
<td>✓0006.2.1 Count objects to 25 using one-to-one correspondence and identify the quantity in the counted group.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Identify and write numerals 0-20. ▪ Identify the position of a whole number less than 20 on a number line.</td>
<td>✓0006.2.2 Match quantities to 25 with numerals and written words.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Count backward from 10 to 1.</td>
<td>✓0006.2.3 Count backward from 10 to 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓0006.2.4 Count to 20 by twos.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>✓0006.2.5 Create a set with a given number of objects.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓0006.2.6 Quickly recognize the number of objects in a small set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Identify equivalent sets of objects by one-to-one correspondence.</td>
<td>✓0006.2.7 Recognize zero (0) as a set with “no objects”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Order numbers less than 20. ▪ Express the relationship between two numbers less than 20 using the words less</td>
<td>✓0006.2.8 Compare sets of ten or fewer objects and identify which are equal to, more than, or less than others.</td>
</tr>
</tbody>
</table>

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring 2008
### No prior grade for Kindergarten

<table>
<thead>
<tr>
<th>Former Blueprint Standards Kindergarten</th>
<th>New Standards kindergarten</th>
</tr>
</thead>
<tbody>
<tr>
<td>than, more than, or equal to.</td>
<td>0006.2.10 Recognize 6 through 10 as “five and some ones.”</td>
</tr>
<tr>
<td>Use the language of ordinal numbers up to tenth.</td>
<td>0006.2.11 Recognize and use ordinal numbers (e.g., first, fourth, last).</td>
</tr>
<tr>
<td>Represent quantities up to 20 on ten - frames. Use concrete objects to develop strategies for addition and subtraction of whole numbers.</td>
<td>0006.2.12 Model simple joining and separating situations with objects.</td>
</tr>
<tr>
<td>formerly in Algebra</td>
<td>0006.2.13 Add and subtract single-digit numbers whose total or difference is between 0 and 10.</td>
</tr>
<tr>
<td>Use concrete objects or pictures to demonstrate addition and subtraction number sentences involving numbers 0 to 5.</td>
<td>0006.2.14 Understand add as “put together” or “count on” and solve addition problems with sums less than 20.</td>
</tr>
<tr>
<td>Read and explain simple addition and subtraction number sentences.</td>
<td>0006.2.15 Understand subtraction as “break apart” or “take away” and solve subtraction problems using numbers 1 through 10.</td>
</tr>
<tr>
<td>Solve simple word problems involving whole numbers 0-10.</td>
<td>0006.2.16 Model, demonstrate, and solve story problems that illustrate addition and subtraction.</td>
</tr>
<tr>
<td>Use words, actions, pictures, or concrete objects to solve problems.</td>
<td></td>
</tr>
<tr>
<td>Explain if the solution to a word problem is reasonable.</td>
<td>0006.1.1 Model addition and</td>
</tr>
<tr>
<td>Use pictures or objects to</td>
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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring  2008
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<td>show one more or one less than any number to 20.</td>
<td>subtraction (e.g., using a number chart, number line and/or concrete objects).</td>
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<tr>
<td></td>
<td></td>
<td>▪ Identify and name coins (penny, nickel, dime, quarter, and half dollar) and their values.</td>
<td>✓ 0006.1.6 Name and identify coins and their values.</td>
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<td></td>
<td></td>
<td>▪ Determine if a figure has been divided into halves.</td>
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### Kindergarten – Algebra

#### Former Learning Expectations
- 2.1 Sort and classify objects by size, number, and other properties.
- 2.2 Represent and analyze patterns and functions.
- 2.3 Use concrete, pictorial, and verbal representations to develop an understanding of the language and symbols of mathematics.
- 2.4 Illustrate general properties of operations.
- 2.5 Analyze change in various contexts.

#### New Grade Level Expectations
- GLE 0006.3.1 Identify, duplicate, and extend simple number patterns and sequential and growing patterns.
- GLE 0006.3.2 Recognize attributes (such as color, shape, size) and patterns (such as repeated pairs, bilateral symmetry).
- GLE 0006.3.3 Describe qualitative change.

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</table>
|                                  |                                 | Create and describe a simple repeating pattern of numbers or figures. | ✓0006.3.1 Use a variety of manipulatives (such as connecting cubes, number cards, shapes) to create patterns.  
✓0006.3.3 Translate simple patterns into rules. |
|                                  |                                 | Identify patterns in the environment, in arrangements of objects, or in pictures.  
✓0006.3.2 Name, copy, and extend patterns. | ✓0006.3.4 Sort, order and classify objects by attribute and identify objects that do not belong in a particular group.  
✓0006.3.5 Describe change in attributes according to qualitative criteria such as longer/shorter, colder/warmer, heavier/lighter. |
|                                  |                                 | Sort objects by color, size, shape, and kind. | ✓ |
|                                  |                                 | Use mathematical terms appropriately. |  |

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
## Kindergarten - Geometry and Measurement

### Former Learning Expectations

1. Analyze characteristics and properties of geometric shapes.
2. Specify locations and describe spatial relationships.
3. Recognize and apply flips, slides, and turns.
4. Demonstrate understanding of units of measure and measurable attributes of objects.
5. Apply appropriate techniques and tools to determine measurements.

### New Grade Level Expectations

1. Interpret and describe the physical world with geometric ideas and vocabulary.
2. Use positional terms to specify locations with simple relationships.
3. Compare and order measurable attributes of objects directly (by comparing them with each other) and indirectly (by comparing both with a third object).

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<td>- Match terms with given shapes (circles, squares, triangles, and rectangles) when shown in various positions.</td>
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<td>- Recognize circles, squares, triangles, and rectangles in the environment and as faces of three-dimensional objects.</td>
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<td>- Recognize basic properties of and similarities and differences between simple geometric figures (e.g., number of sides, corners).</td>
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<td>- Reproduce and create circles, squares, rectangles, and triangles.</td>
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<td>- Reproduce and create structures using three-dimensional shapes.</td>
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<td>- Combine two-dimensional shapes to make pictures.</td>
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<td>- Recognize and show terms of relative position and direction in a variety of situations (e.g., over, under, forward,</td>
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<td>- Identify positions (such as beside, inside, outside, above, below, between, on, over, under, near, far, forward,</td>
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<td>backward, between, right, and left.</td>
<td>backward, top, middle, bottom, left, right) using models, illustrations, and stories.</td>
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<td>▪ Demonstrate understanding of the concept of length.</td>
<td>▪ 0006.4.7 Make direct and indirect comparisons between objects (such as recognize which is shorter, longer, taller, lighter, heavier, or holds more).</td>
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<td>▪ Recognize and show which is larger/smaller, longer/shorter, taller/shorter, heavier/lighter or which holds more/holds less, when given two similar objects.</td>
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<td>▪ Distinguish between light and heavy objects.</td>
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<td>▪ Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, and tomorrow).</td>
<td>▪ 0006.1.3 Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, tomorrow).</td>
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<tr>
<td></td>
<td></td>
<td>▪ Recognize clocks and watches as instruments for measuring time and tell time to the hour.</td>
<td>▪ 0006.1.4 Tell time to the hour.</td>
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<td>▪ Recognize a calendar as a way of measuring time.</td>
<td>▪ 0006.1.5 Recognize a calendar as a way of measuring time.</td>
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<tr>
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<td></td>
<td>▪ Use words to describe temperature (e.g., hot, warm, cool, and cold).</td>
<td>▪ 0006.1.7 Use words to describe temperature (e.g., hot, warm, cool, cold).</td>
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<tr>
<td></td>
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<td>▪ Recognize a thermometer as a device to measure temperature.</td>
<td>▪ 0006.1.8 Recognize a thermometer as a way of measuring temperature.</td>
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<tr>
<td></td>
<td></td>
<td>▪ Measure and estimate length of an object using a variety of nonstandard units.</td>
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</table>
**Kindergarten — Data Analysis, Probability, and Statistics**

**Former Learning Expectations**
5.1 Develop, select, and use appropriate methods to collect, organize, display, and analyze data.
5.2 Apply basic concepts of probability

**New Grade Level Expectations**
GLE 0006.5.1 Sort objects and use one or more attributes to solve problems.
GLE 0006.5.2 Re-sort objects using new attributes.

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<tr>
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<td></td>
<td>0006.5.1 Sort objects into sets and describe how the objects were sorted.</td>
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<td>0006.5.2 Sort objects in different ways.</td>
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<td>0006.5.3 Collect and count data.</td>
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<td>▪ Represent and compare data using concrete objects, pictures, and simple graphs.</td>
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<td>▪ Describe events related to students’ experiences as likely or unlikely.</td>
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</tbody>
</table>
Grade 1 Transition to New TN Mathematics Standards

Grade 1 – Mathematical Processes

New Grade Level Expectations

GLE 0106.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0106.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0106.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0106.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0106.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0106.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0106.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0106.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)

✓ 0106.1.1 Describe the relationship between days and months.
✓ 0106.1.2 Read and write time to the hour, half-hour, and quarter-hour.
✓ 0106.1.3 Compare units of time.
✓ 0106.1.4 Count the value of a set of coins up to fifty cents.
✓ 0106.1.5 Use a thermometer to measure temperature.
✓ 0106.1.6 Recognize scales as a way of measuring weight.
✓ 0106.1.7 Apply spatial sense to recreate a figure from memory.
✓ 0106.1.8 Recognize the “word clues” and mathematical symbols for addition and subtraction.
✓ 0106.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.
# Grade 1 – Number and Operations

## Former Learning Expectations
1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand meanings of operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

## New Grade Level Expectations

### GLE 0106.2.1 Understand and use number notation and place value to 100.

### GLE 0106.2.2 Compare and order whole numbers to 100.

### GLE 0106.2.3 Develop strategies for learning basic addition facts and related subtraction facts.

### GLE 0106.2.4 Use multiple representations (including groups of ten) to model two-digit addition and subtraction.

## Former Blueprint Standards Kindergarten

### Review material

- Identify and write numerals 0-20.
- Identify the position of a whole number less than 20 on a number line.
- Count how many objects are in a set (1-20). Count to 50 by 1’s and 10’s.
- Match quantities up to 20 with numerals.
- Count backward from 10 to 1.

## New Standards Kindergarten

### No spi’s for Kindergarten

- These are Checks for Understanding

### 0006.2.2 Match quantities to 25 with numerals and written words.
### 0006.2.5 Create a set with a given number of objects.
### 0006.2.6 Quickly recognize the number of objects in a small set.
### 0006.2.7 Recognize zero (0) as a set with “no objects”.

## Former Blueprint Standards 1st Grade

### TCAP 2008-2009

### No spi’s for first grade

### These are Checks for Understanding

### 0006.2.2 Match quantities to 25 with numerals and written words.
### 0006.2.5 Create a set with a given number of objects.
### 0006.2.6 Quickly recognize the number of objects in a small set.
### 0006.2.7 Recognize zero (0) as a set with “no objects”.

## New Standards 1st Grade

### TCAP 2009-2010

### No spi’s for first grade

### These are Checks for Understanding

- Read and write numerals up to 100.
- Use concrete objects to model whole numbers to 99 (e.g., base-ten blocks, sticks, and straws).

- Identify and write numerals 0-20.
- Identify the position of a whole number less than 20 on a number line.
- Count how many objects are in a set (1-20). Count to 50 by 1’s and 10’s.
- Match quantities up to 20 with numerals.
- Count backward from 10 to 1.

- Count forward or backward by one beginning with any number less than 100.
- Count by 2’s, 5’s, and 10’s to 100.
- Count by 10’s from any number using a hundreds chart.
- Count how many objects are in a set by 1’s to 100.
- Count how many objects are in a set by 2’s, 5’s, and 10’s up to 30.
- Identify odd and even whole numbers to 50.
- Use a number line or hundreds grid to find one more or one less than any number to 50.

- Identify equivalent sets of objects by one-to-one correspondence.
- Compare sets of ten or fewer objects and identify which set is greater than, less than, or equal to.

- Sequence and order whole numbers less than 100.

- Count forward and backward by ones beginning with any number less than 100.
- Skip count by twos, fives, and tens.
- Use the number line to create visual representations of sequences (such as even numbers, tens, multiples of five).

- Order and compare (less than, greater than, or equal to) whole numbers up to 100.
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<tr>
<td><strong>correspondence.</strong></td>
<td><strong>which are equal to, more than, or less than others.</strong></td>
<td><strong>Compare whole numbers through 100 using the appropriate symbol (e.g., &lt;, &gt;, and =).</strong></td>
<td><strong>equal to) whole numbers to 100.</strong></td>
</tr>
<tr>
<td>ƒ Order numbers less than 20.</td>
<td>ƒ 0006.2.9 Order the numbers through 25 using numerals and words.</td>
<td>ƒ Identify the place value of a digit in numbers to 99.</td>
<td>ƒ 0106.2.6 Recognize the place value of numbers (tens, ones).</td>
</tr>
<tr>
<td>ƒ Express the relationship between two numbers less than 20 using the words less than, more than, or equal to.</td>
<td>ƒ 0006.2.11 Recognize and use ordinal numbers (e.g., first, fourth, last).</td>
<td>ƒ Represent numbers in flexible ways using a variety of materials (e.g., 23 as 23 ones, 1 ten and 13 ones, and/or 2 tens and 3 ones).</td>
<td>ƒ 0106.2.14 Use composition and decomposition of numbers to identify and discuss patterns.</td>
</tr>
<tr>
<td>ƒ Use the language of ordinal numbers up to tenth.</td>
<td>ƒ 006.2.10 Recognize 6 through 10 as “five and some ones.”</td>
<td>ƒ Represent whole numbers between 10 and 100 in groups of tens and ones.</td>
<td>ƒ 0106.2.15 Represent whole numbers between 10 and 100 in groups of tens and ones.</td>
</tr>
<tr>
<td>ƒ Use pictures or objects to show one more or one less than any number to 20.</td>
<td>ƒ 006.1.1 Model addition and subtraction (e.g., using a number chart, number line and/or concrete objects).</td>
<td>ƒ 0106.2.7 Develop fluency with addition and subtraction facts of sums through ten.</td>
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<tr>
<td>ƒ Represent quantities up to 20 on ten - frames.</td>
<td>ƒ 006.2.12 Model simple joining and separating situations with objects.</td>
<td>ƒ 0106.2.9 Add three single-digit numbers.</td>
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<tr>
<td>ƒ Use concrete objects to develop strategies for addition and subtraction of whole numbers.</td>
<td>ƒ 006.2.13 Add and subtract single-digit numbers whose total or difference is between 0 and 10.</td>
<td>ƒ 0106.2.8 Relate “counting on” and “counting back” to addition and subtraction and understand them as inverse operations.</td>
<td>ƒ 0106.2.8 Relate “counting on” and “counting back” to addition and subtraction and understand them as inverse operations.</td>
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<td><em>formerly in Algebra</em></td>
<td>ƒ 006.2.14 Understand add as “put together” or “count on” and solve addition problems with sums less than 20.</td>
<td>ƒ 0106.2.10 Use models (such as discrete objects, connecting cubes, and number lines) to represent “part-whole,” “adding to,” “taking away from,” and “comparing to” situations to develop understanding of the meaning of addition and subtraction.</td>
<td>ƒ 0106.2.10 Use models (such as discrete objects, connecting cubes, and number lines) to represent “part-whole,” “adding to,” “taking away from,” and “comparing to” situations to develop understanding of the meaning of addition and subtraction.</td>
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<td>ƒ Use concrete objects or pictures to demonstrate addition and subtraction number sentences involving numbers 0 to 5.</td>
<td>ƒ 006.2.15 Understand subtraction as “break apart” or “take away” and solve subtraction problems using</td>
<td>ƒ 0106.1.8 Recognize the “word&quot;</td>
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**Solve simple word problems involving whole numbers 0-10.**
- Use words, actions, pictures, or concrete objects to solve problems.
- Explain if the solution to a word problem is reasonable.

**0006.2.16 Model, demonstrate, and solve story problems that illustrate addition and subtraction.**
- 0006.1.2 Begin to develop the concept of estimation using concrete objects.

**Explain whether the solution to a word problem is reasonable.**
- 0106.2.12 Use various models to develop strategies for solving arithmetic problems.
- 0106.2.13 Solve problems that require addition/ subtraction of numbers through 100.

**Determine if a figure has been divided into halves.**

**0006.1.6 Name and identify coins and their values.**

**Identify and name coins (penny, nickel, dime, quarter, and half dollar) and their values.**

**0006.1.4 Count the value of a set of coins up to fifty cents.**

**0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.**

**0106.2.11 Recognize the “part-whole” relationship in representations of basic fractions such as ½ and ¼.**

**0106.2.12 Use various models to develop strategies for solving arithmetic problems.**

**0106.2.13 Solve problems that require addition/ subtraction of numbers through 100.**

**Identify and name coins (penny, nickel, dime, quarter, and half dollar) and their values.**

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**0106.2.12 Use various models to develop strategies for solving arithmetic problems.**

**0106.2.13 Solve problems that require addition/ subtraction of numbers through 100.**
### Grade 1 – Algebra

#### Former Learning Expectations
2.1 Sort and classify objects by size, number, and other properties.
2.2 Represent and analyze patterns and functions.
2.3 Use concrete, pictorial, and verbal representations to develop an understanding of the language and symbols of mathematics.
2.4 Illustrate general properties of operations.
2.5 Analyze change in various contexts.

#### New Grade Level Expectations
GLE 0106.3.1 Identify, describe, and extend simple number patterns to develop strategies for adding and subtracting whole numbers.
GLE 0106.3.2 Understand that addition and subtraction are inverse operations.
GLE 0106.3.3 Extend the strategies for basic facts to include other properties of number and operations.

#### Former Blueprint Standards Kindergarten
- Review material

#### New Standards Kindergarten
- Building blocks for new standards
- **No spi’s for Kindergarten**
- **These are Checks for Understanding**

#### Former Blueprint Standards 1st Grade
- TCAP 2008-2009

#### New Standards 1st Grade
- TCAP 2009-2010
- **No spi’s for first grade**
- **These are Checks for Understanding**

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<td><strong>Create and describe a simple repeating pattern of numbers or figures.</strong></td>
<td>✓0006.3.1 Use a variety of manipulatives (such as connecting cubes, number cards, shapes) to create patterns. ✓0006.3.3 Translate simple patterns into rules.</td>
<td>▪ Identify and describe growing patterns found in literature, in the environment, in physical arrangements, and in pictures. ▪ Translate a repeating pattern from one format to another (e.g., red-blue-blue to snap-clap-clap). formerly in geometry ▪ Identify the position of a whole number on the number line.</td>
<td>✓0106.3.1 Find repeating patterns on the number line, addition table, and hundreds chart.</td>
</tr>
<tr>
<td><strong>Recognize and extend a concrete, visual, or auditory two- or three-part repeating pattern.</strong></td>
<td>✓0006.3.2 Name, copy, and extend patterns.</td>
<td>▪ Create, describe, and extend concrete, visual, auditory, or number patterns. ▪ Identify the unit of a two-part repeating pattern.</td>
<td>✓0106.3.2 Determine a reasonable next term in a given sequence and describe the rule.</td>
</tr>
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<td></td>
<td></td>
<td>▪ Apply the commutative property of addition.</td>
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<td></td>
<td>▪ Show or represent number sentences, involving addition and subtraction and numbers 0-20, with concrete objects. ▪ Interpret and solve simple</td>
<td>✓0106.3.4 Demonstrate understanding of the basic equation a + b = c by using objects to illustrate the number sentences (fact families)</td>
</tr>
</tbody>
</table>

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
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<td>open addition sentences, including finding the missing addend.</td>
<td>associated with any particular sum.</td>
<td>0106.3.5 Use various strategies to find unknowns in problems involving addition and subtraction.</td>
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<td>0106.3.5 Use various strategies to find unknowns in problems involving addition and subtraction.</td>
<td>0106.3.6 Use objects to demonstrate the inverse relationship between addition and subtraction.</td>
<td>0106.3.7 Use the inverse relation between addition and subtraction to check arithmetic problems.</td>
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<td>0106.3.7 Use the inverse relation between addition and subtraction to check arithmetic problems.</td>
<td>0106.3.8 Determine whether a number is odd or even by pairing objects.</td>
<td>0106.3.9 Recognize that zero is the identity element for addition.</td>
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<tr>
<td>- Sort objects by color, size, shape, and kind.</td>
<td>0006.3.4 Sort, order and classify objects by attribute and identify objects that do not belong in a particular group.</td>
<td>- Sort objects by two of the following attributes: color, size, shape, and kind.</td>
<td>- Sort objects by two of the following attributes: color, size, shape, and kind.</td>
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<td>0006.3.4 Sort, order and classify objects by attribute and identify objects that do not belong in a particular group.</td>
<td>- Describe how objects in a group are alike and how they are different.</td>
<td>- Describe how objects in a group are alike and how they are different.</td>
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<td>0006.3.4 Sort, order and classify objects by attribute and identify objects that do not belong in a particular group.</td>
<td>- Use mathematical terms and symbols appropriately.</td>
<td>- Use mathematical terms and symbols appropriately.</td>
</tr>
<tr>
<td>- Use mathematical terms appropriately.</td>
<td>0006.3.5 Describe change in attributes according to qualitative criteria such as longer/shorter, colder/warmer, heavier/lighter.</td>
<td>- Use mathematical terms and symbols appropriately.</td>
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<td>0006.3.5 Describe change in attributes according to qualitative criteria such as longer/shorter, colder/warmer, heavier/lighter.</td>
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### Grade 1 – Geometry and Measurement

#### Former Learning Expectations

3.1 Analyze characteristics and properties of geometric shapes.
3.2 Specify locations and describe spatial relationships.
3.3 Recognize and apply flips, slides, and turns.
4.1 Demonstrate understanding of units of measure and measurable attributes of objects.
4.2 Apply appropriate techniques and tools to determine measurements.

#### New Grade Level Expectations

- GLE 0106.4.1 Recognize, describe, and draw geometric figures.
- GLE 0106.4.2 Compose and decompose geometric shapes.
- GLE 0106.4.3 Use non-standard units in linear measurement.

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- Match terms with given shapes (circles, squares, triangles, and rectangles) when shown in various positions.
- Recognize circles, squares, triangles, and rectangles in the environment and as faces of three-dimensional objects.
- Recognize basic properties of and similarities and differences between simple geometric figures (e.g., number of sides, corners).

- 0006.4.1 Identify, name, and describe a variety of shapes (i.e. circles, squares, triangles, rectangles, hexagons, trapezoids) shown in various positions.
- 0006.4.2 Identify, name, and describe three-dimensional shapes (such as sphere, cube, cone, cylinder).
- 0006.4.3 Sort plane figures into groups, name and describe the attributes of the shapes (such as number of sides and corners (vertices).
- 0006.4.4 Sort solid figures into groups, name and describe the attributes of the shapes.

- Recognize names, basic properties of, and similarities and differences between simple geometric figures (e.g., number of sides, corners).

- Reproduce and create circles, squares, rectangles, and triangles.
- Reproduce and create structures using three-dimensional shapes.
- Combine two-dimensional shapes to make pictures.

- 0006.4.5 Use basic shapes and spatial reasoning to model objects and construct more complex shapes.

- Predict and describe the results of combining and taking apart two- and three-dimensional geometric figures.
- Create a figure made up of shapes from memory.

- 0106.4.3 Model part-whole relationships and properties of plane and solid figures by combining two or more shapes to make a larger shape or by breaking apart an object into its smaller shapes.
- 0106.1.7 Apply spatial sense to...
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<td><strong>Measure and estimate length of an object using a variety of nonstandard units.</strong></td>
<td>• Demonstrate understanding of the concept of length.</td>
<td>• Recognize the need for standard units of measurement.</td>
<td>• 0106.4.5 Estimate and measure length using non-standard units (counting by using groups of tens and ones) to represent addition.</td>
</tr>
<tr>
<td><strong>Demonstrate understanding of the concept of length.</strong> <strong>Recognize and show which is larger/smaller, longer/shorter, taller/shorter, heavier/lighter or which holds more/holds less, when given two similar objects.</strong> <strong>Distinguish between light and heavy objects.</strong></td>
<td>• 0006.4.7 Make direct and indirect comparisons between objects (such as recognize which is shorter, longer, taller, lighter, heavier, or holds more).</td>
<td>• Compare and order objects according to length, capacity, and weight.</td>
<td>• 0106.4.7 Understand and use comparative words such as long, longer, longest; short, shorter, shortest; tall, taller, tallest; high, higher, highest; etc.</td>
</tr>
<tr>
<td><strong>Recognize and show terms of relative position and direction in a variety of situations (e.g., over, under, forward, backward, between, right, and left).</strong></td>
<td>• 0006.4.6 Identify positions (such as beside, inside, outside, above, below, between, on, over, under, near, far, forward, backward, top, middle, bottom, left, right) using models, illustrations, and stories.</td>
<td>• Recognize and show terms of relative position and direction in a variety of situations (e.g., over, under, forward, backward, between, right, and left).</td>
<td>• 0106.1.6 Recognize scales as a way of measuring weight.</td>
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recreate a figure from memory.
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- **Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, and tomorrow).**
- **Recognize a calendar as a way of measuring time.**
- **Recognize clocks and watches as instruments for measuring time and tell time to the hour.**

**Former 1st Grade**
TCAP 2008-2009

- **0006.1.3** Use words to describe time (e.g., day, night, morning, afternoon, yesterday, today, tomorrow).
- **0006.1.5** Recognize a calendar as a way of measuring time.
- **0006.1.4** Tell time to the hour.

**New Standards Kindergarten**
These are Checks for Understanding

- **0006.1.7** Use words to describe temperature (e.g., hot, warm, cool, and cold).
- **0006.1.8** Recognize a thermometer as a way of measuring temperature.

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### Grade 1 – Data, Probability and Statistics

**Former Learning Expectations**
5.1 Develop, select, and use appropriate methods to collect, organize, display, and analyze data.
5.2 Apply basic concepts of probability.

**New Grade Level Expectations**
GLE 0106.5.1 Use various representations to display and compare data.

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<tr>
<td>• Represent and compare data using concrete objects, pictures, and simple graphs.</td>
<td>• Interpret and make pictographs and bar graphs using concrete objects and pictured objects.</td>
<td>• 0106.5.1 Represent measurements and discrete data using concrete objects, picture graphs, and bar graphs.</td>
<td>• 0106.5.4 Count and compare collected data.</td>
</tr>
<tr>
<td></td>
<td>0006.5.1 Sort objects into sets and describe how the objects were sorted.</td>
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<td>0006.5.2 Sort objects in different ways.</td>
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<td></td>
<td>0006.5.3 Collect and count data.</td>
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<td>• Describe events related to students’ experiences as likely or unlikely.</td>
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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
**Grade 2 Transition to New TN Mathematics Standards**

**Grade 2 – Mathematical Processes**

**New Grade Level Expectations**

- **GLE 0206.1.1** Use mathematical language, symbols, and definitions while developing mathematical reasoning.
- **GLE 0206.1.2** Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
- **GLE 0206.1.3** Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
- **GLE 0206.1.4** Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
- **GLE 0206.1.5** Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
- **GLE 0206.1.6** Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
- **GLE 0206.1.7** Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
- **GLE 0206.1.8** Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

**Checks for Understanding (Formative/Summative Assessment)**

- ✔️ 0206.1.1 Read and write time up to five-minute intervals.
- ✔️ 0206.1.2 Relate days, dates, weeks, months, and years to a calendar.
- ✔️ 0206.1.3 Use strategies to make estimates of time.
- ✔️ 0206.1.4 Solve problems involving elapsed time in hour and half-hour intervals.
- ✔️ 0206.1.5 Count the value of a set of coins up to one dollar and use the transitive property of equality to recognize equivalent forms of values up to $1.00.
- ✔️ 0206.1.6 Read thermometers with Fahrenheit and Celsius scales.
- ✔️ 0206.1.7 Measure weight to the nearest pound or kilogram.
- ✔️ 0206.1.8 Use concrete models or pictures to show whether a fraction is less than a half, more than a half, or equal to a half.
- ✔️ 0206.1.9 Match the spoken, written, concrete, and pictorial representations of halves, thirds, and fourths.
- ✔️ 0206.1.10 Develop a story problem that illustrates a given addition or subtraction number sentence.
- ✔️ 0206.1.11 Use manipulatives to demonstrate addition and subtraction sentences written symbolically.
- ✔️ 0206.1.12 Write numbers and translate word clues to number sentences and vice versa.
- ✔️ 0206.1.13 Use manipulatives such as pattern blocks, tangrams, etc. to explore geometric concepts of symmetry and transformations.
- ✔️ 0206.1.14 Create and observe numerical patterns on a calculator by repeatedly adding or subtracting the same number from some starting number.
- ✔️ 0206.1.15 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
### Grade 2 – Number and Operations

**Former Learning Expectations**

1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand meanings of operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

**New Grade Level Expectations**

GLE 0206.2.1 Understand and use place value concepts to 1000.
GLE 0206.2.2 Understand and use the base-ten numeration system.
GLE 0206.2.3 Use efficient and accurate strategies to develop fluency with multi-digit addition and subtraction.
GLE 0206.2.4 Develop an initial understanding of multiplication.

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- Count forward or backward by one beginning with any number less than 100.
- Count by 2’s, 5’s, and 10’s to 100.
- Count by 10’s from any number using a hundreds chart.
- Count how many objects are in a set by 1’s to 100.
- Count how many objects are in a set by 2’s, 5’s, and 10’s up to 30.
- Identify odd and even whole numbers to 50.
- Use a number line or hundreds grid to find one more or one less than any number to 50.
- Identify the place value of a digit in numbers to 99.

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<tr>
<td><strong>0106.2.3</strong> Count forward and backward by ones beginning with any number less than 100.</td>
</tr>
<tr>
<td><strong>0106.2.4</strong> Skip count by twos, fives, and tens</td>
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<td><strong>0106.2.17</strong> Use the number line to create visual representations of sequences (such as even numbers, tens, multiples of five).</td>
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- Count a set of objects to 100 by 2’s, 3’s, 5’s, or 10’s.
- Count forward and backward by one from any number less than 999.
- Identify odd and even numbers to 100.
- Identify the place value of a digit in numbers to 999.
- Identify the place value of a digit in numbers to 999.

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<td><strong>0206.2.1</strong> Starting at any number, count by ones, twos, fives, tens, and hundreds up to 1000.</td>
</tr>
<tr>
<td><strong>0206.2.12</strong> Demonstrate skip counting on the number line and relate to repeated addition and multiplication.</td>
</tr>
<tr>
<td><strong>0206.2.13</strong> Relate patterns in skip counting to multiplication.</td>
</tr>
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</table>

**Former Blueprint Standards 2nd Grade**

- Identify the position of a whole number on the number line.
- Represent whole numbers up to 100 on a number line.
- Read and write numerals to 999, formerly in geometry.
- Identify the position of a whole number on the number line.

**New Standards 2nd Grade**

- Read and write numerals up to 1000 using numerals and up to 100 using words.
- Locate and interpret numbers on a number line.
- Recognize that place-value notation represents the...
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<td>Represent numbers in flexible ways using a variety of materials (e.g., 23 as 23 ones, 1 ten and 13 ones, and/or 2 tens and 3 ones).</td>
<td>✓0106.2.14 Use composition and decomposition of numbers to identify and discuss patterns.</td>
<td>✓ Represent numbers to 999 in flexible ways using a variety of materials (e.g., 23 as 23 ones, 1 ten and 13 ones, and/or 2 tens and 3 ones).</td>
<td>✓0206.2.5 Compare and order multi-digit numbers up to 1000.</td>
</tr>
<tr>
<td>Sequence and order whole numbers less than 100.</td>
<td>✓0106.2.5 Order and compare (less than, greater than, or equal to) whole numbers to 100.</td>
<td>Order and sequence whole numbers less than 1000.</td>
<td></td>
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<td>Compare whole numbers through 100 using the appropriate symbol (e.g., &lt;, &gt;, and =).</td>
<td>✓0106.2.7 Develop fluency with addition and subtraction facts of sums through ten.</td>
<td>Compare two numbers using the appropriate symbol (i.e., &lt;, &gt;, and =).</td>
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<tr>
<td>Identify and use ordinal numbers up to twelfth.</td>
<td>✓0106.2.9 Add three single-digit numbers.</td>
<td>Use and match numerals to ordinal numbers through twentieth.</td>
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<tr>
<td>✓0106.2.10 Use models (such as discrete objects, connecting cubes, and number lines) to represent “part-whole,” “adding to,” “taking away from,” and “comparing to” situations to develop understanding of the meaning of addition and subtraction.</td>
<td>✓0106.2.2 Use addition and subtraction facts of sums through ten.</td>
<td>Use the number line to demonstrate addition and subtraction.</td>
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<tr>
<td>✓0106.2.11 Use manipulatives to demonstrate addition and subtraction sentences written symbolically.</td>
<td>✓0106.2.2 Use addition and subtraction facts of sums through ten.</td>
<td>Add and subtract efficiently and accurately with single-digit numbers up to sums of 18. Add and subtract two-digit whole numbers using a variety of strategies and representations.</td>
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<tr>
<td>✓0106.2.12 Write numbers and translate word clues to number sentences and vice versa.</td>
<td>✓0106.2.2 Use addition and subtraction facts of sums through ten.</td>
<td>Use efficient procedures, and understand why they work, to solve problems involving the addition and subtraction of two- and three-digit whole numbers</td>
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- **1st Grade Standards**
  - Explain whether the solution to a word problem is reasonable.
  - Match the spoken, written, concrete, and pictorial representations of 1/2 and 1/4.

- **2nd Grade Standards**
  - Use various models to develop strategies for solving arithmetic problems.
  - Solve problems that require addition/subtraction of numbers through 100.
  - Use estimation to justify whether the answer to a computation is reasonable.
  - Check for the reasonableness of solutions.
  - Use calculators in problem-solving situations.
  - Write and identify number sentences that describe situations involving addition and subtraction.
  - Write and explain related addition and subtraction sentences.
  - Solve story problems involving numbers to 100.
  - Develop a story problem that illustrates a given addition or subtraction number sentence.
  - Use concrete models or pictures to show whether a fraction is less than 1/2, more than 1/2, or equal to 1/2.
  - Use concrete models or pictures to show whether a fraction is less than a half, more than a half, or equal to a half.
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<td>Match halves and fourths to shaded regions of a single object or figure.</td>
<td>✓0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.</td>
<td>Match the spoken or written word names and concrete or pictorial representations (parts of regions or parts of sets of objects) of halves, thirds, and fourths.</td>
<td>half. ✓0206.1.9 Match the spoken, written, concrete, and pictorial representations of halves, thirds, and fourths.</td>
</tr>
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<td>Show 1/2 and 1/4 of a set of objects.</td>
<td>✓0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.</td>
<td>Compare the unit fractions 1/2, 1/3, and 1/4.</td>
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<td>Recognize one whole as two halves or four fourths.</td>
<td>✓0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.</td>
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<td>Count the value of a set of coins up to 50 cents.</td>
<td>✓0106.1.10 Match the spoken, written, concrete, and pictorial representations of whole numbers, one-half, and one-fourth.</td>
<td>Determine the value of a collection of coins up to $1.00.</td>
<td>✓0206.1.5 Count the value of a set of coins up to one dollar and use the transitive property of equality to recognize equivalent forms of values up to $1.00.</td>
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**Grade 2 – Algebra**

**Former Learning Expectations**

- 2.1 Sort and classify objects by size, number, and other properties.
- 2.2 Represent and analyze patterns and functions.
- 2.3 Use concrete, pictorial, and verbal representations to develop an understanding of the language and symbols of mathematics.
- 2.4 Illustrate general properties of operations.
- 2.5 Analyze change in various contexts.

**New Grade Level Expectations**

- GLE 0206.3.1 Develop pattern recognition.
- GLE 0206.3.2 Extend knowledge of the properties of numbers and operations to multiplication.
- GLE 0206.3.3 Solve simple arithmetic problems using various methods.
- GLE 0206.3.4 Describe quantitative change.

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</table>

- Sort objects by two of the following attributes: color, size, shape, and kind
- Describe how objects in a group are alike and how they are different.
- Identify and describe growing patterns found in literature, in the environment, in physical arrangements, and in pictures.
- Translate a repeating pattern from one format to another (e.g., red-blue-blue to snap-clap-clap).
- Create, describe, and extend concrete, visual, auditory, or number patterns.
- Identify the unit of a two-part repeating pattern.

- 0106.3.1 Find repeating patterns on the number line, addition table, and hundreds chart.
- 0106.3.2 Determine a reasonable next term in a given sequence and describe the rule.
- 0106.3.8 Determine whether a number is odd or even by pairing objects.

- Sort objects by two or more attributes.
- Identify the rules by which objects or numbers have been sorted.
- Extend a growing pattern, involving objects, shapes, or numbers.
- Identify the unit of a three-part repeating pattern.
- Translate a repeating pattern from one format to another (e.g., red-blue-blue to snap-clap-clap).

- 0106.3.3 Use objects to illustrate the commutative property with basic facts and show that subtraction is not commutative.
- 0106.3.9 Recognize that zero is the identity element for addition.

- Demonstrate knowledge of and use the commutative property of addition.
- Show that subtraction is not commutative.
- Apply the addition and subtraction properties of 0 (adding or subtracting 0)

- 0206.3.1 Given rules, complete tables to reveal both arithmetic and geometric patterns.
- 0206.3.2 Given a description, extend or find a missing term in a pattern or sequence.
- 0206.3.3 Record and study patterns in lists of numbers created by repeated addition or subtraction.
- 0206.3.4 Generalize the patterns resulting from the addition, subtraction and multiplication of combinations of odd and even numbers.

- 0206.3.5 Understand and use the commutative and associative properties of addition and multiplication.
### Former Blueprint Standards 1st Grade

Review material

### New Standards 1st Grade

Building blocks for new standards

**No spi’s for first grade**

**These are Checks for Understanding**

### Former Blueprint Standards 2nd Grade

TCAP 2008-2009

### New Standards 2nd Grade

TCAP 2009-2010

**No spi’s for second grade**

**These are Checks for Understanding**

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</table>

- Show or represent number sentences, involving addition and subtraction and numbers 0-20, with concrete objects.
- Interpret and solve simple open addition sentences, including finding the missing addend.

- 0106.3.4 Demonstrate understanding of the basic equation \( a + b = c \) by using objects to illustrate the number sentences (fact families) associated with any particular sum.
- 0106.3.5 Use various strategies to find unknowns in problems involving addition and subtraction.
- 0106.3.6 Use objects to demonstrate the inverse relationship between addition and subtraction.
- 0106.3.7 Use the inverse relation between addition and subtraction to check arithmetic problems.

- Interpret and solve open sentences that involve addition or subtraction.

- 0106.3.6 Relate repeated addition to multiplication.
- 0106.1.14 Create and observe numerical patterns on a calculator by repeatedly adding or subtracting the same number from some starting number.

- Determine the output number for a particular input number given a one-operation rule involving addition or subtraction.

- Describe qualitative change (e.g., a student growing taller).
- Describe quantitative change (e.g., a student growing 2 inches in one year).

- Communicate and use mathematical terms and symbols.

- 0206.3.8 Describe change in measures according to quantitative criteria such as growing 2 inches in one year.
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<td>mathematical terms and symbols appropriately.</td>
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## Grade 2 – Geometry and Measurement

### Former Learning Expectations

- **3.1** Analyze characteristics and properties of geometric shapes.
- **3.2** Specify locations and describe spatial relationships.
- **3.3** Recognize and apply flips, slides, and turns.
- **4.1** Demonstrate understanding of units of measure and measurable attributes of objects.
- **4.2** Apply appropriate techniques and tools to determine measurements.

### New Grade Level Expectations

- **GLE 0206.4.1** Recognize, classify, and transform 2- and 3-dimensional geometric figures.
- **GLE 0206.4.2** Understand the meaning and process of linear measurement.
- **GLE 0206.4.3** Add, subtract, compare, compute and estimate linear measurements.
- **GLE 0206.4.4** Compose and decompose polygons to make other polygons.

### Former Blueprint Standards 1st Grade

**Review material**

- **No spi's for first grade**

### New Standards 1st Grade

**Building blocks for new standards**

**These are Checks for Understanding**

- **0106.4.1** Recognize and describe similarities and differences between 2-dimensional figures (geometric attributes and properties).
- **0106.4.2** Recognize 2- and 3-dimensional figures from different perspectives and orientations.
- **0106.4.4** Identify 2-dimensional shapes as faces of 3-dimensional figures.

### Former Blueprint Standards 2nd Grade

**TCAP 2008-2009**

**No spi's for second grade**

**These are Checks for Understanding**

- **0106.1.7** Apply spatial sense to recreate a figure from memory.
- **0106.4.3** Model part-whole relationships and properties of plane and solid figures by combining two or more shapes to make a larger shape or by breaking apart an object into its smaller shapes.
- **0106.1.4** Identify shapes that have line symmetry.

### New Standards 2nd Grade

**TCAP 2009-2010**

**No spi's for second grade**

**These are Checks for Understanding**

- **0206.4.1** Describe common geometric attributes of familiar plane and solid objects.
- **0206.4.2** Reflect, rotate, and translate shapes to explore the effects of transformations.
- **0206.1.13** Use manipulatives such as pattern blocks, tangrams, etc. to explore geometric concepts of symmetry and transformations.

### Former Blueprint Standards 1st Grade

**No spi's for first grade**

**These are Checks for Understanding**

- **Predict and describe the results of combining and taking apart two- and three-dimensional geometric figures.**
- **Create a figure made up of shapes from memory.**

### New Standards 1st Grade

**Building blocks for new standards**

**These are Checks for Understanding**

- **0106.4.3** Model part-whole relationships and properties of plane and solid figures by combining two or more shapes to make a larger shape or by breaking apart an object into its smaller shapes.
- **0106.1.7** Apply spatial sense to recreate a figure from memory.
- **Illustrate flips, slides, and turns using concrete objects and pictures.**
- **Identify shapes that have line symmetry.**

### New Standards 2nd Grade

**TCAP 2009-2010**

**No spi's for second grade**

**These are Checks for Understanding**

- **0206.4.3** Understand the property of transitivity as it relates to linear measurement (for example: If A is longer...
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<td>to nearest pound or kilogram.</td>
<td>tallest; high, higher, highest; etc.</td>
<td>according to length, capacity, and weight.</td>
<td>than B, and B is longer than C, then A is longer than C.</td>
</tr>
<tr>
<td><strong>Demonstrate understanding of the concept of length.</strong></td>
<td><strong>✓0106.4.5 Estimate and measure length using non-standard units (counting by using groups of tens and ones) to represent addition.</strong></td>
<td><strong>✓0206.4.4 Estimate measure, and calculate length to the nearest unit: meter, centimeter, yard, foot, and inch.</strong></td>
<td><strong>✓0206.1.7 Measure weight to the nearest pound or kilogram.</strong></td>
</tr>
<tr>
<td><strong>Recognize the need for standard units of measurement.</strong></td>
<td><strong>✓0106.4.6 Recognize the essential role of units in measurement, and understand the difference between standard and non-standard units.</strong></td>
<td><strong>✓0206.4.7 Investigate and describe composition, decomposition, and transformations of polygons.</strong></td>
<td><strong>✓0206.4.7 Investigate and describe composition, decomposition, and transformations of polygons.</strong></td>
</tr>
<tr>
<td><strong>Measure and estimate length using a variety of nonstandard units.</strong></td>
<td><strong>✓0206.4.8 Combine polygons to form other polygons and subdivide a polygon into other polygons.</strong></td>
<td><strong>✓0206.4.8 Combine polygons to form other polygons and subdivide a polygon into other polygons.</strong></td>
<td><strong>✓0206.4.9 Recognize the composition and decomposition of polygons.</strong></td>
</tr>
<tr>
<td><strong>Use a ruler to measure a line segment to the nearest inch or centimeter.</strong></td>
<td><strong>✓0206.4.9 Recognize the composition and decomposition of polygons.</strong></td>
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<tr>
<td>▪ Compare units of time.</td>
<td>▪ Identify time to the hour, half-hour, and quarter-hour.</td>
<td>▪ 0206.1.1 Read and write time up to five-minute intervals.</td>
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<tr>
<td>▪ Recognize that a calendar is a way of measuring time.</td>
<td>▪ Relate days, dates, weeks, and months to a calendar.</td>
<td>▪ 0206.1.2 Relate days, dates, weeks, months, and years to a calendar.</td>
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<tr>
<td>▪ Mark specified days and dates on a calendar and describe the relationship between days and months.</td>
<td>▪ Estimate lengths and time intervals.</td>
<td>▪ 0206.1.3 Use strategies to make estimates of time.</td>
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<tr>
<td>▪ Determine time to the nearest hour and half-hour, using a standard clock.</td>
<td>▪ Solve problems involving elapsed time in hours.</td>
<td>▪ 0206.1.4 Solve problems involving elapsed time in hour and half-hour intervals.</td>
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| ▪ Use a thermometer to measure temperature and determine the hotter/colder temperature by selecting the higher/lower column of two thermometers. | ▪ Demonstrate understanding of the concepts of perimeter and area. | ▪ 0206.1.6 Read thermometers with Fahrenheit and Celsius scales. |
| ▪ Find area and perimeter using nonstandard units. | ▪ Find area and perimeter using nonstandard units. |                                       |

| ▪ Recognize and show terms of relative position and direction in a variety of situations (e.g., over, under, forward, backward, between, right, and left). | ▪ Read thermometers with Fahrenheit and Celsius scales. |                                       |
| ▪ 0106.4.5 Estimate and measure length using non-standard units (counting by using groups of tens and ones) to represent addition. | ▪ 0106.4.6 Recognize the essential role of units in measurement, and understand |                                       |
| ▪ Recognize the need for standard units of measurement. | ▪ Recognize the essential role of units in measurement, and understand |                                       |

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring 2008
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<td>- Measure and estimate length using a variety of nonstandard units.</td>
<td>- the difference between standard and non-standard units.</td>
<td>- ✔016.4.7 Understand and use comparative words such as long, longer, longest; short, shorter, shortest; tall, taller, tallest; high, higher, highest; etc.</td>
<td>- ✔016.1.5 Use a thermometer to measure temperature.</td>
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<tr>
<td>- Use a ruler to measure a line segment to the nearest inch or centimeter.</td>
<td>- ✔016.1.6 Recognize scales as a way of measuring weight.</td>
<td>- ✔016.1.1 Describe the relationship between days and months.</td>
<td>- ✔016.1.2 Read and write time to the hour, half-hour, and quarter-hour.</td>
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<td>- Compare and order objects according to length, capacity, and weight.</td>
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<td>✔016.1.3 Compare units of time.</td>
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<td>- Use scales to weigh an object to nearest pound or kilogram.</td>
<td>- ✔016.1.4 Understand and use terms of relative position and direction in a variety of situations (e.g., over, under, forward, backward, between, right, and left).</td>
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- higher/lower column of two thermometers.
# Grade 2 – Data, Probability and Statistics

## Former Learning Expectations
5.1 Develop, select, and use appropriate methods to collect, organize, display, and analyze data.
5.2 Apply basic concepts of probability.

## New Grade Level Expectations
GLE 0206.5.1 Use and understand various representations to depict and analyze data measurements.
GLE 0206.5.2 Determine whether an event is likely or unlikely.

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<tbody>
<tr>
<td>Building blocks for new standards</td>
<td>0106.5.1 Represent</td>
<td>0106.5.1 Read, interpret, and</td>
<td>0206.5.2 Read, interpret, and create tables using tally marks.</td>
</tr>
<tr>
<td>No spi's for first grade</td>
<td>measurements and discrete data using concrete objects, picture graphs, and bar graphs.</td>
<td>analyze data shown in tables, bar graphs and picture graphs.</td>
<td>0206.5.3 Explain whether a real world event is likely or unlikely.</td>
</tr>
<tr>
<td>These are Checks for Understanding</td>
<td>0106.5.2 Represent data in both horizontal and vertical form.</td>
<td>0106.5.4 Predict outcomes of events based on data gathered and displayed.</td>
<td>0206.5.4 Predict outcomes of events based on data gathered and displayed.</td>
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<td>0106.5.3 Display data using appropriate titles and labels.</td>
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- Interpret and make pictographs and bar graphs using concrete objects and pictured objects.
- Describe events related to students’ experiences as likely or unlikely.

- 0106.5.4 Count and compare collected data.
- Pose questions and gather data to answer the questions.
Grade 3 Transition to New TN Mathematics Standards
Grade 3 – Mathematical Processes

New Grade Level Expectations
GLE 0306.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0306.1.2 Apply and adapt a variety of appropriate strategies to problem solving, (i.e. estimation and reasonableness of the solution.)
GLE 0306.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0306.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0306.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0306.1.6 Read and interpret the language of mathematics; use written/oral communication to express mathematical ideas precisely.
GLE 0306.1.7 Recognize the historical development of mathematics, math in context, and the connections between math and the real world.
GLE 0306.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)
✓ 0306.1.1 Read and write time to the nearest minute.
✓ 0306.1.2 Compare and order decimal amounts in the context of money.
✓ 0306.1.3 Count the value of combinations of coins and bills up to five dollars.
✓ 0306.1.4 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, and observing patterns.
✓ 0306.1.5 Determine when and how to break a problem into simpler parts.
✓ 0306.1.6 Use estimation to check answers for reasonableness, and calculators to check for accuracy.
✓ 0306.1.7 Make and investigate mathematical conjectures.
✓ 0306.1.8 Explain and justify answers on the basis of mathematical properties, structures, and relationships.
✓ 0306.1.9 Use manipulatives to demonstrate that the commutative property holds for addition but not for subtraction.
✓ 0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas.
✓ 0306.1.11 Develop strategies for solving problems involving addition and subtraction of measurements.
✓ 0306.1.12 Analyze and evaluate the mathematical thinking and strategies of others.
✓ 0306.1.13 Create and use representations to organize, record, and communicate mathematical ideas.
✓ 0306.1.14 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

State Performance Indicators
SPI 0306.1.1 Solve problems using a calendar.
SPI 0306.1.2 Solve problems involving elapsed time.
SPI 0306.1.3 Determine the correct change from a transaction less than a dollar.
SPI 0306.1.4 Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten.
SPI 0306.1.5 Represent problems mathematically using diagrams, numbers, and symbolic expressions.
SPI 0306.1.6 Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.
SPI 0306.1.7 Select appropriate units and tools to solve problems involving measures.
SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate.

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring  2008
### Grade 3 - Number and Operations

#### Former Learning Expectations
1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand meanings of operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

#### New Grade Level Expectations
GLE 0306.2.1 Understand the place value of whole numbers to ten-thousands place including expanded notation for all arithmetic operations.
GLE 0306.2.2 Develop understanding of multiplication and related division facts through multiple strategies and representations.
GLE 0306.2.3 Relate multiplication and division as inverse operations.
GLE 0306.2.4 Solve multiplication and division problems using various representations.
GLE 0306.2.5 Understand the meaning and uses of fractions.
GLE 0306.2.6 Use various strategies and models to compare and order fractions and identify equivalent fractions.
GLE 0306.2.7 Add and subtract fractions with like denominators using various models.

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- Count a set of objects to 100 by 2’s, 3’s, 5’s, or 10’s.
- Count forward and backward by one from any number less than 999.
- Identify odd and even numbers to 100.

- Read and write numerals to 999.

- Read and write whole numbers to 9,999. D
- Represent whole numbers to 9,999 with models. A

- Count by 10’s, 100’s, or 1,000’s. A
- Skip count by 10’s from any whole number less than 1,000. D

- SPI 0306.2.1 Read and write numbers up to 10,000 in numerals and up to 1,000 in words.
- 0306.2.1 Represent whole numbers up to 10,000 using various models (such as base-ten blocks, number lines, place-value charts) and in standard form, written form, and expanded form.

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
### Former Blueprint Standards 2nd Grade
**Review material**

- Identify the place value of a digit in numbers to 999.
- Represent numbers to 999 in flexible ways using a variety of materials (e.g., 23 as 23 ones, 1 ten and 13 ones, and/or 2 tens and 3 ones).

- Order and sequence whole numbers less than 1000.
- Compare two numbers using the appropriate symbol (i.e., <, >, and =).
- Use and match numerals to ordinal numbers through twentieth.

- Identify the place value of a given digit up to thousands. 
- Represent whole numbers up to 10,000 in expanded form (e.g., 1,000’s + 100’s + 10’s + 1’s). 

### New Standards 2nd Grade
**Building blocks for new standards**

- No spi’s for second grade. These are Checks for Understanding

- Identify the place value of a digit in numbers to 999.
- Represent numbers to 999 in flexible ways using a variety of materials (e.g., 853 as 8 hundreds + 5 tens + 3 ones).

- Order and sequence whole numbers up to 4 digits.
- Compare and order whole numbers up to 9999 using the appropriate symbol (i.e., <, >, and =). 

- Identify repeated addition to multiplication.

- Relate skip counting to multiplication.
- Connect division to sharing situations.
- Demonstrate multiplication using repeated addition (e.g., arrays).
- Relate adding doubles to multiplying by two.

### Former Blueprint Standards 3rd Grade
**TCAP 2008-2009**

- SPI 0306.2.4 Recognize that place-value notation represents the sums of multiples of powers of ten (e.g., 853 as 8 hundreds + 5 tens + 3 ones).

### New Standards 3rd Grade
**TCAP 2009-2010**

- SPI 0306.2.2 Identify the place value of numbers in the ten-thousands, thousands, hundreds, tens, and ones positions.
- SPI 0306.2.3 Convert between expanded and standard form with whole numbers to 10,000.

- SPI 0306.2.4 Compare and order numbers up to 10,000 using the appropriate symbol (i.e., <, >, and =).
- Use the multiplication facts 0, 1, 2, 5, and 10 efficiently and accurately.

- SPI 0306.2.5 Identify various representations of multiplication and division.
- Use the multiplication facts 0, 1, 2, 5, and 10 efficiently and accurately.

- SPI 0306.2.6 Recall basic multiplication facts through 10 times 10 and the related
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<td>• Use known multiplication facts to determine a related product (e.g., 9 x 7 is 7 less than 10 x 7). I</td>
<td>SPI 0306.2.7 Compute multiplication problems that involve multiples of ten using basic number facts.</td>
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<td>• Write and identify number sentences that describe situations involving addition, subtraction, and multiplication. D</td>
<td>SPI 0306.2.8 Solve problems that involve the inverse relationship between multiplication and division.</td>
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<tr>
<td>• SPI 0306.2.10 Identify equivalent fractions given by various representations. SPI 0306.1.4 Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten. A</td>
<td>SPI 0306.2.10 Identify equivalent fractions given by various representations. SPI 0306.1.4 Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten. SPI 0306.2.11 Recognize and use different interpretations of fractions.</td>
<td></td>
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<tr>
<td>• Match the spoken or written word names and concrete or pictorial representations (parts of regions or parts of sets of objects) of halves, thirds, and fourths. ✓0206.1.8 Use concrete models or pictures to show whether a fraction is less than a half, more than a half, or equal to a half. ✓0206.1.9 Match the spoken, written, concrete, and pictorial representations of halves, thirds, and fourths.</td>
<td>✓0306.2.3 Use parentheses to indicate grouping.</td>
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<td>Connect the spoken or written word names and concrete or pictorial representations (regions or sets) of fractions with denominators up to ten. D</td>
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<td></td>
<td>• Connect written and pictorial representations of fractions with denominators up to ten. A</td>
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<td>• Identify the position of 1/2, 1/3, or 1/4 on the number line. D</td>
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- **Use concrete models or pictures to show whether a fraction is less than 1/2, more than 1/2, or equal to 1/2.**
- **Compare the unit fractions 1/2, 1/3, and 1/4.**
- **0206.2.5** Compare and order multi-digit numbers up to 1000.
- **0206.2.9** Apply appropriate methods to estimate and mentally calculate sums or differences with ones, tens, and hundreds.

- **Compare fractions with numerators of 1 and denominators up to 10.**
- **Compare and order decimal amounts written as money.**
- **SPI 0306.2.12** Name fractions in various contexts that are less than, equal to, or greater than one.
- **0306.2.11** Identify fractions as parts of whole units, as parts of sets, as locations on number lines, and as division of two whole numbers.
- **SPI 0306.2.13** Recognize, compare, and order fractions (benchmark fractions, common numerators, or common denominators).
- **0306.2.13** Understand that when a whole is divided into equal parts to create unit fractions, the sum of all the parts adds up to one.

- **Compare fractions using drawings, concrete objects, and benchmark fractions.**
- **SPI 0306.2.14** Add and subtract fractions with like denominators.
- **0306.2.4** Use a variety of methods to perform mental computations and compare the efficiency of those methods.

- **Use the number line to demonstrate addition and subtraction.**
- **Add and subtract efficiently**
- **0206.1.12** Write numbers and translate word clues to number sentences and vice versa.
- **0206.1.11** Use manipulatives to

- **Add and subtract efficiently and accurately with single-digit whole numbers.**
- **Add efficiently and accurately**

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<tr>
<td>and accurately with single-digit numbers up to sums of 18. Add and subtract two-digit whole numbers using a variety of strategies and representations.  ▪ Explain and justify solution strategies used in problem solving.  ▪ Use calculators in problem-solving situations.</td>
<td>demonstrate addition and subtraction sentences written symbolically.  ▪ 0206.2.6 Use various models such as number lines, pictures, and base-ten blocks to illustrate addition and subtraction.  ▪ 0206.2.7 Develop fluency at recalling basic addition facts and related subtraction facts.  ▪ 0206.2.8 Use efficient procedures, and understand why they work, to solve problems involving the addition and subtraction of two- and three-digit whole numbers (including those that require regrouping for addition only).  ▪ 0206.2.10 Add three two-digit numbers.</td>
<td>with two- and/or three-digit whole numbers. A  ▪ Subtract efficiently and accurately with two- and/or three-digit whole numbers. A</td>
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<td>▪ Use estimation to justify whether the answer to a computation is reasonable.  ▪ Check for the reasonableness of solutions.</td>
<td>▪ Explain and justify solution strategies used in problem solving. D  ▪ Explain the reasonableness of a solution to a computation or to a word problem. D  ▪ Use strategies, including rounding, to estimate in story problems. D  ▪ Use estimation to select a reasonable solution in problem solving (addition and subtraction only). A</td>
<td>SPI 0306.1.5 Represent problems mathematically using diagrams, numbers, and symbolic expressions.  ▪ 0306.1.4 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, and observing patterns.  ▪ 0306.1.5 Determine when and how to break a problem into simpler parts.  ▪ 0306.1.6 Use estimation to check answers for reasonableness, and calculators</td>
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| Building blocks for new standards

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| TCAP 2008-2009

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| **Write and identify number sentences that describe situations involving addition and subtraction.**
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| **Write and identify number sentences that describe situations involving addition and subtraction.**
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.
| 0206.1.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Write and explain related addition and subtraction sentences.**
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| 0206.1.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.
| 0206.1.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Solve story problems involving numbers to 100.**
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| **Solve story problems involving numbers to 100.**
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.
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| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Develop a story problem that illustrates a given addition of subtraction number sentence.**
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| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Solve real-world problems using addition or subtraction of whole numbers. A**
| **Solve real-world problems using addition or subtraction of whole numbers. A**
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| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Select and use an appropriate strategy to solve word problems (e.g., organized list, guess and check, diagram, and table). D**
| **Select and use an appropriate strategy to solve word problems (e.g., organized list, guess and check, diagram, and table). D**
| **Select and use an appropriate strategy to solve word problems (e.g., organized list, guess and check, diagram, and table). D**
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Identify whole numbers as odd or even. A**
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| **Identify whole numbers as odd or even. A**
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.
| 0206.2.11 Solve addition and subtraction problems in context using various representations.
| 0206.1.10 Develop a story problem that illustrates a given addition of subtraction number sentence.

| **Determine the value of a collection of coins up to $1.00.**
| **Determine the value of a collection of coins up to $1.00.**
| **Determine the value of a collection of coins up to $1.00.**
| 0206.1.5 Count the value of a set of coins up to one dollar and
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| **Recognize the value of combinations of coins and bills**
| **Recognize the value of combinations of coins and bills**
| **Recognize the value of combinations of coins and bills**
| SPI 0306.1.3 Determine the correct change from a
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<td>✔ 0306.1.2 Compare and order decimal amounts in the context of money. ✔ 0306.1.3 Count the value of combinations of coins and bills up to five dollars.</td>
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- use the transitive property of equality to recognize equivalent forms of values up to $1.00.
- up to $5. **A**
  - Determine the correct change from a transaction that is less than $1.00. **A**

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**Grade 3 – Algebra**

### Former Learning Expectations
2.1 Sort and classify objects by size, number, and other properties.
2.2 Represent and analyze patterns and functions.
2.3 Use concrete, pictorial, and verbal representations to develop an understanding of the language and symbols of mathematics.
2.4 Illustrate general properties of operations.
2.5 Analyze change in various contexts.

### New Grade Level Expectations
GLE 0306.3.1 Develop meaning for and apply the commutative, associative, and distributive properties using various representations.
GLE 0306.3.2 Develop understanding that a letter or a symbol can represent an unknown quantity in a simple mathematical expression/equation.
GLE 0306.3.3 Describe and analyze patterns and relationships in contexts.
GLE 0306.3.4 Create and represent patterns using words, tables, graphs, and symbols.

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- ** Former Blueprints Standards 2nd Grade **
  - Demonstrate knowledge of and use the commutative property of addition.
  - Show that subtraction is not commutative.
  - Apply the addition and subtraction properties of 0 (adding or subtracting 0 doesn’t change a given number).

- ** New Standards 2nd Grade **
  - 0206.3.5 Understand and use the commutative and associative properties of addition and multiplication.

- ** Former Blueprint Standards 3rd Grade **
  - Demonstrate knowledge (with words or symbols) of the commutative properties of addition and multiplication. **D**
  - Use the commutative property of addition and multiplication. **D**
  - Show that subtraction is not commutative. **D**
  - Apply the addition and subtraction properties of 0 (adding or subtracting 0 doesn’t change a number). **M**
  - Apply the zero and identity properties of multiplication (adding 0 or multiplying by 1 doesn’t change a number). **I**
  - Use arrays to represent the commutative property of multiplication. **I**

- ** New Standards 3rd Grade **
  - SPI 0306.3.1 Verify a conclusion using algebraic properties.
  - 0306.3.1 Show that addition and multiplication are commutative operations.
  - 0306.1.9 Use manipulatives to demonstrate that the commutative property holds for addition but not for subtraction.
  - 0306.3.2 Show that subtraction and division are not commutative operations.
  - 0306.3.3 Use commutative, associative, and distributive properties to multiply whole numbers.
  - 0306.3.4 Solve problems using the commutative, associative, and distributive properties.

- ** SPI 0306.3.2 Express mathematical relationships using number sentences/equations.**
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- Determine the output number for a particular input number given a one-operation rule involving addition or subtraction.
- Interpret and solve open sentences that involve addition or subtraction.

- Sort objects by two or more attributes.
- Identify the rules by which objects or numbers have been sorted.
- Extend a growing pattern, involving objects, shapes, or numbers.
- Identify the unit of a three-part repeating pattern.
- Translate a repeating pattern from one format to another (e.g., red-blue-blue to snap-clap-clap).

**formerly in geometry**
- Identify the position of a whole number on the number line.

### Former Blueprint Standards 2nd Grade

- **No spi’s for second grade.**
  - These are Checks for Understanding

### New Standards 2nd Grade

- **Building blocks for new standards**
  - These are Checks for Understanding

### Former Blueprint Standards 3rd Grade

- **TCAP 2008-2009**

### New Standards 3rd Grade

- **TCAP 2009-2010**

- **D** Demonstrate understanding that an equation is a number sentence stating two quantities are equal.
- **I** Solve open sentences that involve addition and subtraction of whole numbers zero to twenty.
- **A** Connect open sentences to real-world situations.
- **A** Determine the output number for a particular input number given a one-operation function rule involving addition or subtraction.

- **SPI 0306.3.3** Find the missing values in simple multiplication and division equations.
  - 0306.3.5 Find unknowns in number sentences and problems involving addition, subtraction, multiplication, or division.

- **0206.3.1** Given rules, complete tables to reveal both arithmetic and geometric patterns.
- **0206.3.2** Given a description, extend or find a missing term in a pattern or sequence.
- **0206.3.3** Record and study patterns in lists of numbers created by repeated addition or subtraction.
- **0206.3.4** Generalize the patterns resulting from the addition, subtraction and multiplication of combinations of odd and even numbers.

- **0206.3.1** Given rules, complete tables to reveal both arithmetic and geometric patterns.
- **0206.3.2** Given a description, extend or find a missing term in a pattern or sequence.
- **0206.3.3** Record and study patterns in lists of numbers created by repeated addition or subtraction.
- **0206.3.4** Generalize the patterns resulting from the addition, subtraction and multiplication of combinations of odd and even numbers.

- **SPI 0306.3.4** Describe or extend (including finding missing terms) geometric and numeric patterns.
  - 0306.3.6 Analyze patterns in words, tables, and graphs to draw conclusions.
  - 0306.3.7 Create different representations of a pattern given a verbal description.
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<td>▪ Describe a growing pattern, involving objects, shapes, or numbers. <strong>D</strong></td>
<td>▪ 0306.3.8 Analyze patterns in quantitative change resulting from computation.</td>
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<tr>
<td>▪ Describe qualitative change (e.g., a student growing taller).</td>
<td>✓0206.3.8 Describe change in measures according to quantitative criteria such as growing 2 inches in one year.</td>
<td>▪ Describe qualitative change (e.g., a student growing taller). <strong>D</strong></td>
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<tr>
<td>▪ Describe quantitative change (e.g., a student growing 2 inches in 1 year).</td>
<td></td>
<td>▪ Describe quantitative change (e.g., a student growing two inches in one year). <strong>D</strong></td>
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<tr>
<td>▪ Communicate and use mathematical terms and symbols appropriately.</td>
<td></td>
<td>▪ Demonstrate knowledge and understanding of grade level mathematical terms. <strong>D</strong></td>
<td>SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate. ✓0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas.</td>
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### Grade 3 – Geometry and Measurement

#### Former Learning Expectations

3.1 Analyze characteristics and properties of geometric shapes.
3.2 Specify locations and describe spatial relationships.
3.3 Recognize and apply flips, slides, and turns.
4.1 Demonstrate understanding of units of measure and measurable attributes of objects.
4.2 Apply appropriate techniques and tools to determine measurements.

#### New Grade Level Expectations

GLE 0306.4.1 Describe, compare, and analyze properties of polygons.
GLE 0306.4.2 Understand and apply the concepts of congruence and symmetry.
GLE 0306.4.3 Understand and use attributes of 2- and 3-dimensional figures to solve problems.
GLE 0306.4.4 Use appropriate units, strategies and tools to solve problems involving perimeter.
GLE 0306.4.5 Solve measurement problems involving fractional parts of linear units and capacity units.

#### Former Blueprint Standards 2nd Grade

- Review material

#### New Standards 2nd Grade

- Building blocks for new standards
- No spi's for second grade.
- These are Checks for Understanding

- Identify, build, draw, and compare two- and three-dimensional geometric figures.
- Describe characteristics and parts of two- and three-dimensional geometric figures.

- ✓ 0206.4.1 Describe common geometric attributes of familiar plane and solid objects.

#### Former Blueprint Standards 3rd Grade

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#### New Standards 3rd Grade

- TCAP 2009-2010

- SPI 0306.4.1 Recognize polygons and be able to identify examples based on geometric definitions.
  - ✓ 0306.4.1 Describe properties of plane figures (such as circles, triangles, squares and rectangles) and solid shapes (such as spheres, cubes and cylinders).
  - ✓ 0306.4.2 Classify polygons according to the number of their sides and angles.
  - SPI 0306.1.6 Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.
  - ✓ 0306.4.3 Classify lines and segments as parallel, perpendicular, or intersecting.

- SPI 0306.4.2 Determine if two figures are congruent based on size and shape.

- SPI 0306.4.3 Identify the line of symmetry
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<td><strong>in a two-dimensional design or shape. A</strong>&lt;br&gt;- Draw lines of symmetry in two-dimensional designs and shape. D</td>
<td><strong>of symmetry in a two-dimensional design or shape.</strong>&lt;br&gt;- 0306.4.4 Identify, create, and describe figures with line symmetry.</td>
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<tr>
<td><strong>Investigate and predict the results of combining and taking apart two- and three-dimensional geometric figures.</strong>&lt;br&gt;- Demonstrate understanding of the concepts of perimeter and area.&lt;br&gt;- Find area and perimeter using nonstandard units.</td>
<td>✓0206.4.7 Investigate and describe composition, decomposition, and transformations of polygons.&lt;br&gt;✓0206.4.8 Combine polygons to form other polygons and subdivide a polygon into other polygons.&lt;br&gt;✓0206.4.9 Recognize the composition and decomposition of polygons.</td>
<td>✓ Find the perimeter of polygons. D</td>
<td>SPI 0306.4.4 Calculate the perimeter of shapes made from polygons.</td>
</tr>
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<td><strong>Identify what can be measured about objects in the environment.</strong>&lt;br&gt;- Compare and order objects according to length, capacity, and weight.&lt;br&gt;- Measure and estimate weight and capacity using a variety of nonstandard units.&lt;br&gt;- Read thermometers with Fahrenheit and Celsius scales.</td>
<td>✓0206.4.3 Understand the property of transitivity as it relates to linear measurement (for example: If A is longer than B, and B is longer then C, then A is longer than C).&lt;br&gt;✓0206.1.7 Measure weight to the nearest pound or kilogram.&lt;br&gt;✓0206.1.6 Read thermometers with Fahrenheit and Celsius scales.</td>
<td>✓ Find the perimeter of a rectangle on a grid. A Solve real-world problems involving addition and subtraction of one- or two-digit measurements. A&lt;br&gt;✓ Read thermometers with Fahrenheit and Celsius scales (positive whole number temperatures). A&lt;br&gt;✓ Select and apply the most appropriate standard units of length, area, capacity, weight, time, and temperature. D&lt;br&gt;✓ Solve real-world problems involving measurement. D&lt;br&gt;✓ Determine when an estimate of a measurement is sufficient. D&lt;br&gt;✓ Demonstrate understanding of reasonable units of measure, estimate common measurements using benchmarks, and use appropriate tools to make measurements. SPI 0306.1.7 Select appropriate units and tools to solve problems involving measures. SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate. ✓ 0306.4.5 Understand that all measurements require units. ✓ 0306.4.6 Recognize the use of fractions in liquid measures.</td>
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| Review material                     | Building blocks for new standards **No spi’s for second grade. These are Checks for Understanding** | the concepts of perimeter, area, and capacity. D  
- Use strategies to estimate or determine length, perimeter, area, capacity, weight, time, and temperature. D  
- Measure to the nearest liter, cup, pint, quart, and gallon. D  
- Measure to the nearest ounce, pound, kilogram, and gram. D | ✓ 0306.4.7 Recognize the relationships among cups, pints, quarts, and gallons.  
✓ 0306.4.8 Estimate and/or measure the capacity of a container.  
✓ 0306.4.9 Measure weight to the nearest ounce or gram.  
✓ 0306.4.10 Use reasonable units of length (i.e. kilometer, meter, centimeter, mile, yard, foot, inch) in estimates and measures.  
✓ 0306.4.12 Make and record measurements that use mixed units within the same system of measurement (such as feet and inches, meters and centimeters). |

- Measure length to the nearest centimeter, foot, half-inch, and inch.  
- Explain the relationship between inches and feet.  
  ✓ 0206.4.4 Estimate measure, and calculate length to the nearest unit: meter, centimeter, yard, foot, and inch.  
  ✓ 0206.4.5 Use rulers to measure the lengths of sides and diagonals of common 2-dimensional figures and polygons.  
  ✓ 0206.4.6 Understand the inverse relationship between the size of a unit and the number of units used in a particular measurement (the smaller the unit, the more iterations needed to cover the

- Select an appropriate standard unit to measure length. A  
- Use estimation to determine if a length measurement is reasonable. A  
- Measure length to the nearest centimeter and inch. A  
- Explain the relationships among inches, feet, and yards. D  
- Measure to the nearest centimeter, foot, half-inch, and inch. D  

SPI 0306.4.6 Measure length to the nearest centimeter or half inch.  
✓ 0306.4.11 Know common equivalences for length (1 meter = 100 centimeters, 1 yard = 3 feet, 1 foot = 12 inches).  
✓ 0306.4.13 Use common abbreviations: km, m, cm, in, ft, yd, mi.
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- Identify time to the hour, half-hour, and quarter-hour.
- Relate days, dates, weeks, and months to a calendar.
- Estimate lengths and time intervals.
- Solve problems involving elapsed time in hours.

- Solve real-world problems using a calendar. A
- Solve real-world problems involving elapsed time to the half-hour. A
- Read and write time at five-minute intervals. A
- Read and write time to the nearest hour, half-hour, and quarter-hour. A

- SPI 0306.4.7 Solve problems requiring the addition and subtraction of lengths.
- ✓0306.1.11 Develop strategies for solving problems involving addition and subtraction of measurements.
- ✓0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas.

- SPI 0306.1.1 Solve problems using a calendar.
- SPI 0306.1.2 Solve problems involving elapsed time
  ✓0306.1.1 Read and write time to the nearest minute.

- ✓0206.1.1 Read and write time up to five-minute intervals.
- ✓0206.1.2 Relate days, dates, weeks, months, and years to a calendar.
- ✓0206.1.3 Use strategies to make estimates of time.
- ✓0206.1.4 Solve problems involving elapsed time in hour and half-hour intervals.

- ✓0206.4.2 Reflect, rotate, and translate shapes to explore the effects of transformations.
- ✓0206.1.13 Use manipulatives such as pattern blocks, tangrams, etc. to explore geometric concepts of symmetry and transformations.

- Identify shapes that have line symmetry.

- Identify a location on a grid using whole number coordinates. I
- Use appropriate mathematical language to find a point on a grid.
<table>
<thead>
<tr>
<th><strong>Former Blueprint Standards 2nd Grade</strong></th>
<th><strong>New Standards 2nd Grade</strong></th>
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<tbody>
<tr>
<td>Review material</td>
<td>Building blocks for new standards <strong>No spi’s for second grade. These are Checks for Understanding</strong></td>
<td><strong>TCAP 2008-2009</strong></td>
<td><strong>TCAP 2009-2010</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>grid using whole number coordinates. <strong>A</strong></td>
<td></td>
</tr>
</tbody>
</table>
**Grade 3 Data Analysis, Statistics, and Probability**

### Former Learning Expectations
5.1 Develop, select, and use appropriate methods to collect, organize, display, and analyze data.
5.2 Apply basic concepts of probability.

### New Grade Level Expectations
GLE 0306.5.1 Organize, display, and analyze data using various representations to solve problems.

#### Former Blueprint Standards 2nd Grade
**Review material**

- Pose questions and gather data to answer the questions.
- Construct pictographs and bar graphs.
- Interpret and solve problems with tables, bar graphs, and pictographs.
- Read, interpret, and construct tables using tally marks.

#### New Standards 2nd Grade
**Building blocks for new standards**

- 0206.5.1 Read, interpret, and analyze data shown in tables, bar graphs and picture graphs.
- 0206.5.2 Read, interpret, and create tables using tally marks.

#### Former Blueprint Standards 3rd Grade
**TCAP 2008-2009**

- Write questions and gather data to answer questions. **D**
- Interpret and construct tables using tally marks. **D**
- Construct pictographs and bar graphs. **D**

#### New Standards 3rd Grade
**TCAP 2009-2010**

**SPI 0306.5.1 Interpret a frequency table, bar graph, pictograph and line plot.**
- 0306.5.1 Collect and organize data using observations, surveys, and experiments.
- 0306.5.3 Compare and interpret different representations of the same data.
- 0306.5.2 Construct a frequency table, bar graph, pictograph, or line plot of collected data.
- 0306.1.13 Create and use representations to organize, record, and communicate mathematical ideas.

**SPI 0306.5.2 Solve problems in which data is represented in tables or graph.**
- 0306.5.4 Solve problems using data from frequency tables, bar graphs, pictographs, or line plots.

**SPI 0306.5.3 Make predictions based on various representations of data.**

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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
Grade 4 Transition to New TN Mathematics Standards

Grade 4 – Mathematical Processes

New Grade Level Expectations

GLE 0406.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0406.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0406.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0406.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0406.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0406.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0406.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0406.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)

✓ 0406.1.1 Understand the relationship between use of answers and the accuracy of the number.
✓ 0406.1.2 Identify the range of appropriate estimates, including over-estimate and under-estimate.
✓ 0406.1.3 Connect operations with decimals to money and make estimates.
✓ 0406.1.4 Use commutative, associative, and distributive properties of numbers including oral descriptions of mathematical reasoning.
✓ 0406.1.5 Measure using ruler, meter stick, clock, thermometer, or other scaled instruments.
✓ 0406.1.6 Identify geometric or physical attributes that are appropriate to measure in a given situation.
✓ 0406.1.7 Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.
✓ 0406.1.8 Match the spoken, written, concrete (including base ten blocks), and pictorial representations of decimals.
✓ 0406.1.9 Develop a story problem that illustrates a given multiplication or division number sentence.
✓ 0406.1.10 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

State Performance Indicators

SPI 0406.1.1 Verify a conclusion using the commutative, associative and distributive properties.
SPI 0406.1.2 Compare decimals using concrete and pictorial representations.
SPI 0406.1.3 Determine the correct change from a transaction.
SPI 0406.1.4 Compare objects with respect to a given geometric or physical attribute and select appropriate measurement instrument.
### Grade 4 – Number and Operations

#### Former Learning Expectations

1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand meanings of operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

#### New Grade Level Expectations

- **GLE 0406.2.1** Understand place value of numbers from hundredths to the hundred-thousands place.
- **GLE 0406.2.2** Develop fluency with multiplication and single-digit division.
- **GLE 0406.2.3** Identify prime and composite numbers.
- **GLE 0406.2.4** Understand and use the connections between fractions and decimals.
- **GLE 0406.2.5** Add and subtract fractions with like and unlike denominators.
- **GLE 0406.2.6** Solve problems involving whole numbers, fractions, and/or decimals using all four arithmetic operations.

### Former Blueprint Standards

#### 3rd Grade

- **Review material**

#### New Standards 3rd Grade

- **Building blocks for new standards**

#### 4th Grade

- **TCAP 2008-2009**

#### Former Blueprint Standards

- **SPI 0306.2.1** Read and write numbers up to 10,000 in numerals and up to 1,000 in words.
  - 0306.2.1 Represent whole numbers up to 10,000 using various models (such as base-ten blocks, number lines, place-value charts) and in standard form, written form, and expanded form.

#### New Standards 4th Grade

- **TCAP 2009-2010**

#### SPI 0406.2.1 Read and write numbers from hundredths to hundred-thousands in numerals and in words.

#### SPI 0306.2.2 Identify the place value of numbers in the ten-thousands, thousands, hundreds, tens, and ones positions.

#### SPI 0306.2.3 Convert between expanded and standard form with whole numbers to 10,000.

#### SPI 0406.2.3 Identify the place value of a specified digit in a number and the quantity it represents.

#### SPI 0406.2.4 Find factors, common factors, multiples, and common multiples of two numbers.

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- Compare and order whole numbers up to 9999 using the appropriate symbol (i.e., <, >, and =). A
- Connect written and pictorial representations of fractions with denominators up to ten. A
- Compare fractions with numerators of 1 and denominators up to 10. A
- Order and sequence whole numbers up to 4 digits. D
- Connect the spoken or written word names and concrete or pictorial representations (regions or sets) of fractions with denominators up to ten. D
- Identify the position of 1/2, 1/3, or 1/4 on the number line. D
- Compare and order decimal amounts written as money. I

**Former Blueprint Standards 4th Grade**

- SPI 0306.2.4 Compare and order numbers up to 10,000 using the words less than, greater than, and equal to, and the symbols <, >, =. A
- SPI 0306.2.10 Identify equivalent fractions given by various representations. A
- SPI 0306.1.4 Match the spoken, written, concrete, and pictorial representations of fractions with denominators up to ten. A
- SPI 0306.2.11 Recognize and use different interpretations of fractions. A
- SPI 0306.2.12 Name fractions in various contexts that are less than, equal to, or greater. A

**New Standards 4th Grade**

- SPI 0406.2.2 Locate and place mixed numbers on the number line. A
- SPI 0406.2.5 Generate equivalent forms of common fractions and decimals and use them to compare size. A
- SPI 0406.2.6 Use the symbols <, >, and = to compare common fractions and decimals in both increasing and decreasing order. A
- SPI 0406.1.2 Compare decimals using concrete and pictorial representations. A
- SPI 0406.2.7 Convert improper fractions into mixed numbers and/or decimals. A
- SPI 0406.2.8 Generate equivalent forms of whole numbers, decimals, and common fractions (e.g., 1/10, 1/4, 1/2, ¾). A
- SPI 0406.2.9 Compare equivalent forms whole numbers.
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<th><strong>Former Blueprint Standards 3rd Grade</strong></th>
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<tbody>
<tr>
<td>than one.</td>
<td>0306.2.13 Understand that when a whole is divided into equal parts to create unit fractions, the sum of all the parts adds up to one. SPI 0306.2.13 Recognize, compare, and order fractions (benchmark fractions, common numerators, or common denominators).</td>
<td>Add and subtract fractions with like denominators. A</td>
<td>SPI 0406.2.8 Add and subtract proper fractions with like and unlike denominators and simplify the answer.</td>
</tr>
<tr>
<td>SPI 0306.2.14 Add and subtract fractions with like denominators.</td>
<td>Add and subtract fractions with like denominators. A</td>
<td>Add and subtract fractions with like denominators. A</td>
<td>SPI 0406.2.9 Add and subtract decimals through hundredths. SPI 0406.1.3 Determine the correct change from a transaction.</td>
</tr>
<tr>
<td>Solve real-world problems using addition or subtraction of whole numbers. A</td>
<td>SPI 0306.2.9 Solve contextual problems involving the addition (with and without regrouping) and subtraction (with and without regrouping) of two- and three-digit whole numbers. 0306.2.3 Use parentheses to indicate grouping. 0306.2.6 Solve a variety of addition and subtraction story problems including those with irrelevant information. SPI 0306.1.3 Determine the correct change from a transaction less than a dollar. 0306.1.2 Compare and order decimal amounts in the</td>
<td>SPI 0406.2.9 Add and subtract decimals (includes monetary units). A</td>
<td></td>
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<tr>
<td>Add and subtract efficiently and accurately with single-digit whole numbers. A</td>
<td>0306.2.3 Use parentheses to indicate grouping. 0306.2.6 Solve a variety of addition and subtraction story problems including those with irrelevant information. SPI 0306.1.3 Determine the correct change from a transaction less than a dollar. 0306.1.2 Compare and order decimal amounts in the</td>
<td>Add and subtract decimals (includes monetary units). A</td>
<td></td>
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<td>Add efficiently and accurately with two- and/or three-digit whole numbers. A</td>
<td>0306.2.6 Solve a variety of addition and subtraction story problems including those with irrelevant information. SPI 0306.1.3 Determine the correct change from a transaction less than a dollar. 0306.1.2 Compare and order decimal amounts in the</td>
<td>Add and subtract decimals (includes monetary units). A</td>
<td></td>
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<tr>
<td>Subtract efficiently and accurately with two- and/or three-digit whole numbers. A</td>
<td></td>
<td>SPI 0406.1.3 Determine the correct change from a transaction.</td>
<td></td>
</tr>
<tr>
<td>Recognize the value of combinations of coins and bills up to $5. A</td>
<td></td>
<td></td>
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<tr>
<td>Determine the correct change from a transaction that is less than $1.00. A</td>
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</tr>
<tr>
<td>- Select and use an appropriate strategy to solve word problems (e.g., organized list, guess and check, diagram, and table). <strong>D</strong></td>
<td>- <strong>0306.1.3</strong> Count the value of combinations of coins and bills up to five dollars.</td>
<td>- **Select appropriate methods and tools for computing with whole numbers (e.g., mental computation, estimation, calculators, paper and pencil, guess and check). <strong>I</strong></td>
<td><strong>SPI 0406.2.10</strong> Solve contextual problems using whole numbers, fractions, and decimals including money.</td>
</tr>
<tr>
<td>- Write and identify number sentences that describe situations involving addition, subtraction, and multiplication. <strong>D</strong></td>
<td>- <strong>0306.2.4</strong> Use a variety of methods to perform mental computations and compare the efficiency of those methods.</td>
<td>- <strong>0406.2.13</strong> Solve multi-step problems of various types using whole numbers, fractions, and decimals. <strong>A</strong></td>
<td><strong>0406.2.13</strong> Solve multi-step problems of various types using whole numbers, fractions, and decimals. <strong>A</strong></td>
</tr>
<tr>
<td>- Write and explain related addition and subtraction sentences.</td>
<td></td>
<td>- <strong>0406.1.7</strong> Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.</td>
<td><strong>0406.1.7</strong> Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.</td>
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<tr>
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<td></td>
<td><strong>0406.1.9</strong> Develop a story</td>
</tr>
<tr>
<td>- Mentally calculate the sum or difference of any two numbers up to 100. <strong>I</strong></td>
<td><strong>SPI 0306.1.5</strong> Represent problems mathematically using diagrams, numbers, and symbolic expressions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Use a variety of thinking strategies to add and subtract whole numbers (e.g., sums of ten, doubles plus one). <strong>D</strong></td>
<td>- <strong>0306.1.4</strong> Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, and observing patterns.</td>
<td><strong>0406.1.9</strong> Develop a story</td>
<td></td>
</tr>
<tr>
<td>- Explain and justify solution strategies used in problem solving. <strong>D</strong></td>
<td>- <strong>0306.1.5</strong> Determine when and how to break a problem into simpler parts.</td>
<td></td>
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</tr>
<tr>
<td>- Explain the reasonableness of a solution to a computation or to a word problem. <strong>D</strong></td>
<td>- <strong>0306.1.6</strong> Use estimation to check answers for reasonableness, and calculators to check for accuracy.</td>
<td></td>
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</tr>
<tr>
<td>- Use strategies, including rounding, to estimate in story problems. <strong>D</strong></td>
<td></td>
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</tr>
<tr>
<td>- Use estimation to select a reasonable solution in problem solving (addition and subtraction only). <strong>A</strong></td>
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</tbody>
</table>
| Review material                      | Building blocks for new standards | and/or too much information in word problems I.  
• Apply logical reasoning to solve real-world problems. I  
• Estimate the results of whole-number computations. D  
• Use estimation to select a reasonable solution to a whole number computation involving addition, subtraction, or multiplication. A | problem that illustrates a given multiplication or division number sentence.  
• 0406.1.1 Understand the relationship between use of answers and the accuracy of the number.  
• 0406.1.2 Identify the range of appropriate estimates, including over-estimate and under-estimate.  
• 0406.1.3 Connect operations with decimals to money and make estimates. |
| 0306.1.7 Make and investigate mathematical conjectures.  
0306.1.8 Explain and justify answers on the basis of mathematical properties, structures, and relationships.  
0306.1.13 Create and use representations to organize, record, and communicate mathematical ideas.  
0306.1.12 Analyze and evaluate the mathematical thinking and strategies of others  
0306.2.5 Use highest order value (such as tens or hundreds digit) to make simple estimates. | SPI 0306.2.5 Identify various representations of multiplication and division.  
• 0306.2.7 Represent multiplication using various representations such as equal-size groups, arrays, area models, and equal jumps on number lines.  
• 0306.2.8 Represent division using various representations such as successive subtraction, the number of equal jumps, partitioning, and sharing.  
• 0306.2.9 Describe contexts for multiplication and division facts.  
SPI 0306.2.6 Recall basic | SPI 0406.2.11 Solve problems using whole number multi-digit multiplication.  
• 0406.2.3 Multiply two- and three-digit whole numbers.  
• 0406.2.4 Understand and use a reliable algorithm for multiplying multi-digit numbers and dividing numbers by a single-digit divisor accurately and efficiently.  
SPI 0406.2.12 Solve problems using whole number division with one- or two-digit divisors.  
• 0406.2.4 Understand and use a reliable algorithm for multiplying multi-digit numbers |
| • Relate skip counting to multiplication. I  
• Connect division to sharing situations. I  
• Demonstrate multiplication using repeated addition (e.g., arrays). I/D  
• Relate adding doubles to multiplying by two. I  
• Use the multiplication facts 0, 1, 2, 5, and 10 efficiently and accurately. A  
• Use known multiplication facts to determine a related product (e.g., 9 x 7 is 7 less than 10 x 7). I |  |  |  |
<table>
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</table>
| **multiplication facts through 10 times 10 and the related division facts.**  | **- Explain how addition, subtraction, multiplication, and division affect the size and order of numbers. I** |  | **- and dividing numbers by a single-digit divisor accurately and efficiently.**  
| **SPI 0306.2.7 Compute multiplication problems that involve multiples of ten using basic number facts.** |  | **- 0406.2.5 Understand that division by zero is undefined.** | **- 0406.2.6 Divide three-digit whole numbers by one-digit divisors fluently with pencil and paper.**  
| **SPI 0306.2.8 Solve problems that involve the inverse relationship between multiplication and division.** |  | **- 0406.2.10 Use models to understand division as the inverse of multiplication, partitioning, and repeated subtraction** | **- 0406.2.14 Understand the role of the remainder in division.** |
|  |  | **- Demonstrate knowledge and understanding of grade level mathematical terms. D** |  |
### Former Learning Expectations

- 2.1 Understand patterns, relations, and functions.
- 2.2 Represent and analyze mathematical situations and structures using algebraic symbols.
- 2.3 Illustrate general properties of operations.
- 2.4 Analyze change in various contexts.

### New Grade Level Expectations

- GLE 0406.3.1 Extend understanding of a variable to equations involving whole numbers, fractions, decimals, and/or mixed numbers.
- GLE 0406.3.2 Use mathematical language and modeling to develop descriptions, rules and extensions of patterns.
- GLE 0406.3.3 Translate between different forms of representations of whole number relationships.

### Former Blueprint Standards 3rd Grade

- Review material

### New Standards 3rd Grade

- Building blocks for new standards

<table>
<thead>
<tr>
<th>SPI 0306.3.2 Express mathematical relationships using number sentences/equations.</th>
<th>SPI 0306.3.3 Find the missing values in simple multiplication and division equations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ 0306.3.5 Find unknowns in number sentences and problems involving addition, subtraction, multiplication, or division.</td>
<td>✓ 0306.3.5 Find unknowns in number sentences and problems involving addition, subtraction, multiplication, or division.</td>
</tr>
</tbody>
</table>

### Former Blueprint Standards 4th Grade

- TCAP 2008-2009

<table>
<thead>
<tr>
<th>SPI 0406.3.1 Use letters and symbols to represent an unknown quantity and write a simple mathematical expression.</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ 0406.3.1 Find an unknown quantity in simple equations involving whole numbers, fractions, decimals, and mixed numbers.</td>
</tr>
<tr>
<td>✓ 0406.3.2 Translate between symbols and words to represent quantities in expressions or equations.</td>
</tr>
<tr>
<td>✓ 0406.1.7 Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.</td>
</tr>
</tbody>
</table>

### New Standards 4th Grade

- TCAP 2009-2010

<table>
<thead>
<tr>
<th>SPI 0406.3.2 Make generalizations about geometric and numeric patterns.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI 0406.3.3 Represent and analyze patterns using words,</td>
</tr>
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</table>

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### Former Blueprint Standards 3rd Grade

**Review material**

- Identify the rules by which objects or numbers have been sorted. **A**
- Recognize, describe, complete, translate, or create patterns of figures or numbers. **D**
- Extend repeating and growing numerical or geometric patterns. **A**
- Represent repeating geometric patterns as repeating numerical patterns. **A**
- Describe a growing pattern, involving objects, shapes, or numbers. **D**
- Describe qualitative change (e.g., a student growing taller). **D**
- Describe quantitative change (e.g., a student growing two inches in one year). **D**

- Demonstrate knowledge (with words or symbols) of the commutative properties of addition and multiplication. **D**
- Use the commutative property of addition and multiplication. **D**
- Show that subtraction is not commutative. **D**
- Apply the addition and subtraction properties of 0 (adding or subtracting 0 doesn’t change a number). **M**
- Apply the zero and identity properties of multiplication

### New Standards 3rd Grade

**Building blocks for new standards**

- Draw conclusions.
- **0306.3.7** Create different representations of a pattern given a verbal description.
- **0306.3.8** Analyze patterns in quantitative change resulting from computation.

### Former Blueprint Standards 4th Grade

**TCAP 2008-2009**

- Use the commutative, associative, zero, and identity properties for addition and multiplication. **D**

### New Standards 4th Grade

**TCAP 2009-2010**

- **0406.3.3** Create, explain and use a rule to generate terms of a pattern or sequence.
- **0406.3.4** Translate between symbolic, numerical, verbal, or pictorial representations of a whole number pattern or relationship.

### SPI 0306.3.1 Verify a conclusion using algebraic properties.

- **0306.3.1** Show that addition and multiplication are commutative operations.
- **0306.1.9** Use manipulatives to demonstrate that the commutative property holds for addition but not for subtraction.
- **0306.3.2** Show that subtraction and division are not commutative operations.
- **0306.3.3** Use commutative, associative, and distributive

### SPI 0406.1.1 Verify a conclusion using the commutative, associative and distributive properties.

- **0406.1.4** Use commutative, associative, and distributive properties of numbers including oral descriptions of mathematical reasoning.

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</table>
| (adding 0 or multiplying by 1 doesn’t change a number). I  
• Use arrays to represent the commutative property of multiplication. I | properties to multiply whole numbers.  
✓ 0306.3.4 Solve problems using the commutative, associative, and distributive properties. | | Investgate how a change in one variable relates to a change in a second variable. I |
| ▪ Demonstrate knowledge and understanding of grade level mathematical terms. D | SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate.  
✓ 0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas. | | |
Grade 4 – Geometry and Measurement

Former Learning Expectations

3.1 Analyze characteristics and properties of two- and three-dimensional shapes.
3.2 Specify locations and describe spatial relationships using coordinate geometry.
3.3 Apply transformations and use symmetry to analyze mathematical situations.
3.4 Use visualization, spatial reasoning, and geometric modeling to solve problems.
4.1 Understand measurable attributes of objects and the units, systems, and processes of measurement.
4.2 Apply appropriate techniques, tools, and formulas to determine measurements.

New Grade Level Expectations

GLE 0406.4.1 Understand and use the properties of lines, segments, angles, polygons, and circles.
GLE 0406.4.2 Understand and use measures of length, area, capacity, and weight.
GLE 0406.4.3 Solve problems that involve estimating and measuring length, area, capacity and weight.
GLE 0406.4.4 Understand the representation of location and movement within the first quadrant of a coordinate system.

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<tr>
<td>▪ Identify and draw horizontal and vertical lines. I</td>
<td>✓0306.4.3 Classify lines and segments as parallel, perpendicular, or intersecting.</td>
<td>▪ Identify points, lines, and rays. A</td>
<td>SPI 0406.4.1 Classify lines and line segments as parallel, perpendicular, or intersecting.</td>
</tr>
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<td></td>
<td></td>
<td>▪ Identify and draw points, lines, line segments, rays, and angles. D</td>
<td>✓0406.4.15 Explore properties of paths between points.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Create and describe mental images of objects, patterns, and paths. D</td>
<td>SPI 0406.4.4 Identify acute, obtuse, and right angles in 2-dimensional shapes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Describe the relationships between lines and the characteristics of angles (e.g., parallel, perpendicular, intersecting, right, acute, and obtuse). I</td>
<td>✓0406.4.3 Classify angles and triangles as obtuse, acute, or right.</td>
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<td></td>
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<td></td>
<td>✓0406.4.4 Measure and draw angles.</td>
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<td></td>
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<td></td>
<td>✓0406.4.2 Understand the definition of degree as it relates to the circle.</td>
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<tr>
<td>▪ Recognize geometric figures that are the same size and shape. A</td>
<td>SPI 0306.4.2 Determine if two figures are congruent based on size and shape.</td>
<td>▪ Recognize congruent geometric figures A.</td>
<td></td>
</tr>
<tr>
<td>▪ Read thermometers with Fahrenheit and Celsius scales</td>
<td>SPI 0306.4.5 Choose reasonable units of measure,</td>
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<tr>
<td></td>
<td></td>
<td>▪ Select appropriate standard units to measure length,</td>
<td>SPI 0406.1.4 Select appropriate measurement</td>
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<tr>
<td>(positive whole number temperatures). A</td>
<td>estimate common measurements using benchmarks, and use appropriate tools to make measurements. SPI 0306.1.7 Select appropriate units and tools to solve problems involving measures. SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate.</td>
<td>perimeter, area, capacity, volume, weight, time, temperature, and angles. A Read temperature using Fahrenheit and Celsius thermometers. A</td>
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<tr>
<td>• Select and apply the most appropriate standard units of length, area, capacity, weight, time, and temperature. D</td>
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<tr>
<td>• Solve real-world problems involving measurement. D</td>
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<td>• Determine when an estimate of a measurement is sufficient. D</td>
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<td>• Demonstrate understanding of the concepts of perimeter, area, and capacity. D</td>
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<tr>
<td>• Use strategies to estimate or determine length, perimeter, area, capacity, weight, time, and temperature. D</td>
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<td>• Measure to the nearest liter, cup, pint, quart, and gallon. D</td>
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<tr>
<td>• Measure to the nearest ounce, pound, kilogram, and gram. D</td>
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<td>• Identify, compare, and analyze attributes of two- and three-dimensional shapes. D</td>
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<tr>
<td>• Develop and use mathematical language to describe characteristics and properties of geometric figures. D</td>
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<tr>
<td>• Compare properties of two- and three-dimensional geometric figures. D</td>
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<tr>
<td>• Demonstrate understanding of the concepts of length, perimeter, area, weight, capacity, volume, time, and angle measure. D</td>
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<tr>
<td>• Select and use tools to measure weight and volume in customary or metric units. D</td>
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<tr>
<td>• Use strategies to estimate or determine length, perimeter, area, capacity, weight, time, and temperature. D</td>
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<tr>
<td>• Demonstrate understanding of the concepts of perimeter, area, capacity, weight, time, temperature, and angles. A</td>
<td>instrument and compare objects with respect to a given geometric or physical attribute. SPI 0406.4.7 Determine appropriate size of unit of measurement in problem situations involving length, capacity or weight.</td>
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<tr>
<td>• Read temperature using Fahrenheit and Celsius thermometers. A</td>
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</tr>
<tr>
<td>• Identify, compare, and analyze attributes of two- and three-dimensional shapes. D</td>
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<td>• Demonstrate understanding of the concepts of length, perimeter, area, weight, capacity, volume, time, and angle measure. D</td>
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<tr>
<td>• Select and use tools to measure weight and volume in customary or metric units. D</td>
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<tr>
<td>▪ Select an appropriate standard unit to measure length. <strong>A</strong>&lt;br&gt;▪ Use estimation to determine if a length measurement is reasonable. <strong>A</strong>&lt;br&gt;▪ Measure length to the nearest centimeter and inch. <strong>A</strong>&lt;br&gt;▪ Explain the relationships among inches, feet, and yards. <strong>D</strong>&lt;br&gt;▪ Measure to the nearest centimeter, foot, half-inch, and inch. <strong>D</strong></td>
<td><strong>SPI 0306.4.6 Measure length to the nearest centimeter or half inch.</strong>&lt;br&gt;0306.4.11 Know common equivalences for length (1 meter = 100 centimeters, 1 yard = 3 feet, 1 foot = 12 inches).&lt;br&gt;0306.4.13 Use common abbreviations: km, m, cm, in, ft, yd, mi.</td>
<td>▪ Demonstrate understanding of the relationships among units of length. <strong>D</strong>&lt;br&gt;▪ Measure length to the nearest 1/4 inch or nearest centimeter. <strong>A</strong></td>
<td></td>
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<tr>
<td>▪ Identify a location on a grid using whole number coordinates. <strong>I</strong>&lt;br&gt;▪ Use appropriate mathematical language to find a point on a grid using whole number coordinates. <strong>A</strong></td>
<td></td>
<td>▪ Use estimation to determine if a length or volume measurement is reasonable <strong>A</strong>.&lt;br&gt;▪ Estimate using standard units of measure. <strong>D</strong>&lt;br&gt;▪ Demonstrate understanding that measurements are approximations. <strong>I</strong></td>
<td><strong>SPI 0406.4.6 Determine situations in which a highly accurate measurement is important.</strong>&lt;br&gt;0406.4.12 Estimate the size of an object with respect to a given measurement attribute (length, perimeter, area, or capacity).</td>
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<td>▪ Locate and specify points in Quadrant 1 of a coordinate system. <strong>A</strong>&lt;br&gt;▪ Construct and draw two- and three-dimensional geometric figures. <strong>D</strong></td>
<td><strong>SPI 0406.4.2 Graph and interpret points with whole number or letter coordinates on grids or in the first quadrant of the coordinate plane.</strong>&lt;br&gt;<strong>SPI 0406.4.3 Construct geometric figures with vertices at points on a coordinate grid.</strong>&lt;br&gt;0406.4.14 Explain how the components of a coordinate system are used to determine</td>
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| **Review material**                          | **Building blocks for new standards** | **SPI 0306.4.1 Recognize polygons and be able to identify examples based on geometric definitions.**  
**SPI 0306.1.6 Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.**  
✓ 0306.4.1 Describe properties of plane figures (such as circles, triangles, squares and rectangles).  
✓ 0306.4.2 Classify polygons according to the number of their sides and angles. | **SPI 0406.4.5 Identify attributes of simple and compound figures composed of 2- and 3-dimensional shapes.**  
✓ 0406.4.1 Identify the basic parts of circles.  
✓ 0406.4.5 Determine if a figure is a polygon.  
✓ 0406.4.21 Recognize two-dimensional faces of three-dimensional shapes. |
| ▪ Identify, build, draw, and compare two- and three-dimensional geometric figures (e.g., rectangle, square, triangle, circle, cube, cylinder, sphere, and cone). **D** | | ▪ Identify two- or three-dimensional shapes given defining attributes. **A**  
▪ Investigate and describe the results of subdividing and combining two-dimensional geometric figures. **D** | |
| ▪ Name two-dimensional geometric figures (e.g., rectangle, square, triangle, circle, cube, cylinder, sphere, and cone). **A** | | | |
| ▪ Name three-dimensional geometric figures (e.g., rectangle, square, triangle, circle, cube, cylinder, sphere, and cone). **A** | | | |
| ▪ Identify and draw diagonals of polygons. **I** | | | |
| ▪ Solve real-world problems involving addition and subtraction of one- or two-digit measurements. **A** | **SPI 0306.4.7 Solve problems requiring the addition and subtraction of lengths.**  
✓ 0306.1.11 Develop strategies | **SPI 0406.4.8 Convert measurements within a single system that are common in daily life (e.g., hours and minutes, inches and feet, centimeters and meters, quarts and gallons, liters and milliliters).**  
✓ 0406.4.7 Measure liquids using both standard units and metric units.  
✓ 0406.4.6 Recognize the use of decimals in metric measures. | **SPI 0406.4.9 Solve problems involving area and/or perimeter of rectangular figures.** |

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</table>
| • Find the perimeter of a rectangle on a grid. A  
• Find the perimeter of polygons. D | for solving problems involving addition and subtraction of measurements.  
SPI 0306.4.4 Calculate the perimeter of shapes made from polygons. | • Solve real-world problems involving addition and subtraction of measurements. A  
• Explore perimeter and area using a variety of models (e.g., geoboards, graph paper). D  
• Develop strategies for estimating the perimeters and areas (such as counting square units) of geometric figures. D  
• Use geometric models to solve real-world problems. I | ✓ 0406.4.8 Recognize that a measure of area represents the total number of same-sized units that cover the shape without gaps or overlaps.  
✓ 0406.4.9 Recognize that area does not change when 2-dimensional figures are cut apart and rearranged.  
✓ 0406.4.10 Connect area measure to multiplication using a rectangular area model.  
✓ 0406.4.10 Estimate areas of rectangles in square inches and square centimeters. |
| • Identify the result of a transformation that has been applied to a simple two-dimensional geometric shape (i.e., flips or slides). A  
• Identify the line of symmetry in a two-dimensional design or shape. A  
• Draw lines of symmetry in two-dimensional designs and shape. D  
• Predict and identify the results of sliding, flipping, or turning two-dimensional shapes. D | SPI 0306.4.3 Identify the line of symmetry in a two-dimensional design or shape. ✓ 0306.4.4 Identify, create, and describe figures with line symmetry. | • Identify lines of symmetry for two-dimensional geometric figures. A  
• Identify the result of a transformation (flip or slide) that has been applied to a simple two-dimensional geometric shape. A  
• Identify and draw lines of symmetry for two-dimensional geometric figures. D  
• Identify, predict, and describe the results of transformations of two-dimensional geometric figures (i.e., slides, flips, and turns). D Describe a motion that will show that two shapes are congruent. I | SPI 0406.4.10 Identify images resulting from reflections, translations, or rotations.  
✓ 0406.4.16 Examine transformations in the coordinate plane.  
✓ 0406.4.17 Predict the results of a transformation of a geometric shape.  
✓ 0406.4.18 Determine whether a geometric shape has line and/or rotational symmetry.  
✓ 0406.4.19 Design and analyze simple tilings and tessellations.  
✓ 0406.4.20 Draw lines of symmetry in 2-dimensional figures. |
| • Solve real-world problems | SPI 0306.1.1 Solve problems | • Tell time to the nearest | |

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### Former Blueprint Standards 3rd Grade

**Review material**

- Solve real-world problems involving elapsed time to the half-hour. **A**
- Read and write time at five-minute intervals. **A**
- Read and write time to the nearest hour, half-hour, and quarter-hour. **A**

### New Standards 3rd Grade

**Building blocks for new standards**

- Using a calendar.
- SPI 0306.1.2 Solve problems involving elapsed time
  - 0306.1.1 Read and write time to the nearest minute.

### Former Blueprint Standards 4th Grade

**TCAP 2008-2009**

- Solve real-world problems involving elapsed time to the quarter-hour. **A**

### New Standards 4th Grade

**TCAP 2009-2010**

- 0306.1.10 Use correct, clearly written and oral mathematical language to pose questions and communicate ideas.
**Grade 4 – Data, Probability and Statistics**

**Former Learning Expectations**

5.1 Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer questions.

5.2 Select and use appropriate statistical methods to analyze data.

5.3 Develop and evaluate inferences and predictions that are based on data.

5.4 Understand and apply basic concepts of probability.

**New Grade Level Expectations**

GLE 0406.5.1 Collect, record, arrange, present, and interpret data using tables and various representations.

GLE 0406.5.2 Use probability to describe chance events.

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<tr>
<td>▪ Write questions and gather data to answer questions. D</td>
<td>✓ 0306.5.1 Collect and organize data using observations, surveys, and experiments.</td>
<td>▪ Collect data using observations, surveys, and experiments. I</td>
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<td></td>
<td>▪ Understand how data-collection methods could affect the results. I</td>
<td>▪ Design investigations to try to answer a question. I</td>
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<tr>
<td>▪ Interpret and construct tables using tally marks. D</td>
<td>SPI 0306.5.1 Interpret a frequency table, bar graph, pictograph and line plot. SPI 0306.5.2 Solve problems in which data is represented in tables or graph. SPI 0306.1.8 Express answers clearly in verbal, numerical, or graphical (bar and picture) form, using units when appropriate. ✓0306.5.3 Compare and interpret different representations of the same data. ✓0306.5.2 Construct a frequency table, bar graph, pictograph, or line plot of collected data.</td>
<td>✓ 0306.5.1 Create and label appropriate scales for graphs. ✓ 0406.5.2 Evaluate how well various representations show the collected data. ✓ 0406.5.3 Interpret and prepare pie charts using appropriate measurements of angles. ✓ 0406.5.4 Develop and use stem-and-leaf plots.</td>
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<tr>
<td>▪ Construct pictographs and bar graphs. D</td>
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### SPI 0306.5.3 Make predictions based on various representations of data.
- 0306.5.4 Solve problems using data from frequency tables, bar graphs, pictographs, or line plots.

- **New Standards 3rd Grade**
  - Make predictions from data. **D**

- **New Standards 4th Grade**
  - Explore and determine measures of central tendency (i.e., mean, median, and mode). **D**
  - Determine the median of a data set. **A**

### SPI 0406.5.2 Solve problems using estimation and comparison within a single set of data.

- **New Standards 4th Grade**
  - SPI 0406.5.3 Given a set of data or a graph, describe the distribution of the data using median, range, or mode.
  - 0406.5.5 Use measures of central tendency to compare two sets of related data.

### New Standards 4th Grade
- SPI 0406.5.4 List all possible outcomes of a given situation or event.

- **New Standards 4th Grade**
  - 0406.5.6 Determine a simple probability.
  - 0406.5.7 Express a probability pictorially.
Grade 5 Transition to New TN Mathematics Standards

Grade 5 – Mathematical Processes

New Grade Level Expectations

GLE 0506.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0506.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0506.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0506.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0506.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0506.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0506.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0506.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)

✓ 0506.1.1 Make and test conjectures about geometric properties and develop logical arguments to justify conclusions.
✓ 0506.1.2 Make reasonable estimates of fraction and decimal sums or differences using models.
✓ 0506.1.3 Explore different methods of estimation including rounding and truncating.
✓ 0506.1.4 Explore problems in different contexts to interpret the meaning of remainders as discrete values or not.
✓ 0506.1.5 Solve problems in more than one way and explain why one process may be more effective than another.
✓ 0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units.
✓ 0506.1.7 Organize and consolidate verbal statements involving fractions and mixed numbers into diagrams, symbols, and numerical expressions.
✓ 0506.1.8 Use patterns, models, and relationships as contexts for writing inequalities and simple equations.
✓ 0506.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.

State Performance Indicators

SPI 0506.1.1 Given a series of geometric statements, draw a conclusion about the figure described.
SPI 0506.1.2 Estimate fraction and decimal sums or differences.
SPI 0506.1.3 Recognize the unit associated with the remainder in a division problem or the meaning of the fractional part of a whole given in either decimal or fraction form.
SPI 0506.1.4 Identify missing information and/or too much information in contextual problems.
**Grade 5th – Number and Operation**

**Former Learning Expectations**

1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand meanings of operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

**New Grade Level Expectations**

GLE 0506.2.1 Extend the understanding of place value through millions and millionths in various contexts and representations.
GLE 0506.2.2 Write natural numbers (to 50) as a product of prime factors and understand that this is unique (apart from order).
GLE 0506.2.3 Develop fluency with division of whole numbers. Understand the relationship of divisor, dividend, and quotient in terms of multiplication and division.
GLE 0506.2.4 Develop fluency with addition and subtraction of proper and improper fractions and mixed numbers. Explain and model the algorithm.
GLE 0506.2.5 Develop fluency in solving multi-step problems using whole numbers, fractions, mixed numbers, and decimals.

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- **Read and write numbers from hundred-thousands to hundredths. A**
- **Represent whole numbers to 9999. A**
- **Identify the place value of a given digit from hundred-thousands to hundredths. A**
- **Represent whole numbers up to 10,000 in expanded form (1,000’s + 100’s +10’s +1’s). A**

- **SPI 0406.2.1 Read and write numbers from hundredths to hundred-thousands in numerals and in words.**
- **SPI 0406.2.3 Identify the place value of a specified digit in a number and the quantity it represents.**
  - 0406.2.1 Compose and decompose quantities according to place value.
  - 0406.2.12 Understand and use decimal numbers up to hundredths and write them as fractions.

- **SPI 0406.2.4 Find factors, common factors, multiples, and common multiples of two numbers.**
  - 0406.2.7 Identify factors of whole numbers and model factors and products beyond basic multiplication facts using

- **SPI 0406.2.5 Develop fluency in solving multi-step problems using whole numbers, fractions, mixed numbers, and decimals.**

- **Read and write numbers from millions to thousandths. A**
- **Identify the place value of a given digit from millions to thousandths. A**
- **Represent whole numbers and two-place decimals in expanded form. A**

- **SPI 0506.2.1 Read and write numbers from millions to millionths in various contexts.**

- **SPI 0506.2.2 Write the prime factorization of numbers through 50 using both exponential and standard notation.**
  - 0506.2.1 Identify prime numbers up to 50.
  - 0506.2.2 Use the prime...
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| **Review material**                     | arrays and area models.     |                                        | factorization of two whole numbers to determine the greatest common factor and the least common multiple.  
|                                         |                             |                                        | ✓ 0506.2.4 Use divisibility rules to factor numbers.  
|                                         |                             |                                        | ✓ 0506.2.10 Use exponential notation to represent repeated multiplication of whole numbers.  |
| **Select appropriate methods and tools for computing with whole numbers (e.g., mental computation, estimation, calculators, paper and pencil, guess and check).** I |                             | **Multiply a fraction by a multiple of its denominator (denominator less than or equal to 10).** A  
|                                         |                             | **Select appropriate methods and tools for computations (e.g., mental computation, estimation, calculators, and paper and pencil).** D  |
| **Multiply efficiently and accurately with single-digit whole numbers.** A  
| **Multiply decimals (includes monetary units).** I  
| **Explain the relationship between addition and subtraction.** D  
| **Divide efficiently and accurately with single-digit whole numbers.** D  
| **Explain the relationship between multiplication and division.** I  
| **Explain how addition, subtraction, multiplication, and division affect the size and order of numbers.** I  | **SPI 0406.2.11 Solve problems using whole number multi-digit multiplication.**  
✓ 0406.2.3 Multiply two- and three-digit whole numbers.  
✓ 0406.2.4 Understand and use a reliable algorithm for multiplying multi-digit numbers and dividing numbers by a single-digit divisor accurately and efficiently.  
**SPI 0406.2.12 Solve problems using whole number division with one- or two-digit divisors.**  
✓ 0406.2.4 Understand and use a reliable algorithm for multiplying multi-digit numbers  | **Add, subtract, multiply, and divide whole numbers (multipliers and divisors no more than two-digits).** A  
|                                         |                             | **Explain and demonstrate the inverse nature of addition and subtraction.** D  
|                                         |                             | **Explain and demonstrate the inverse nature of multiplication and division.** D  
<p>|                                         |                             | <strong>Explain how addition, subtraction, multiplication, and division affect the size and order of numbers.</strong> D  |<br />
|                                         |                             | 0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units.  |</p>
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- Solve one-step real-world problems involving addition or subtraction of whole numbers and/or decimals. A
- Solve one-step real-world problems involving multiplication of whole numbers and/or decimals. A
- Select the appropriate computational and operational method to solve word problems. D
- Solve story problems using whole numbers, fractions, and decimals (includes money). D
- Identify missing information and/or too much information in word problems I.
- Apply logical reasoning to solve real-world problems. I
- Estimate the results of whole-number and dividing numbers by a single-digit divisor accurately and efficiently.

  - 0406.2.5 Understand that division by zero is undefined.
  - 0406.2.6 Divide three-digit whole numbers by one-digit divisors fluently with pencil and paper.
  - 0406.2.10 Use models to understand division as the inverse of multiplication, partitioning, and repeated subtraction
  - 0406.2.14 Understand the role of the remainder in division.

- SPI 0406.2.10 Solve contextual problems using whole numbers, fractions, and decimals including money.

  - 0406.2.13 Solve multi-step problems of various types using whole numbers, fractions, and decimals.
  - 0406.1.7 Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.
  - 0406.1.9 Develop a story problem that illustrates a given multiplication or division number sentence.
  - 0406.1.1 Understand the relationship between use of

- SPI 0406.2.10 Solve contextual problems using whole numbers, fractions, and decimals including money.

- SPI 0506.1.4 Identify missing information and/or too much information in contextual problems.

  - 0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units.
  - 0506.1.7 Organize and consolidate verbal statements involving fractions and mixed numbers into diagrams, symbols, and numerical expressions.
  - 0506.1.5 Solve problems in more than one way and explain why one process may be more effective than another.
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- Use estimation to select a reasonable solution to a whole number computation involving addition, subtraction, or multiplication. **A**
- Add, subtract, multiply, and divide whole numbers (multipliers and divisors no more than two-digits). **A**
- Add, subtract, and multiply decimals. **A**
- **D**

- **0406.1.2** Identify the range of appropriate estimates, including over-estimate and under-estimate.
- **0406.1.3** Connect operations with decimals to money and make estimates.

- **SPI 0506.1.3** Recognize the unit associated with the remainder in a division problem or the meaning of the fractional part of a whole given in either decimal or fraction form.
- **SPI 0506.2.3** Select a reasonable solution to a real-world division problem in which the remainder must be considered.
- **SPI 0506.2.4** Solve problems involving the division of two- and three-digit whole numbers by one- and two-digit whole numbers.
- **0506.2.7** Understand the placement of the decimal point in calculations of multiplication and long division, including the placement in the estimation of the answer.
### Former Blueprint Standards 4th Grade

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- Add and subtract fractions with like denominators. A
- Add and subtract decimals (includes monetary units). A
- SPI 0406.2.8 Add and subtract proper fractions with like and unlike denominators and simplify the answer.
- SPI 0406.2.9 Add and subtract decimals through hundredths.
- SPI 0406.1.3 Determine the correct change from a transaction.
- Add and subtract commonly used fractions. A
- Add, subtract, and multiply decimals. A
- SPI 0506.2.6 Add and subtract proper and improper
- SPI 0506.2.5 Solve addition and subtraction problems involving both fractions and decimals.
  - 0506.2.3 Use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals.
  - 0506.2.5 Make reasonable estimates of fraction and decimal sums and differences.

Division by zero is undefined.
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| ▪ Identify fractions as parts of whole units, as parts of sets, as locations on number lines, and as divisions of whole numbers **A**.  
▪ Generate equivalent forms of whole numbers, commonly used fractions, and decimals. **A**  
▪ Represent numbers as both improper fractions and mixed numbers. **A**  
▪ Use concrete or pictorial representations to compare and order commonly used fractions. **D**  
▪ Use concrete and pictorial representations to compare decimals. **D**  
▪ Use various models and equivalent forms to represent, order, and compare whole numbers. **D** | SPI 0406.2.2 Locate and place mixed numbers on the number line.  
SPI 0406.2.5 Generate equivalent forms of common fractions and decimals and use them to compare size.  
SPI 0406.2.7 Convert improper fractions into mixed numbers and/or decimals.  
✓0406.2.8 Generate equivalent forms of whole numbers, decimals, and common fractions (e.g., 1/10, ¼, ½, ¾). | ▪ Add, subtract, and multiply decimals. **A**  
▪ Connect symbolic representations of proper and improper fractions to models of proper and improper fractions. **A**  
▪ Represent numbers as both improper fractions and mixed numbers. **A**  
▪ Generate equivalent forms of commonly used fractions, decimals, and percents (e.g., 1/10, 1/4, 1/2, .75, 50%). **A**  
▪ Represent proper fractions, improper fractions, and mixed numbers using concrete objects, pictures, and the number line. **D**  
▪ Identify and change improper fractions to mixed numbers and vice versa. **D**  
▪ Recognize relationships among commonly used fractions and mixed numbers as well as mixed numbers.  
SPI 0506.1.2 Estimate fraction and decimal sums or differences.  
✓0506.2.6 Add and subtract mixed numbers.  
✓0506.1.2 Make reasonable estimates of fraction and decimal sums or differences using models.  
✓0506.1.3 Explore different methods of estimation including rounding and truncating. | SPI 0506.2.7 Recognize equivalent representations for the same number.  
SPI 0506.2.8 Write terminating decimals in the form of fractions or mixed numbers.  
✓0506.1.6 Communicate answers in correct verbal and numerical form; including use of mixed numbers or fractions and use of units. |
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| numbers and commonly used fractions and mixed numbers (e.g., number lines, base ten blocks, expanded notation, Venn diagrams, and hundreds boards). **D** | | Decimals. **D** | SPI 0506.2.9 Compare whole numbers, decimals and fractions using the symbols <, >, and =.  
✓ 0506.2.9 Explore numbers less than 0 by extending the number line through familiar applications (e.g., temperatures below zero, owing money, measuring elevation below sea level). |
| **•** Compare and order whole numbers to 9999 using the appropriate symbols (>, <, and =). **A**  
**•** Use various models and equivalent forms to represent, order, and compare whole numbers and commonly used fractions and mixed numbers (e.g., number lines, base ten blocks, expanded notation, Venn diagrams, and hundreds boards). **D** | SPI 0406.2.6 Use the symbols <, > and = to compare common fractions and decimals in both increasing and decreasing order.  
SPI 0406.1.2 Compare decimals using concrete and pictorial representations.  
✓ 0406.1.8 Match the spoken, written, concrete (including base ten blocks), and pictorial representations of decimals.  
✓ 0406.2.2 Understand decimal notation as an extension of the base-ten number system.  
✓ 0406.2.9 Compare equivalent forms whole numbers, fractions, and decimals to each other and to benchmark numbers.  
✓ 0406.2.11 Use models, benchmarks, and equivalent forms to compare fractions/decimals and locate them on the number line. | Represent, compare, and order whole numbers and decimals to thousandths **A**.  
**•** Compare and order fractions using the appropriate symbol (<, >, and =). **A**  
**•** Order and compare (<, >, or =) whole numbers, fractions, mixed numbers, and decimals using models (e.g., number lines, base ten blocks, Venn diagrams, and hundreds boards). **D** | |
| **•** Demonstrate knowledge and understanding of grade level mathematical terms. **D** | | **•** Demonstrate knowledge and understanding of grade level mathematical terms. **D** |  
**•** Use commutative, associative, and identity properties. **M** |

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### Grade 5th – Algebra

**Former Learning Expectations**
- 2.1 Understand patterns, relations, and functions.
- 2.2 Represent and analyze mathematical situations and structures using algebraic symbols.
- 2.3 Illustrate general properties of operations.
- 2.4 Analyze change in various contexts.

**New Grade Level Expectations**
- GLE 0506.3.1 Understand and use order of operations.
- GLE 0506.3.2 Develop and apply the concept of variable.
- GLE 0506.3.3 Understand and apply the substitution property.
- GLE 0506.3.4 Solve single-step linear equations and inequalities.

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<tr>
<td>▪ Generalize and extend or complete patterns involving geometric figures or numbers. D</td>
<td>SPI 0406.3.2 Make generalizations about geometric and numeric patterns.</td>
<td>▪ Generalize and extend or complete patterns involving geometric figures or numbers. D</td>
<td></td>
</tr>
<tr>
<td>▪ Extend numerical and geometric patterns. A</td>
<td>SPI 0406.3.3 Represent and analyze patterns using words, function tables, and graphs. ✓ 0406.3.3 Create, explain and use a rule to generate terms of a pattern or sequence. ✓ 0406.3.4 Translate between symbolic, numerical, verbal, or pictorial representations of a whole number pattern or relationship.</td>
<td>▪ Extend numerical patterns. A</td>
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<tr>
<td>▪ Represent and analyze patterns and relationships using words, tables, and graphs. D</td>
<td></td>
<td>▪ Extend geometric patterns. A</td>
<td></td>
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<tr>
<td>▪ Determine the function rule for data in a function table. A</td>
<td></td>
<td>▪ Generalize numerical patterns using a variable. A</td>
<td></td>
</tr>
<tr>
<td>▪ Apply basic function rules. A</td>
<td></td>
<td>▪ Represent and analyze patterns and functions using words, tables, and graphs. D</td>
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<tr>
<td>▪ Use the commutative, associative, zero, and identity properties for addition and multiplication. D</td>
<td>SPI 0406.1.1 Verify a conclusion using the commutative, associative and distributive properties. ✓ 0406.1.4 Use commutative, associative, and distributive properties of numbers including oral descriptions of mathematical reasoning.</td>
<td>▪ Determine or apply a function rule involving data in a function table. D</td>
<td>SPI 0506.3.2 Evaluate multi-step numerical expressions involving fractions using order of operations. SPI 0506.3.1 Evaluate algebraic expressions involving decimals and fractions using order of operations. 0506.3.1 Evaluate an expression by substituting non-negative rational number values for letter variables in the expression.</td>
</tr>
<tr>
<td>▪ Solve open sentences involving addition and</td>
<td>SPI 0406.3.1 Use letters and symbols to represent an</td>
<td>▪ Apply basic function rules. A</td>
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<td></td>
<td></td>
<td>▪ Apply commutative, associative, zero, distributive, and identity properties. M</td>
<td>▪ Show that division is not commutative. M</td>
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<td>▪ Demonstrate understanding that an equation is a number</td>
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<td>SPI 0506.3.3 Find the unknown in single-step</td>
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<td>subtraction A.</td>
<td><strong>unknown quantity and write a simple mathematical expression.</strong></td>
<td><strong>sentence stating two quantities are equal. M</strong></td>
<td>equations involving fractions and mixed numbers. SPI 0506.3.4 Given a set of values, identify those that make an inequality a true statement.</td>
</tr>
<tr>
<td>• Solve open sentences involving multiplication and division. A Connect open sentences to real-world situations. A</td>
<td>✓ 0406.3.1 Find an unknown quantity in simple equations using whole numbers, fractions, decimals, and mixed numbers. ✓ 0406.3.2 Translate between symbols and words to represent quantities in expressions or equations. ✓ 0406.1.7 Translate the details of a contextual problem into diagrams and/or numerical expressions, and express answers using appropriate units.</td>
<td>✓ Solve open sentences involving addition, subtraction, multiplication, and division. A Connect open sentences to real-world situations. A Represent the idea of a variable as an unknown quantity using a letter or a symbol. D Select an equation that represents a given mathematical relationship. A</td>
<td>✓ 0506.1.5 Solve problems in more than one way and explain why one process may be more effective than another. ✓ 0506.1.8 Use patterns, models, and relationships as contexts for writing inequalities and simple equations. ✓ 0506.3.2 Use variables appropriately to represent numbers whose values are not yet known. ✓ 0506.3.3 Solve single-step linear equations using inverse operations. ✓ 0506.3.4 Solve single-step linear inequalities and graph solutions on a number line. ✓ 0506.3.5 Determine if a given value is a solution to a linear equation/inequality.</td>
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<tr>
<td>• Demonstrate understanding that an equation is a number sentence stating that two quantities are equal. D</td>
<td></td>
<td></td>
<td>✓ 0506.3.6 Recognize there are many numbers between any two whole numbers on the number line.</td>
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<tr>
<td>• Represent the idea of a variable as an unknown quantity by using a letter or a symbol. I</td>
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<tr>
<td>• Investigate how a change in one variable relates to a change in a second variable. I</td>
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<tr>
<td>• Investigate how a change in one variable relates to a change in a second variable. D</td>
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5th Grade  
TCAP 2008-2009 | **New Standards** 5th Grade  
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|---|---|---|---|
|  |  | constant and/or varying rates of change and to solve real-world problems (e.g., extending rate charts). **D**  
- Extend rate charts to solve real-world problems. **A** |  |
**Grade 5 Geometry and Measurement**

**Former Learning Expectations**

3.1 Analyze characteristics and properties of two- and three-dimensional shapes.
3.2 Specify locations and describe spatial relationships using coordinate geometry.
3.3 Apply transformations and use symmetry to analyze mathematical situations.
3.4 Use visualization, spatial reasoning, and geometric modeling to solve problems.
4.1 Understand measurable attributes of objects and the units, systems, and processes of measurement.
4.2 Apply appropriate techniques, tools, and formulas to determine measurements.

**New Grade Level Expectations**

GLE 0506.4.1 Use basic formulas and visualization to find the area of geometric figures.
GLE 0506.4.2 Describe polyhedral solids and analyze their properties, including volume and surface area.
GLE 0506.4.3 Describe length/distance relationships using the first quadrant of the coordinate system.
GLE 0506.4.4 Solve problems that require attention to both approximation and precision of measurement.

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<td>Find the perimeter of rectangles. A</td>
<td>SPI 0406.4.9 Solve problems involving area and/or perimeter of rectangular figures. A 0406.4.8 Recognize that a measure of area represents the total number of same-sized units that cover the shape without gaps or overlaps. A 0406.4.9 Recognize that area does not change when 2-dimensional figures are cut apart and rearranged. A 0406.4.10 Connect area measure to multiplication using</td>
<td>Solve real-world problems involving addition and area of rectangles. A Apply formulas to find the area of parallelograms and triangles. A Use strategies to estimate perimeter and area of rectangles. A Solve real-world problems involving addition and subtraction of measurements. A Solve real-world problems involving perimeter and area</td>
<td>SPI 0506.4.1 Solve contextual problems that require calculating the area of triangles and parallelograms. A 0506.4.1 Develop the formula for the area of a triangle as it relates to the area of a parallelogram/rectangle. SPI 0506.4.2 Decompose irregular shapes to find perimeter and area. A 0506.4.2 Find the area of a convex polygon by decomposing it into triangles/rectangles.</td>
</tr>
<tr>
<td>Apply the formula for finding the area of a rectangle A</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Solve real-world problems involving addition and subtraction of measurements. A</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Explore perimeter and area using a variety of models (e.g., geoboards, graph paper). D</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Develop strategies for estimating the perimeters and areas (such as counting</td>
<td>A</td>
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- **D** Use geometric models to solve real-world problems.  
- **A** Explore what happens to measurements of a two-dimensional shape when the shape is changed in some way (e.g., perimeter, area).

### 4th Grade

- **D** Identify, compare, and analyze attributes of two- and three-dimensional shapes.  
- **A** Develop and use mathematical language to describe characteristics and properties of geometric figures.  
- **D** Compare properties of two- and three-dimensional geometric figures.

#### Former Standards

- **SPI 0406.4.5** Identify attributes of simple and compound figures composed of 2- and 3- dimensional shapes.  
  - **0406.4.1** Identify the basic parts of circles.  
  - **0406.4.5** Determine if a figure is a polygon.  
  - **0406.4.21** Recognize two-dimensional faces of three-dimensional shapes.

#### New Standards

- **D** Develop informal strategies to identify the three-dimensional figure created from a two-dimensional representation (net) of that figure (i.e., cube, rectangular prism, pyramid, cone, or cylinder).  
- **A** Construct and draw two- and three-dimensional geometric figures.

### 5th Grade

- **D** Identify, compare, and analyze attributes of two- and three-dimensional figures.  
- **A** Develop and use mathematical language to describe characteristics and properties of geometric figures.  
- **D** Identify, compare, and analyze attributes of two- and three-dimensional figures.  
- **I** Make and test hypothesis about geometric properties.

#### Former Standards

- **SPI 0506.1.1** Given a series of geometric statements, draw a conclusion about the figure described.  
  - **0506.1.1** Make and test conjectures about geometric properties and develop logical arguments to justify conclusions.

#### New Standards

- **SPI 0506.4.3** Identify a three-dimensional object from two-dimensional representations of that object and vice versa.  
  - **0506.4.3** Build, draw, and work with prisms by means of orthogonal views, projective views, and nets.  
  - **0506.4.4** Describe and identify the five regular (Platonic) solids and their properties with respect to faces, shapes of faces, edges, and vertices.
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| ▪ Identify points, lines, and rays. **A**           | **SPI 0406.4.1 Classify lines and line segments as parallel, perpendicular, or intersecting.**  
✓ 0406.4.15 Explore properties of paths between points. | ▪ Identify lines, line segments, rays, and angles. **A**  
▪ Identify and draw points, lines, line segments, rays, and angles. **D**  
▪ Create and describe mental images of objects, patterns, and paths. **D** | ▪ Determine the surface area and volume of rectangular solids. **I**  
▪ Recognize and build a 3-dimensional object from a 2-dimensional representation (net) of that object (e.g., cube, rectangular prism, pyramid, cone, or cylinder). **D**  
▪ Use visualization and spatial reasoning (e.g., geometric models) to solve problems. **I**  
▪ **SPI 0506.4.5 Find the length of vertical or horizontal line segments in the first quadrant of the coordinate system, including problems that require the use of fractions and decimals.**  
✓ 0506.4.8 Identify characteristics of the set of points that define vertical and horizontal line segments. |
| ▪ Locate and specify points in Quadrant 1 of a coordinate system. **A** | **SPI 0406.4.2 Graph and interpret points with whole number or letter coordinates on grids or in the first quadrant of the coordinate plane.**  
**SPI 0406.4.3 Construct geometric figures with vertices at points on a coordinate grid.**  
✓ 0406.4.14 Explain how the components of a coordinate system are used to determine location. | ▪ Locate and specify a point in Quadrant I of a coordinate system **A**. |  |
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| • Describe the relationships between lines and the characteristics of angles (e.g., parallel, perpendicular, intersecting, right, acute, and obtuse). I | SPI 0406.4.4 Identify acute, obtuse, and right angles in 2-dimensional shapes. ✓ 0406.4.3 Classify angles and triangles as obtuse, acute, or right. ✓ 0406.4.4 Measure and draw angles. ✓ 0406.4.2 Understand the definition of degree as it relates to the circle. | • Describe the relationships between lines and the characteristics of angles (e.g., parallel, perpendicular, intersecting, right, acute, obtuse, and straight). D | \[
\text{SPI 0506.4.6 Record measurements in context to reasonable degree of accuracy using decimals and/or fractions.} \\
\text{✓ 0506.4.7 Understand, select and use units of appropriate size and type to measure angles, lengths/distances, area, surface area and volume.} \\
\text{✓ 0506.4.9 Correctly interpret significant digits in the accuracy of measurements and associated calculations.✓} \\
\text{0506.4.10 Recognize that measurements are never exact.} \\
\text{✓ 0506.4.11 Understand the usefulness of approximations.} \\
\text{✓ 0506.4.12 Develop strategies for choosing correct tools of measurement.} \\
\text{✓ 0506.4.13 Recognize and use measures of weight and temperature.}
\] |
<p>| • Use estimation to determine if a length or volume measurement is reasonable A. • Select appropriate standard units to measure length, perimeter, area, capacity, volume, weight, time, temperature, and angles. A • Read temperature using Fahrenheit and Celsius thermometers. A • Measure length to the nearest 1/4 inch or nearest centimeter. A • Estimate using standard units of measure. D • Demonstrate understanding that measurements are approximations. I • Demonstrate understanding of the concepts of length, perimeter, area, weight, capacity, volume, time, and angle measure. D • Select and use tools to measure weight and volume in | SPI 0406.4.6 Determine situations in which a highly accurate measurement is important. ✓ 0406.4.12 Estimate the size of an object with respect to a given measurement attribute (length, perimeter, area, or capacity). SPI 0406.1.4 Select appropriate measurement instrument and compare objects with respect to a given geometric or physical attribute. SPI 0406.4.7 Determine appropriate size of unit of measurement in problem situations involving length, capacity or weight. ✓ 0406.1.6 Identify geometric or physical attributes that are appropriate to measure in a given situation. ✓ 0406.1.5 Measure using ruler, meter stick, clock, | • Use a ruler to measure to the nearest centimeter and ¼ inch. A • Connect simple units of measurement within the same system of measurement. A • Select appropriate standard units to measure length, perimeter, area, capacity, volume, weight, time, temperature, and angles. A • Use estimation to determine if a length or volume measurement is reasonable. A • Demonstrate understanding of the relationships among the units within both customary and metric systems of measurement. D • Demonstrate understanding that measurements are approximations. D • Demonstrate understanding of the concepts of length, perimeter, circumference, area, weight, capacity, |</p>
<table>
<thead>
<tr>
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<tr>
<td><strong>Review material</strong></td>
<td><strong>Building blocks for new standards</strong></td>
<td><strong>TCAP 2008-2009</strong></td>
<td><strong>Identify lines of symmetry in two-dimensional geometric figures. A</strong></td>
</tr>
<tr>
<td>customary or metric units. <strong>D</strong></td>
<td>thermometer, or other scaled instruments.</td>
<td>volume, elapsed time, and angle measure. <strong>D</strong></td>
<td><strong>Use spatial reasoning to predict the result of sliding, flipping, or turning a two-dimensional shape. A</strong></td>
</tr>
<tr>
<td>Demonstrate understanding of the relationships among units of length. <strong>D</strong></td>
<td>0406.4.13 Compare objects with respect to a given attribute such as length, area, and capacity.</td>
<td>Select and use appropriate standard units to measure length, perimeter, area, capacity, volume, weight, time, temperature, and angles. <strong>D</strong></td>
<td><strong>Recognize, name, compare, and contrast congruent and symmetrical geometric figures. D</strong></td>
</tr>
<tr>
<td>Tell time to the nearest minute. <strong>A</strong></td>
<td>SPI 0406.4.8 Convert measurements within a single system that are common in daily life (e.g., hours and minutes, inches and feet, centimeters and meters, quarts and gallons, liters and milliliters).</td>
<td>Select and use appropriate tools for measuring in real-world situations. <strong>D</strong></td>
<td><strong>Identify, predict, and describe the results of transformations of two-dimensional figures (i.e., slides, flips, and turns). D</strong></td>
</tr>
<tr>
<td>Solve real-world problems involving elapsed time to the quarter-hour. <strong>A</strong></td>
<td>0406.4.7 Measure liquids using both standard units and metric units.</td>
<td>Understand how differences in units affect precision of measurements. <strong>I</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
</tr>
<tr>
<td><strong>Recognize congruent geometric figures A.</strong></td>
<td>0406.4.6 Recognize the use of decimals in metric measures.</td>
<td><strong>Identify the results of a transformation (slide, flip, or turn) that has been applied to a simple two-dimensional geometric shape. A</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
</tr>
<tr>
<td><strong>Identify lines of symmetry for two-dimensional geometric figures. A</strong></td>
<td><strong>SPI 0406.4.10 Identify images resulting from reflections, translations, or rotations.</strong></td>
<td><strong>Identify the results of a transformation (slide, flip, or turn) that has been applied to a simple two-dimensional geometric shape. A</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
</tr>
<tr>
<td><strong>Identify the result of a transformation (slide, flip, or turn) that has been applied to a simple two-dimensional geometric shape. A</strong></td>
<td>0406.4.16 Examine transformations in the coordinate plane.</td>
<td><strong>Use spatial reasoning to predict the result of sliding, flipping, or turning a two-dimensional shape. A</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
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<tr>
<td><strong>Identify and draw lines of symmetry for two-dimensional geometric figures. D</strong></td>
<td>0406.4.17 Predict the results of a transformation of a geometric shape.</td>
<td><strong>Recognize, name, compare, and contrast congruent and symmetrical geometric figures. D</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
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<tr>
<td><strong>Identify, predict, and describe the results of transformations of two-dimensional geometric figures (i.e., slides, flips, and turns). D</strong></td>
<td>0406.4.18 Determine whether a geometric shape has line and/or rotational symmetry.</td>
<td><strong>Identify, predict, and describe the results of transformations of two-dimensional figures (i.e., slides, flips, and turns). D</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
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<td><strong>Identify, predict, and describe the results of transformations of two-dimensional geometric figures (i.e., slides, flips, and turns). D</strong></td>
<td>0406.4.19 Design and analyze simple tilings and tessellations.</td>
<td><strong>Identify, predict, and describe the results of transformations of two-dimensional figures (i.e., slides, flips, and turns). D</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
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<tr>
<td><strong>Identify, predict, and describe the results of transformations of two-dimensional geometric figures (i.e., slides, flips, and turns). D</strong></td>
<td>0406.4.20 Draw lines of symmetry in two-dimensional figures.</td>
<td><strong>Identify, predict, and describe the results of transformations of two-dimensional figures (i.e., slides, flips, and turns). D</strong></td>
<td><strong>Describe a motion or a series of motions that will show that full transformation occurs. D</strong></td>
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- Describe a motion that will show that two shapes are congruent. **I**
- **D** Describe two shapes are congruent.
- **D** Describe location and movement using appropriate mathematical language.
- **D** Describe and identify line and rotational symmetry in two-dimensional figures. **I**
- **I** Explain and demonstrate how scale in maps and drawings shows relative size and distance.
- **D** Explore similarity and how the sides and angles of similar triangles are related. **I**
### Former Learning Expectations

5.1 Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer questions.

5.2 Select and use appropriate statistical methods to analyze data.

5.3 Develop and evaluate predictions that are based on data.

5.4 Understand and apply basic concepts of probability.

### Grade 5 Data, Probability and Statistics

#### New Grade Level Expectations

- **GLE 0506.5.1** Make, record, display and interpret data and graphs that include whole numbers, decimals, and fractions.
- **GLE 0506.5.2** Describe the shape and important features of a set of data using the measures of central tendency.

#### Former Blueprint Standards 4th Grade

- **4th Grade Review material**

#### New Standards 4th Grade

- **Building blocks for new standards**

#### Former Blueprint Standards 5th Grade

- **5th Grade TCAP 2008-2009**

#### New Standards 5th Grade

- **TCAP 2009-2010**

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</thead>
<tbody>
<tr>
<td>**- Construct tables, pictographs, line graphs, and bar graphs D.**<strong>Interpret simple charts, tables, pictographs, line graphs, and bar graphs. D</strong> <strong>Interpret data displayed in bar graphs and pictographs. A</strong> <strong>Connect data in tables to pictographs, line graphs, or bar graphs. A</strong></td>
<td>SPI 0406.5.1 Depict data using various representations (e.g., tables, pictographs, line graphs, bar graphs). ✓ 0406.5.1 Create and label appropriate scales for graphs. ✓ 0406.5.3 Interpret and prepare pie charts using appropriate measurements of angles. ✓ 0406.5.4 Develop and use stem-and-leaf plots.</td>
<td>▪ Represent and interpret data in bar graphs and pictographs. ✓ Represent data using pictographs, bar graphs, tables, circle graphs, and line graphs. D <strong>Interpret data displayed in pictographs, bar graphs, tables, circle graphs, and line graphs. D</strong></td>
<td><strong>SPI 0506.5.1 Depict data using various representations, including decimal and/or fractional data.</strong> ✓ 0506.5.1 Construct and analyze double bar and line graphs. ✓ 0506.5.2 Represent data using ordered pairs in the first quadrant of the coordinate system.</td>
</tr>
<tr>
<td><strong>- Evaluate how well various representations show the collected data I.</strong></td>
<td>✓ 0406.5.2 Evaluate how well various representations show the collected data.</td>
<td>▪ Examine various graphical representations of data to evaluate how accurately the data is depicted. D</td>
<td>✓ 0506.5.4 Recognize the differences in representing categorical and numerical data.</td>
</tr>
<tr>
<td><strong>- Collect data using observations, surveys, and experiments. I</strong> <strong>Understand how data-collection methods could affect the results. I</strong> <strong>Design investigations to try to answer a question. I</strong></td>
<td>SPI 0406.5.2 Solve problems using estimation and comparison within a single set.</td>
<td>▪ Collect data using observations, surveys, and experiments. D <strong>Design investigations to address a question. D</strong> <strong>Understand how data-collection methods could affect the results. D</strong> <strong>Explain the importance of sample size in investigations. I</strong></td>
<td>✓ 0506.5.3 Design investigations to address a question and consider how data collection methods affect the nature of the data set.</td>
</tr>
</tbody>
</table>
| **- Make predictions from data. D** | SPI 0406.5.2 Make predictions based on various data representations. | ▪ Make predictions based on data. A **Make predictions and justify** | **SPI 0506.5.2 Make predictions based on various data representations,**
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<tr>
<td>Review material</td>
<td>Building blocks for new standards</td>
<td>conclusions based on data. D</td>
<td>including double bar and line graphs.</td>
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<tr>
<td>▪ Determine the median of a data set. A</td>
<td>SPI 0406.5.3 Given a set of data or a graph, describe the distribution of the data using median, range, or mode. ✓ 0406.5.5 Use measures of central tendency to compare two sets of related data.</td>
<td>▪ Determine the mean, median, and mode of a data set. A</td>
<td>SPI 0506.5.3 Calculate measures of central tendency to analyze data. ✓ 0506.5.5 Evaluate how different measures of central tendency describe data. ✓ 0506.5.6 Identify outliers and determine their effect on mean, median, mode and range.</td>
</tr>
<tr>
<td>▪ Explore and determine measures of central tendency (i.e., mean, median, and mode). D</td>
<td></td>
<td>▪ Use measures of central tendency (i.e., mean, median, and mode). D</td>
<td></td>
</tr>
<tr>
<td>▪ Select all possible outcomes of a simple experiment (i.e., spinner, coin toss, number or color cube). A</td>
<td>SPI 0406.5.4 List all possible outcomes of a given situation or event. ✓ 0406.5.6 Determine a simple probability. ✓ 0406.5.7 Express a probability pictorially.</td>
<td>▪ Determine the most likely, least likely, or equally likely outcomes in simple experiments. A</td>
<td></td>
</tr>
<tr>
<td>▪ Determine the most likely, least likely, or equally likely outcomes in simple experiments. A</td>
<td></td>
<td>▪ Represent the likelihood of an event using a fractional number from zero to one. A</td>
<td></td>
</tr>
<tr>
<td>▪ Describe the likelihood or chance of events as certain, possible, or impossible. M</td>
<td></td>
<td>▪ Describe the likelihood or chance of events as likely, unlikely, certain, equally likely, or impossible. D</td>
<td></td>
</tr>
<tr>
<td>▪ Explain whether an event is likely or unlikely. M</td>
<td></td>
<td>▪ Use a sample space to predict the probability of an event. D</td>
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</tbody>
</table>

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring  2008
Grade 6 Transition to New TN Mathematics Standards

Grade 6 – Mathematical Processes

New Grade Level Expectations

GLE 0606.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0606.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0606.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0606.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0606.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0606.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0606.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0606.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)

✓ 0606.1.1 Recognize different conventions used in calculator and computer spreadsheets (e.g., * for multiplication, ^ for exponent), but use mathematical notation in written work.
✓ 0606.1.2 Recognize when an estimate is more appropriate than an exact answer in a variety of problem situations.
✓ 0606.1.3 Recognize errors generated by rounding.
✓ 0606.1.4 Describe how changes in one quantity or variable result in changes in another.
✓ 0606.1.5 Illustrate properties of operations by showing that two expressions are equivalent in a given context (e.g., using an area model for distributive property, and grouping/set models for commutative and associative properties).
✓ 0606.1.6 Model situations by devising and carrying out experiments and simulations.
✓ 0606.1.7 Formulate questions, design studies, and collect real world data.
✓ 0606.1.8 Determine an appropriate sample to test an hypothesis.
✓ 0606.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0606.1.10 Use various methods (such as dynamic geometry software) to explore properties of triangles and quadrilaterals.
✓ 0606.1.11 Model algebraic expressions with manipulatives, technology, and pencil and paper.

State Performance Indicators

SPI 0606.1.1 Make conjectures and predictions based on data.
SPI 0606.1.2 Judge the reasonableness of the results of rational number estimates and/or computations.
SPI 0606.1.3 Use concrete, pictorial, and symbolic representation for integers.
SPI 0606.1.4 Select the representation that models one of the arithmetic properties (commutative, associative, or distributive).
SPI 0606.1.5 Model algebraic expressions using algebra tiles.
## Grade 6 – Number and Operation

**Former Learning Expectations**

1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

**New Grade Level Expectations**

- GLE 0606.2.1 Understand and explain the procedures for multiplication and division of fractions, mixed numbers, and decimals.
- GLE 0606.2.2 Solve multi-step mathematical, contextual and verbal problems using fractions, mixed numbers, and decimals.
- GLE 0606.2.3 Understand and use ratios, rates and percents.
- GLE 0606.2.4 Understand and convert between fraction, decimal, and percent forms of rational numbers.
- GLE 0606.2.5 Develop meaning for integers; represent and compare quantities with integers.

### Former Standards 5th Grade Review Material

- Solve one- or two-step real-world problems involving addition, subtraction, and/or multiplication of whole numbers and decimals.
- Multiply a fraction by a multiple of its denominator (denominator less than or equal to 10).

### New Standards 5th Grade Building blocks for new standards

<table>
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<tr>
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<tbody>
<tr>
<td>SPI 0506.2.6 Add and subtract proper and improper fractions as well as mixed numbers.</td>
</tr>
<tr>
<td>SPI 0506.2.5 Solve addition and subtraction problems involving both fractions and decimals.</td>
</tr>
</tbody>
</table>

- Add and subtract commonly used fractions.
- Add, subtract, and multiply decimals.

### Former Standards 6th Grade TCAP 2008-2009

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<tbody>
<tr>
<td>SPI 0606.2.1 Solve problems involving the multiplication and division of fractions.</td>
</tr>
<tr>
<td>SPI 0606.2.2 Solve problems involving the addition, subtraction, multiplication, and division of mixed numbers.</td>
</tr>
<tr>
<td>SPI 0606.2.3 Solve problems involving the addition, subtraction, multiplication, and division of decimals.</td>
</tr>
</tbody>
</table>

- Compute efficiently and accurately with whole numbers, fractions, and decimals.
- Make reasonable estimates.

### New Standards 6th Grade TCAP 2009-2010

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<tbody>
<tr>
<td>SPI 0606.2.2 Solve problems involving the addition, subtraction, multiplication, and division of fractions.</td>
</tr>
<tr>
<td>SPI 0606.2.3 Solve problems involving the addition, subtraction, multiplication, and division of decimals.</td>
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</table>

- Use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals.
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</table>
| - Add, subtract, multiply, and divide whole numbers (multipliers and divisors no more than two-digits). | SPI 0506.2.4 Solve problems involving the division of two- and three-digit numbers by one- and two-digit whole numbers.  
✓ 0506.2.7 Understand placement of the decimal point in calculations of multiplication and long division, including placement in the estimation of the answer.  
✓ 0506.2.8 Understand that division by zero is undefined. | SPI 0606.2.4 Solve multi-step arithmetic problems using fractions, mixed numbers, and decimals.  
SPI 0606.2.5 Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers).  
✓ 0606.2.8 Recognize that a terminating decimal equals a fraction with a denominator that is a power of ten.  
✓ 0606.2.9 Recognize that the decimal form of a rational number either terminates or repeats. |  |
| - Connect symbolic representations of proper and improper fractions to models of proper and improper fractions. | SPI 0606.2.4 Solve multi-step arithmetic problems using fractions, mixed numbers, and decimals.  
SPI 0606.2.5 Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers).  
✓ 0606.2.8 Recognize that a terminating decimal equals a fraction with a denominator that is a power of ten.  
✓ 0606.2.9 Recognize that the decimal form of a rational number either terminates or repeats. |  |  |
| - Read and write numbers from millions to thousandths.  
- Identify the place value of a given digit from millions to thousandths.  
- Represent whole numbers and two-place decimals in expanded form. | SPI 0506.2.1 Read and write numbers from millions to millionths in various contexts.  
✓ 0506.2.10 Use exponential notation to represent repeated multiplication of whole numbers. | SPI 0506.2.2 Write the prime  
- Identify prime and composite |  |

estimates of fraction and decimal sums and differences.
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<tr>
<td><strong>factorization of numbers through 50 using both exponential and standard notation.</strong>&lt;br&gt;✓ 0506.2.1 Identify prime numbers up to 50.&lt;br&gt;✓ 0506.2.2 Use the prime factorization of two whole numbers to determine greatest common factor, least common multiple.&lt;br&gt;✓ 0506.2.4 Use divisibility rules to factor numbers.</td>
<td>numbers up to 50. <strong>A</strong>&lt;br&gt;▪ Develop meaning for number theory concepts (i.e., divisibility, factors, and multiples). <strong>D</strong></td>
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<tr>
<td>▪ Represent numbers as both improper fractions and mixed numbers.&lt;br&gt;▪ Generate equivalent forms of commonly used fractions, decimals and percents (1/10,1/4,1/2,.75,50%)&lt;br&gt;<strong>SPI 0506.2.7 Recognize equivalent representations for the same number.</strong>&lt;br&gt;<strong>SPI 0506.2.8 Write terminating decimals in the form of fractions or mixed numbers.</strong></td>
<td>▪ Develop understanding of equivalent number representations (i.e., fractions, decimals, and percents). <strong>D</strong></td>
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<td>▪ Solve problems involving ratio and proportion. <strong>A</strong>&lt;br&gt;▪ Identify a ratio using three forms: 3 to 5; 3/5; 3:5. <strong>D</strong>&lt;br&gt;▪ Determine if two ratios form a proportion, and find the missing number in a proportion. <strong>D</strong>&lt;br&gt;▪ Connect ratios to a variety of models, real-world situations, and symbolic representations. <strong>A</strong>&lt;br&gt;▪ Use scales to read maps. <strong>A</strong></td>
<td><strong>SPI 0606.2.6 Solve problems involving ratios, rates, and %.</strong>&lt;br&gt;✓ 0606.2.4 Understand ratio as a fraction used to compare two quantities by division.&lt;br&gt;✓ 0606.2.5 Recognize a:b, a/b, and “a to b” as notations for ratios.&lt;br&gt;✓ 0606.2.6 Recognize common percentages as ratios based on fractions whose denominators are 2, 3, 4, 5, or 10.&lt;br&gt;✓ 0606.2.7 Connect ratio and rate to multiplication and division.</td>
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<td>▪ Connect whole numbers, mixed numbers, fractions, and decimals to locations on the number line. <strong>A</strong></td>
<td><strong>SPI 0606.1.3 Use concrete, pictorial, and symbolic representation for integers.</strong></td>
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</table>

- Represent, compare, and order whole numbers and decimals to thousandths.
- Compare and order fractions using the appropriate symbol (<, >, =).

**SPI 0506.2.9 Compare whole numbers, decimals and fractions using the symbols <, >, and =.**
- 0506.2.9 Explore numbers less than 0 by extending the number line through familiar applications (e.g., temperatures below zero, owing money, measuring elevation below sea level).
- Demonstrate understanding of percents greater than 100 and less than one. **D**

- Use estimation to determine a reasonable solution to a whole number computation.

**SPI 0506.2.3 Select a reasonable solution to a real-world division problem in which the remainder must be considered.**
- Use estimation to select a reasonable answer to a computation involving whole numbers, fractions and/or decimals. **A**

- Select a reasonable solution to a real-world division problem in which the remainder must be considered. **A**

- Compare and order whole numbers, fractions, decimals, and percents using the appropriate symbol (<, >, =). **A**

- Demonstrate understanding of percents greater than 100 and less than one. **D**

- Use estimation to select a reasonable answer to a computation involving whole numbers, fractions and/or decimals. **A**

**SPI 0606.1.2 Judge the reasonableness of the results of rational number estimates and/or computations.**

- SPI 0606.2.8 Locate integers on the number line.
  - 0606.2.10 Explore contexts that can be described with negative numbers (money, elevation, temperature).
### Grade 6 – Algebra

**Former Learning Expectations**
2.1 Understand patterns, relations, and functions.
2.2 Represent and analyze mathematical situations and structures using algebraic symbols.
2.3 Use mathematical models to represent and understand quantitative relationships.
2.4 Analyze change in various contexts.

**New Grade Level Expectations**
GLE 0606.3.1 Write and solve two-step equations and inequalities.
GLE 0606.3.2 Interpret and represent algebraic relationships with variables in expressions, simple equations and inequalities.
GLE 0606.3.3 Extend order of operations to include grouping symbols and exponents.
GLE 0606.3.4 Use expressions, equations and formulas to solve problems.
GLE 0606.3.5 Use multiple representations including symbolic algebra to model and/or solve contextual problems that involve linear relationships.
GLE 0606.3.6 Understand and use the Cartesian coordinate system.

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<tr>
<th>Former Standards 5th Grade Review Material</th>
<th>New Standards 5th Grade Building blocks for new standards</th>
<th>Former Standards 6th Grade TCAP 2008-2009</th>
<th>New Standards 6th Grade TCAP 2009-2010</th>
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<tbody>
<tr>
<td>SPI 0506.3.4 Given a set of values, identify those that make an inequality a true statement. ✓0506.3.4 Solve single-step linear inequalities and graph solutions on a number line. ✓0506.3.5 Determine if a given value is a solution to a linear equation/inequality.</td>
<td>▪️ Evaluate algebraic expressions for a given value of the variable. A</td>
<td>SPI 0606.3.1 Represent on a number line the solution of a linear inequality. ✓0606.3.2 Write and solve one-step inequalities corresponding to given situations (non-negative numbers only). ✓0506.3.6 Recognize there are many numbers between any two whole numbers on the number line.</td>
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</tr>
<tr>
<td>SPI 0506.3.2 Evaluate multi-step numerical expressions involving fractions using order of operations. SPI 0506.3.1 Evaluate algebraic expressions involving decimals and fractions using order of operations. ✓0506.3.1 Evaluate an expression by substituting non-negative rational number</td>
<td></td>
<td>SPI 0606.3.2 Use order of operations and parentheses to simplify expressions and solve problems. ✓0606.3.5 Use the commutative, associative and distributive properties to show that two expressions are equivalent.</td>
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<tr>
<td>▪ Apply basic function rules.</td>
<td>▪ Apply function rules. A</td>
<td>SPI 0606.3.3 Write equations that correspond to given situations or represent a given mathematical relationship. ▪ 0606.3.6 Use equations to describe simple relationships shown in a table or graph.</td>
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</tr>
<tr>
<td>▪ Connect open sentences to real-world situations.</td>
<td>▪ Select an equation that represents a given mathematical relationship. A</td>
<td>▪ Develop an initial conceptual understanding of different uses of variables. D ▪ Represent mathematical statements and real-world situations using symbols. D ▪ Model algebraic expressions using manipulatives, technology, and paper and pencil. I</td>
<td>SPI 0606.3.5 Translate between verbal expressions/sentences and algebraic expressions or equations. ▪ 0606.3.7 Move fluently between different representations (such as verbal, tabular, numerical, algebraic, and graphical) of equations and expressions.</td>
</tr>
<tr>
<td>▪ Select an equation that represents a given mathematical relationship.</td>
<td>▪ SPI 0506.3.3 Find the unknown in single-step equations involving fractions and mixed numbers.</td>
<td>▪ Find missing addends or factors represented as variables in simple equations. A</td>
<td>SPI 0606.3.6 Solve two-step linear equations using number sense, properties, and inverse operations.</td>
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<td>▪ Solve open sentences involving addition, subtraction, multiplication, and division.</td>
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</table>
| 0506.3.2 Use variables appropriately to represent numbers whose values are not yet known.  
0506.3.3 Solve single-step linear equations using inverse operations. | 0506.3.1 Write and solve two-step linear equations corresponding to given situations (non-negative numbers only). | SPI 0606.3.7 Use algebraic expressions and properties to analyze numeric and geometric patterns.  
0606.3.8 Represent patterns using words, graphs, and simple symbolic notation. |
|  |  | SPI 0606.3.8 Select the qualitative graph that models a contextual situation (e.g., water filling then draining from a bathtub).  
0606.3.4 Generate data and graph relationships concerning measurement of length, area, volume, weight, time, temperature, money, and information.  
0606.3.9 Write a contextual story modeled by a given graph. |
| Extend numerical patterns.  
Extend geometric patterns.  
Generalize numerical patterns using a variable. |  | SPI 0606.3.9 Graph ordered pairs of integers in all four quadrants of the Cartesian coordinate system.  
0606.3.11 Identify the quadrant of the coordinate system in which a point lies.  
0606.3.10 Understand that in an ordered pair (x, y), the x represents horizontal location and y represents vertical location. |
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<td>▪ Describe how changes in one quantity or variable result in changes in another. <strong>D</strong></td>
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</table>
### Grade 6 – Geometry and Measurement

**Former Learning Expectations**

#### 3.1 Analyze characteristics and properties of two- and three-dimensional geometric figures.

#### 3.2 Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

#### 3.3 Apply transformations and use symmetry to analyze mathematical situations.

#### 3.4 Use visualization, spatial reasoning, and geometric modeling to solve problems.

**New Grade Level Expectations**

#### GLE 0606.4.1 Understand and use basic properties of triangles, quadrilaterals, and other polygons.

#### GLE 0606.4.2 Use the concepts of translation, rotation, reflection, and symmetry to understand congruence in the plane.

#### GLE 0606.4.3 Develop and use formulas to determine the circumference and area of circles, and the area of trapezoids, and develop strategies to find the area of composite shapes.

#### GLE 0606.4.4 Develop and use formulas for surface area and volume of 3-dimensional figures.

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<tbody>
<tr>
<td>• Identify two- or three-dimensional shapes given defining attributes. A</td>
<td>• Classify two-dimensional geometric figures using properties. A</td>
<td>• Classify quadrilaterals using their defining properties. A</td>
<td>SPI 0606.4.1 Identify, define or describe geometric shapes given a visual representation or a written description of its properties.</td>
</tr>
<tr>
<td>• Identify lines, line segments, rays, and angles. A</td>
<td>• Classify angles as acute, obtuse, right, and straight. A</td>
<td>• Describe, classify, and understand relationships among types of two-dimensional figures. D</td>
<td>✓ 0606.4.3 Verify basic properties of triangles and quadrilaterals using protractor and ruler.</td>
</tr>
<tr>
<td>• Classify geometric figures using properties. A</td>
<td>• Identify parallel, perpendicular, and intersecting lines. A</td>
<td>• Identify and use appropriate mathematical language to describe characteristics of lines (e.g., parallel, perpendicular, and intersecting). D</td>
<td>✓ 0606.4.4 Classify triangles by side lengths (scalene, isosceles, and equilateral) and angle measure (acute, right, obtuse, isosceles and equiangular).</td>
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<td>SPI 0606.4.2 Find a missing angle measure in problems involving interior/exterior angles and/or their sums.</td>
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<td>✓ 0606.4.1 Investigate the sum of the angles in a triangle and a</td>
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<tr>
<td>▪ Use strategies to estimate perimeter and area of rectangles. <strong>A</strong></td>
<td>SPI 0506.4.1 Solve contextual problems that require calculating the area of triangles and parallelograms. ✓ 0506.4.1 Develop the formula for the area of a triangle by relating it to the area of a parallelogram or rectangle.</td>
<td>▪ Use strategies to estimate perimeter and area of rectangles. <strong>A</strong></td>
<td>✓ 0606.4.14 Relate the area of a trapezoid to the area of a parallelogram.</td>
</tr>
<tr>
<td>▪ Solve real-world problems involving perimeter and area of rectangles. <strong>A</strong></td>
<td>▪ Apply formulas to determine the area of rectangles and triangles. <strong>A</strong></td>
<td>▪ Solve real-world problems involving perimeter and area of rectangles. <strong>A</strong></td>
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<tr>
<td>▪ Solve real-world problems involving addition and subtraction of measurements. <strong>A</strong></td>
<td>▪ Estimate measurements involving length, perimeter, circumference, area, and volume. <strong>D</strong></td>
<td>▪ Determine the area of triangles and parallelograms using a formula. <strong>D</strong></td>
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<tr>
<td>▪ Apply formulas to find the area of parallelograms and triangles. <strong>A</strong></td>
<td>▪ Use a variety of manipulatives to develop formulas to determine the area of trapezoids and circles. <strong>D</strong></td>
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<tr>
<td>▪ SPI 0506.4.2 Decompose irregular shapes to find perimeter and area. ✓ 0506.4.2 Find the area of a convex polygon by decomposing it into triangles/rectangles.</td>
<td>▪ Complete investigations to develop formulas to determine the circumference of circles. <strong>D</strong></td>
<td>▪ SPI 0606.4.3 Solve problems using the Triangle Inequality Theorem. ✓ 0606.4.5 Model and use the Triangle Inequality Theorem.</td>
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<td></td>
<td>▪ SPI 0606.4.4 Calculate with circumferences and areas of circles. ✓ 0606.4.12 Derive the meaning of Pi using concrete models and/or appropriate technology. ✓ 0606.4.11 Relate the circumference of a circle with</td>
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- quadrilateral using various methods.
- 0606.4.2 Relate the sum of the angles in a triangle to the sum of the angles in polygons.
- 0606.4.6 Use the properties of interior and exterior angles of polygons to solve problems.
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- **Select appropriate standard units to measure length, perimeter, area, capacity, volume, weight, time, temperature, and angles.**  

- **Use spatial reasoning to identify the three-dimensional figure created from a two-dimensional representation (net) of that figure (i.e., cube, rectangular prism, pyramid, cone, or cylinder).**  

- **Use estimation to determine if a length or volume measurement is reasonable.**  

- **Select units of appropriate size and type to measure angles, perimeter, area, capacity, volume, and weight.**  

- **SPI 0506.4.3 Identify a three-dimensional object from two-dimensional representations of that object and vice versa.**  

- **SPI 0506.4.4 Solve problems involving surface area and volume.**  

- **SPI 0506.4.5 Quantify total volume as filling space with same-sized units of volume without gaps or overlap.**  

- **SPI 0506.4.5 Determine the surface area and volume of prisms, pyramids and cylinders.**  

- **0506.4.13 Understand the relationships among the radius, diameter, circumference and area of a circle, and that the ratio of the circumference to the diameter is the same as the ratio of the area to the square of the radius, and that this ratio is called Pi.**  

- **0506.4.7 Understand, select and use units of appropriate size and type to measure angles, lengths/distances, area, surface area and volume.**  

- **Use visualization and spatial reasoning (e.g., geometric models) to solve real-world problems.**  

- **Explore surface area and volume of selected prisms and cylinders.**  

- **SPI 0606.4.6 Given the volume of a cone/pyramid, determine its height.**
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<td>volume of rectangular prisms</td>
<td>cylinders using models and</td>
<td>find the volume of the related</td>
<td>cylinders using models and</td>
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<td>and polyhedral solids.</td>
<td>manipulatives. D</td>
<td>cylinder/prism or vice versa.</td>
<td>manipulatives. D</td>
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<td>✓0506.4.4 Describe and identify</td>
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<td>✓0606.4.17 Use manipulatives to</td>
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<td>the five regular (Platonic)</td>
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<td>discover the volume of a</td>
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<td>solids and their properties</td>
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<td>pyramid is one-third the</td>
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<td>with respect to faces, shapes</td>
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<td>volume of the related prism</td>
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<td>of faces, edges, and vertices.</td>
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<td>✓0606.4.18 Use manipulatives</td>
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<td>to discover the volume of a</td>
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<td>✓0606.4.15 Find lengths given</td>
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<td>areas or volumes, and vice</td>
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<td>✓0606.4.16 Solve contextual</td>
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<td>problems involving area and</td>
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<td>prisms, pyramids, cones, and</td>
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<td>▪ Use spatial reasoning to</td>
<td>▪ Identify the results of</td>
<td>▪ Identify the differences</td>
<td>▪ 0606.4.9 Analyze the</td>
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<td>predict the result of sliding,</td>
<td>transformations of two-</td>
<td>between congruence and</td>
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<td>flipping, or turning a two-</td>
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<td>dimensional shape. A</td>
<td>slides/translations,</td>
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<td>▪ Identify lines of symmetry</td>
<td>flips/reflections, and</td>
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<td>turns/rotations). A</td>
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<td>▪ Predict, and describe the</td>
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<td>▪ Describe line and rotational</td>
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<td>▪ Describe a motion or a</td>
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<td>▪ Describe similarity and</td>
<td>▪ 0606.4.7 Work with</td>
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<td>congruence. D</td>
<td>transformations in a plane and</td>
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<td>▪ Solve problems involving</td>
<td>explore their meanings through</td>
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<td>drawings and manipulatives.</td>
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<td>▪ 0606.4.8 Understand scaling,</td>
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<td>dilation and their relation</td>
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<td>to similarity.</td>
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<td>▪ 0606.4.10 Describe the effect</td>
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<td>of a transformation on a 2-</td>
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<td>▪ 0606.4.9 Analyze the</td>
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<td>differences between congruence</td>
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<tr>
<td>SPI 0506.4.5 Find the length of vertical or horizontal line segments in the first quadrant of the coordinate system, including problems that require the use of fractions and decimals. ✓0506.4.8 Identify characteristics of the set of points that define vertical/horizontal line segments.</td>
<td>Determine the distance between two points on the x- or the y- axis in Quadrant I. A</td>
<td>Convert from one unit to another within the same system (metric and customary). A</td>
<td>Solve real-world problems involving elapsed time. A</td>
</tr>
<tr>
<td>▪ Connect simple units of measurement within the same system of measurement.</td>
<td>▪ Plot a given set of points in Quadrant I of a coordinate system, use ordered pairs to describe or specify points, and find the distance between 2 points on the x- or y-axis. D</td>
<td>▪ Demonstrate understanding of both metric and customary systems of measurement. D</td>
<td>▪ Solve real-world problems involving elapsed time. D</td>
</tr>
<tr>
<td>▪ Solve real-world problems involving elapsed time.</td>
<td>▪ Identify relationships among units within the same system (metric and customary). D</td>
<td>▪ Recognize the need for measurement precision. D</td>
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<tr>
<td>▪ Use a ruler to measure to the nearest centimeter and ¼ inch.</td>
<td>SPI 0506.4.6 Record measurements in context to reasonable degree of accuracy using decimals and/or fractions. ✓0506.4.9 Correctly interpret significant digits in the accuracy of measurements and associated calculations. ✓0506.4.10 Recognize that measurements are never exact. ✓0506.4.11 Understand the usefulness of approximations.</td>
<td>▪ Identify and use units of appropriate size and type to measure angles, perimeter, area, surface area, and volume. D</td>
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<td>▪ Read temperatures on a thermometer using Fahrenheit and Celsius scales.</td>
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<td>0506.4.12 Develop strategies for choosing correct tools of measurement.</td>
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<td>0506.4.13 Recognize and use measures of weight and temperature.</td>
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**Former Learning Expectations**

5.1 Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer questions.

5.2 Select and use appropriate statistical methods to analyze data.

5.3 Develop and evaluate inferences and predictions that are based on data.

5.4 Understand and apply basic concepts of probability.

**New Grade Level Expectations**

GLE 0606.5.1 Understand the meaning of probability and how it is expressed.

GLE 0606.5.2 Interpret representations of data from surveys and polls, and describe sample bias and how data representations can be misleading.

<table>
<thead>
<tr>
<th>Former Standards 5th Grade Review Material</th>
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<th>New Standards 6th Grade TCAP 2009-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Determine the most likely, least likely, or equally likely outcomes in simple experiments. A</td>
<td>▪ Use a tree diagram or organized list to determine all possible outcomes of a simple compound event. A</td>
<td>▪ Represent and interpret data in SPI 0506.5.1 Depict data</td>
<td>▪ SPI 0606.5.1 Determine the theoretical probability of simple and compound events in familiar contexts. ✓ 0606.5.1 Understand that the probability of an event is a number between zero and one that expresses the likelihood of its occurrence. ✓ 0606.5.2 Identify the probability of an event as the ratio of the number of its actual occurrences to the total number of its possible occurrences. ✓ 0606.5.3 Express probabilities in different ways. ✓ 0606.5.4 Understand the difference between probability and odds. ✓ 0606.5.5 Analyze a situation that involves probability of an independent event. ✓ 0606.5.6 Estimate the probability of simple and compound events through experimentation or simulation. ✓ 0606.5.7 Apply procedures to calculate the probability of complimentary events.</td>
</tr>
<tr>
<td>▪ Represent the likelihood of an event using a fractional number from zero to one. A</td>
<td>▪ Represent the likelihood of an event using a number from 0-1. A</td>
<td>▪ Interpret bar and line graphs to SPI 0606.5.2 Identify features</td>
<td></td>
</tr>
<tr>
<td><strong>Former Standards 5th Grade</strong>&lt;br&gt;Review Material</td>
<td><strong>New Standards 5th Grade</strong>&lt;br&gt;Building blocks for new standards</td>
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</tbody>
</table>
| bar graphs and pictographs. **A** | using various representations, including decimal and/or fractional data.  
- 0506.5.1 Construct and analyze double bar and line graphs.  
- 0506.5.2 Represent data using ordered pairs in the first quadrant of the coordinate system.  
- 0506.5.4 Recognize the differences in representing categorical and numerical data. | answer questions and solve real-world problems. **A**  
- Connect data sets and their graphical representations (i.e., bar graphs, circle graphs, and stem-and-leaf-plots). **A**  
- Examine various representations of data to evaluate how accurately the data is depicted. **D** | of graphs that may be misleading.  
- 0606.5.8 Connect data sets and their graphical representations (such as bar graphs, circle, graphs, and stem-and-leaf plots). |
| **Determine the mean, median, and mode of a data set. **A** | **SPI 0506.5.3 Calculate measures of central tendency to analyze data.**  
- 0506.5.5 Evaluate how different measures of central tendency describe data.  
- 0506.5.6 Identify outliers and determine their effect on mean, median, mode and range. | **Determine the mean of a data set. **A**  
- Determine the mode of a data set. **A**  
- Determine the median from a stem-and-leaf-plot. **A**  
- Determine, use, and interpret measures of center and spread (e.g., mean, median, mode, and interquartile range). **D** | **0606.5.11 Select the appropriate measure of center to describe a data set.** |
| **Make predictions based on data. **A** | **SPI 0506.5.2 Make predictions based on various data representations, including double bar and line graphs.**  
- 0506.5.3 Design investigations to address a question and consider how data collection methods affect the nature of the data set. | **Make conjectures and predictions based on data (e.g., in a chart, table, or graph). **A**  
- Determine if a sample is biased. **A**  
- Formulate questions, design studies, and collect real-world data. **D**  
- Understand how data-collection methods affect the nature of the data set. **D**  
- Explain the importance of sample size in investigations. **D**  
- Conduct a survey using random sampling. **D** | **SPI 0606.1.1 Make conjectures and predictions based on data.**  
**SPI 0606.5.3 Determine whether or not a sample is biased.**  
- 0606.5.9 Determine the sample space for a given situation.  
- 0606.5.10 Distinguish between a random and nonrandom sample.  
- 0606.5.12 Predict the characteristics of a population based on the analysis of sample data. |
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</thead>
<tbody>
<tr>
<td></td>
<td>Make and test conjectures about the results of experiments and simulations. D</td>
<td>▪ Make conjectures to formulate new questions for future studies. I</td>
<td>▪ Model situations by devising and carrying out experiments and simulations. I</td>
</tr>
</tbody>
</table>
Grade 7 Transition to New TN Mathematics Standards

New Grade Level Expectations

Grade 7 – Mathematical Processes

GLE 0706.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0706.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0706.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0706.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0706.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0706.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0706.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0706.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)

✓ 0706.1.1 Recognize common abbreviations (such as gcd/gcf and lcm).
✓ 0706.1.2 Recognize round-off error and the inaccuracies it introduces.
✓ 0706.1.3 Check answers both by estimation and by appropriate independent calculations, using calculators or computers judiciously.
✓ 0706.1.4 Recognize quantities that are inversely proportional (such as the relationship between the lengths of the base and the side of a rectangle with fixed area).
✓ 0706.1.5 Understand that a linear function in which f(0) = 0 is called a directly proportional relationship.
✓ 0706.1.6 Develop meaning of intercept and rate of change in contextual problems.
✓ 0706.1.7 Explain and demonstrate how scale in maps and drawings shows relative size and distance.
✓ 0706.1.8 Recognize the applications of scale factor by exploring blueprints, shadow measuring, and scale models.
✓ 0706.1.9 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0706.1.10 Model algebraic equations with manipulatives, technology, and pencil and paper.
✓ 0706.1.11 Translate from calculator notation to scientific/standard notation.
✓ 0706.1.12 Use dynamic geometry software to explore scale factor and similarity.

State Performance Indicators

SPI 0706.1.1 Use proportional reasoning to solve mixture/concentration problems.
SPI 0706.1.2 Generalize a variety of patterns to a symbolic rule from tables, graphs, or words.
SPI 0706.1.3 Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship.
SPI 0706.1.4 Use scales to read maps.

Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
## Former Learning Expectations

1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

## New Grade Level Expectations

| GLE 0706.2.1 | Extend understandings of addition, subtraction, multiplication and division to integers. |
| GLE 0706.2.2 | Understand and work with the properties of and operations on the system of rational numbers. |
| GLE 0706.2.3 | Develop an understanding of and apply proportionality. |
| GLE 0706.2.4 | Use ratios, rates and percents to solve single- and multi-step problems in various contexts. |
| GLE 0706.2.5 | Understand and work with squares, cubes, square roots and cube roots. |
| GLE 0706.2.6 | Introduce the concept of negative exponents. |
| GLE 0706.2.7 | Understand and use scientific notation. |

### Former Standards 6th Grade

- Compute efficiently and accurately with whole numbers, fractions, and decimals.
- Apply order of operations when computing with whole numbers.

### New Standards 6th Grade

| SPI 0606.2.2 | Solve problems involving the addition, subtraction, multiplication, and division of mixed numbers. |
| SPI 0606.2.3 | Solve problems involving the addition, subtraction, multiplication, and division of decimals. |
| SPI 0606.2.4 | Solve multi-step arithmetic problems using fractions, mixed numbers, and decimals. |

### Former Standards 7th Grade

| SPI 0706.2.1 Simplify numerical expressions involving rational numbers. |
- 0706.2.1 Understand that the set of rational numbers includes any number that can be written as a ratio of two integers in which the denominator is not zero.
- 0706.2.2 Develop and analyze algorithms and compute efficiently with integers and rational numbers.

### New Standards 7th Grade

- Compute efficiently and accurately with whole numbers, fractions, and decimals.
- Apply order of operations when computing with whole numbers (no more than two parentheses and no exponents).
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<tr>
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</thead>
<tbody>
<tr>
<td>▪ Compare and order whole numbers, fractions, decimals, and percents using the appropriate symbol (&lt;, &gt;, and =).&lt;br&gt;▪ Connect whole numbers, mixed numbers, fractions, and decimals to locations on the number line.</td>
<td><strong>SPI 0606.2.7 Locate positive rational numbers on the number line.</strong>&lt;br&gt;✓ 0606.2.1 Efficiently compare and order fractions, decimals and percents; determine their approximate locations on a number line.&lt;br&gt;<strong>SPI 0606.2.8 Locate integers on the number line.</strong>&lt;br&gt;✓ 0606.2.10 Explore contexts that can be described with negative numbers (such as money, elevation, and temperature).</td>
<td>▪ Compare rational numbers using the appropriate symbol (&lt;, &gt;, and =).&lt;br&gt;▪ Connect rational numbers to locations on a number line.</td>
<td>✓ 0706.2.3 Recognize that rational numbers satisfy the commutative and associative laws of addition and multiplication and the distributive law. ✓ 0706.2.13 Use the meaning of negative exponents to represent small numbers; translate between scientific and standard notation.</td>
</tr>
</tbody>
</table>

**90706.2.3 Recognize that rational numbers satisfy the commutative and associative laws of addition and multiplication and the distributive law.**

**90706.2.13 Use the meaning of negative exponents to represent small numbers; translate between scientific and standard notation.**

**90706.2.7 Locate positive rational numbers on the number line.**

**90606.2.1 Efficiently compare and order fractions, decimals and percents; determine their approximate locations on a number line.**

**90606.2.8 Locate integers on the number line.**

**90606.2.10 Explore contexts that can be described with negative numbers (such as money, elevation, and temperature).**

**90706.2.9 Efficiently compare and order rational numbers and roots of perfect squares/cubes; determine their approximate locations on a number line.**

**90706.2.14 Express numbers in scientific notation and recognize its importance in representing the magnitude of a number.**

**90706.2.2 Compare rational numbers using appropriate inequality symbols.**

**90706.2.3 Use rational numbers and roots of perfect squares/cubes to solve contextual problems.**

**90706.2.4 Determine the approximate location of square/cube roots on a number line.**

**90706.2.9 Efficiently compare and order [rational numbers and] roots of perfect squares/cubes; determine their approximate locations on a number line.**

**90706.2.10 Recognize that when a whole number is not a...**
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<tr>
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<th>Former Standards 7th Grade</th>
<th>New Standards 7th Grade</th>
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</tbody>
</table>

- **Former Standards 6th Grade**
- **New Standards 6th Grade**
- **Former Standards 7th Grade**
- **New Standards 7th Grade**

**Building blocks for new standards**

- perfect square, then its square root is not rational and cannot be written as the ratio of two integers.
- 0706.2.11 Estimate square/cube roots and use calculators to find approximations.
- 0706.2.12 Recognize

$$\sqrt{mn} = \sqrt{m} \cdot \sqrt{n} \text{ and } (\sqrt{m})^2 = m.$$  

- **Solve one-step real-world problems involving whole numbers and decimals.**
  - SPI 0606.2.1 Solve problems involving the multiplication and division of fractions.
    - 0606.2.2 Use area models to represent multiplication of fractions.
  - Identify the opposite and the reciprocal of a rational number.
  - Solve one- and two-step real-world problems involving whole numbers, fractions, and decimals.
- SPI 0706.2.5 Solve contextual problems that involve operations with integers.
  - 0706.2.4 Understand that a and –a are additive inverses and are located the same distance from zero on the number line; relate distance from zero to absolute value.
  - 0706.2.5 Understand that –(–a) = a for any number a.
  - 0706.2.6 Use the number line to demonstrate addition and subtraction with integers.

- **Select a reasonable solution to a real-world division problem in which the remainder must be considered.**
  - 0606.2.3 Create and solve contextual problems that lead naturally to division of fractions.
  - Select a reasonable solution to a real-world division problem in which the remainder must be considered.
- SPI 0706.2.6 Express the ratio between two quantities as a percent, and a percent as a ratio or fraction.
  - Connect percents greater than 100 and percents less than one to real-world situations.
  - Use ratios to represent quantitative relationships.
  - Convert from one unit to another within the same system. (formerly in

- **Solve problems involving ratio and proportion.**
- Connect ratios to a variety of models, real-world situations, and symbolic representations.
- Convert from one unit to another within the same system (metric and

- SPI 0606.2.6 Solve problems involving ratios, rates and percents.
  - 0606.2.4 Understand ratio as a fraction used to compare two quantities by division.
  - 0606.2.5 Recognize a:b, a/b, and “a to b” as notations for

- SPI 0706.2.7 Use ratios and proportions to solve problems.
  - 0706.2.7 Write number sentences to solve contextual problems involving ratio and percent.
  - 0706.2.8 Apply ratios, rates,
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>customary). <em>(formerly in Measurement)</em></td>
<td>0606.2.6 Recognize common percentages as ratios based on fractions whose denominators are 2, 3, 4, 5, or 10.</td>
<td>Measurement)</td>
<td>proportions and percents (such as discounts, interest, taxes, tips, distance/rate/time, and percent increase or decrease). SPI 0706.1.1 Use proportional reasoning to solve mixture/concentration problems.</td>
</tr>
<tr>
<td>▪ Use scales to read maps.</td>
<td>0606.2.7 Connect ratio and rate to multiplication and division.</td>
<td>▪ Solve problems involving scale factors using ratios and proportions. <em>(formerly in Measurement)</em></td>
<td>SPI 0706.1.4 Use scales to read maps.</td>
</tr>
<tr>
<td>▪ Use estimation to select a reasonable answer to a computation involving whole numbers, fractions, and/or decimals.</td>
<td></td>
<td>▪ Use estimation strategies to select a reasonable solution to a computation involving rational numbers.</td>
<td>0706.2.15 Report results of calculations appropriately in a given context (i.e. using rules of rounding, degree of accuracy, and/or significant digits).</td>
</tr>
<tr>
<td>▪ Represent numbers using a variety of models and equivalent forms (i.e., whole numbers, mixed numbers, fractions, decimals, and percents).</td>
<td>SPI 0606.2.5 Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers).</td>
<td>▪ Represent numbers using a variety of equivalent forms (i.e., mixed numbers, fractions, decimals, percents, and integers).</td>
<td></td>
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<tr>
<td>▪ Identify prime and composite numbers up to 50.</td>
<td></td>
<td>▪ Identify prime and composite numbers up to 50.</td>
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<tr>
<td>▪ Identify the place value of a given digit.</td>
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</table>
### Grade 7 – Algebra

**Former Learning Expectations**

2.1 Understand patterns, relations, and functions.
2.2 Represent and analyze mathematical situations and structures using algebraic symbols.
2.3 Use mathematical models to represent and understand quantitative relationships.
2.4 Analyze change in various contexts.

**New Grade Level Expectations**

- GLE 0706.3.1 Recognize and generate equivalent forms for simple algebraic expressions.
- GLE 0706.3.2 Understand and compare various representations of relations and functions.
- GLE 0706.3.3 Understand the concept of function as a rule that assigns to a given input one and only one number (the output).
- GLE 0706.3.4 Use function notation where \( f(x) \) represents the output that the function \( f \) assigns to the input \( x \).
- GLE 0706.3.5 Understand and graph proportional relationships.
- GLE 0706.3.6 Conceptualize the meanings of slope using various interpretations, representations, and contexts.
- GLE 0706.3.7 Use mathematical models involving linear equations to analyze real-world phenomena.
- GLE 0706.3.8 Use a variety of strategies to efficiently solve linear equations and inequalities.

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<tr>
<td>Evaluate algebraic expressions for a given value of the variable.</td>
<td>SPI 0606.3.2 Use order of operations and parentheses to simplify expressions and solve problems. ✓ 0606.3.5 Use the commutative, associative and distributive properties to show that two expressions are equivalent.</td>
<td></td>
<td>SPI 0706.3.1 Evaluate algebraic expressions involving rational values for coefficients and/or variables. ✓ 0706.3.1 Perform basic operations on linear expressions (including grouping, order of operations, exponents, simplifying and expanding).</td>
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<tr>
<td></td>
<td></td>
<td>SPI 0706.1.3 Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship.</td>
<td>SPI 0706.3.2 Determine whether a relation (represented in various ways) is a function. ✓ 0706.3.3 Identify a function from a written description, table, graph, rule, set of ordered pairs, and/or mapping. ✓ 0706.3.7 Distinguish proportional relationships ( y/x = k ), or ( y = kx ) from other relationships, including inverse proportionality ( xy = k ), or ( y = k/x ).</td>
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<tr>
<td>▪ Apply function rules.</td>
<td>SPI 0606.3.3 Write equations that correspond to</td>
<td>▪ Extend geometric and</td>
<td>SPI 0706.3.3 Given a table of</td>
</tr>
<tr>
<td>▪ Select an equation that represents a</td>
<td>given situations or represent a given</td>
<td>numerical patterns.</td>
<td>inputs x and outputs f(x),</td>
</tr>
<tr>
<td>mathematical relationship.</td>
<td>mathematical relationship.</td>
<td>▪ Generalize patterns in data</td>
<td>identify the function rule and</td>
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<tr>
<td>▪ Extend geometric and numerical</td>
<td>✓ 0606.3.6 Use equations to describe simple</td>
<td>represented in tables and</td>
<td>continue the pattern.</td>
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<tr>
<td>patterns.</td>
<td>relationships shown in a table or graph.</td>
<td>graphs.</td>
<td>✓ 0706.3.4 Make tables of inputs</td>
</tr>
<tr>
<td>▪ Generalize patterns in data</td>
<td>SPI 0606.3.7 Use algebraic expressions and</td>
<td>▪ Extend rate charts to solve</td>
<td>x and outputs f(x) for a variety</td>
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<tr>
<td>represented in tables.</td>
<td>properties to analyze numeric and geometric</td>
<td>real-world problems.</td>
<td>of rules that include rational</td>
</tr>
<tr>
<td>▪ Extend rate charts to solve</td>
<td>patterns.</td>
<td>▪ Apply function rules.</td>
<td>numbers (including negative</td>
</tr>
<tr>
<td>real-world word problems.</td>
<td>✓ 0606.3.8 Represent patterns using words,</td>
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<td>numbers) as inputs.</td>
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<td>graphs, and simple symbolic notation.</td>
<td></td>
<td>✓ 0706.3.13 Given a graph that</td>
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<td>✓ 0606.3.4 Generate data and graph relationships</td>
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<td>exhibits the intersection of a</td>
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<td>concerning measurement of length, area,</td>
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<td>line and the y-axis, write a</td>
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<td></td>
<td>volume, weight, time, temperature, money, and</td>
<td></td>
<td>linear function in slope-intercept</td>
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<td></td>
<td>information.</td>
<td></td>
<td>form: y = mx + b.</td>
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<td></td>
<td>SPI 0606.3.8 Select the qualitative graph that</td>
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<td>SPI 0706.1.2 Generalize a</td>
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<td></td>
<td>models a contextual situation (e.g., water</td>
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<td>variety of patterns to a symbolic</td>
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<td>filling then draining from a bathtub).</td>
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<td>rule from tables, graphs, or</td>
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<td>✓ 0606.3.9 Write a contextual story modeled by</td>
<td></td>
<td>words.</td>
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<td></td>
<td>a given graph.</td>
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<td>▪ Select a scatterplot to represent data</td>
<td>▪ Interpret graphs which</td>
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<td>presented in tabular form.</td>
<td>represent rates of change.</td>
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<td></td>
<td>▪ Interpret graphs which represent rates of</td>
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<td>change.</td>
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<td>SPI 0706.3.4 Interpret the slope of a line as</td>
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<td>a unit rate given the graph of a proportional</td>
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<td></td>
<td>relationship.</td>
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<td>✓ 0706.3.5 Plot points to represent tables of</td>
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<td></td>
<td>linear function values.</td>
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<td>✓ 0706.3.8 Understand slope as the ratio of</td>
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<td>vertical change to</td>
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<td>horizontal change.</td>
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<td>✓0706.3.9 Identify a function exhibiting a constant rate of change as a linear function and identify the slope as a unit rate.</td>
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<td>✓0706.3.11 Relate the features of a linear equation to a table and/or graph of the equation.</td>
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<td>✓0706.3.12 Use linear equations to solve problems and interpret the meaning of slope, m, and the y-intercept, b, in ( f(x) = mx + b ) in terms of the context.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>SPI 0706.3.5 Represent proportional relationships with equations, tables and graphs.</td>
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<td>✓0706.3.10 Solve problems involving unit rates (e.g., miles per hour, words per minute).</td>
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<td>SPI 0706.3.6 Solve linear equations with rational coefficients symbolically or graphically.</td>
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<td></td>
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<td></td>
<td>✓0706.3.6 Understand that the graph of a linear function ( f ) is the set of points on a line representing the ordered pairs ((x, f(x))).</td>
</tr>
<tr>
<td><strong>SPI 0606.3.4</strong> Rewrite expressions to represent quantities in different ways.</td>
<td>✓0606.3.3 Recognize the use of juxtaposition (such as ( 3x, ab )) to stand for multiplication, and the convention in these cases of writing numbers before letters.</td>
<td><strong>SPI 0606.3.5</strong> Translate between verbal</td>
<td><strong>SPI 0706.3.7</strong> Translate between verbal and symbolic representations of real-world phenomena involving linear equations</td>
</tr>
<tr>
<td><strong>SPI 0606.3.5</strong> Translate between verbal</td>
<td>✓ Represent mathematical statements and real-world situations using symbols.</td>
<td></td>
<td>✓0706.3.2 Represent and analyze mathematical situations using algebraic symbols.</td>
</tr>
<tr>
<td><strong>Former Standards 6th Grade</strong> Review Material</td>
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<tr>
<td><strong>expressions/sentences and algebraic expressions or equations.</strong></td>
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<tr>
<td>✓ 0606.3.7 Move fluently between different representations (such as verbal, tabular, numerical, algebraic, and graphical) of equations and expressions.</td>
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<tr>
<td><strong>Find missing addends or factors represented as variables in simple equations.</strong></td>
<td>SPI 0606.3.6 Solve two-step linear equations using number sense, properties, and inverse operations.</td>
<td>SPI 0706.3.8 Solve contextual problems involving two-step linear equations.</td>
<td></td>
</tr>
<tr>
<td>✓ 0606.3.1 Write and solve two-step linear equations corresponding to given situations (non-negative numbers only).</td>
<td>✓ 0606.3.2 Write and solve one-step inequalities corresponding to given situations (non-negative numbers only).</td>
<td>✓ 0706.3.9 Solve linear inequalities in one variable with rational coefficients symbolically or graphically.</td>
<td>✓ 0706.3.14 Understand that when solving linear inequalities, multiplication or division by a negative reverses the inequality symbol.</td>
</tr>
<tr>
<td>✓ 0506.3.6 Recognize there are many numbers between any two whole numbers on the number line.</td>
<td>✓ Identify whole numbers that satisfy a given one-variable inequality.</td>
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</tr>
<tr>
<td><strong>Use ordered pairs to describe given points in Quadrant 1 of a coordinate system.</strong></td>
<td>SPI 0606.3.9 Graph ordered pairs of integers in all four quadrants of the Cartesian coordinate system.</td>
<td><strong>Use ordered pairs to describe given points in a coordinate system. (formerly in Geometry)</strong></td>
<td></td>
</tr>
<tr>
<td>✓ 0606.3.11 Identify the quadrant of the coordinate system in which a point lies.</td>
<td>✓ 0606.3.10 Understand that in an ordered pair (x, y), the x represents horizontal location and y represents vertical location.</td>
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</table>
### Grade 7 – Geometry and Measurement

**Former Learning Expectations**

3.1 Analyze characteristics and properties of two- and three-dimensional geometric figures.

3.2 Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

3.3 Apply transformations and use symmetry to analyze mathematical situations.

3.4 Use visualization, spatial reasoning, and geometric modeling to solve problems.

4.1 Understand measurable attributes of objects and the units, systems, and processes of measurement.

4.2 Apply appropriate techniques, tools, and formulas to determine measurements.

**New Grade Level Expectations**

GLE 0706.4.1 Understand the application of proportionality with similar triangles.

GLE 0706.4.2 Apply proportionality to converting among different units of measurements to solve problems involving rates such as motion at a constant speed.

GLE 0706.4.3 Understand and use scale factor to describe the relationships between length, area, and volume.

GLE 0706.4.4 Understand and use ratios, derived quantities, and indirect measurements.

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**SPI 0706.4.1 Solve contextual problems involving similar triangles.**

- 0706.4.1 Solve problems involving indirect measurement such as finding the height of a building by comparing its shadow with the height and shadow of a known object.
- 0706.4.2 Use similar triangles and proportionality to find the lengths of unknown line segments in a triangle.
- 0706.4.5 Solve problems using ratio quantities: velocity (measured in units such as miles per hour), density (measured in units such as kilograms per liter), pressure (measured in units such as pounds per square foot), and population density (measured in units such as persons per square mile).
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<tr>
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<td></td>
<td>SPI 0706.4.2 Use SSS, SAS, and AA to determine if two triangles are similar.</td>
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<tr>
<td>▪ Apply spatial reasoning and visualization to solve real-world problems.</td>
<td>✓ 0606.4.8 Understand scaling, dilation and their relation to similarity.</td>
<td></td>
<td>SPI 0706.4.3 Apply scale factor to solve problems involving area and volume.</td>
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<tr>
<td></td>
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<td></td>
<td>✓ 0706.4.3 Understand that if a scale factor describes how corresponding lengths in two similar objects are related, then the square of the scale factor describes how corresponding areas are related, and the cube of the scale factor describes how corresponding volumes are related.</td>
</tr>
<tr>
<td></td>
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<td>✓ 0706.4.4 Compare angles, side lengths, perimeters and areas of similar shapes.</td>
</tr>
<tr>
<td>▪ Classify two-dimensional geometric figures using properties.</td>
<td>SPI 0606.4.1 Identify, define or describe geometric shapes given a visual representation or a written description of its properties.</td>
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<tr>
<td>▪ Classify angles as acute, obtuse, right, and straight.</td>
<td>✓ 0606.4.3 Verify the basic properties of triangles and quadrilaterals using a protractor and ruler.</td>
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<tr>
<td>▪ Identify parallel, perpendicular, and intersecting lines.</td>
<td>✓ 0606.4.4 Classify triangles by side lengths (scalene, isosceles, and equilateral) and angle measure (acute, right, obtuse, isosceles and equiangular).</td>
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<tr>
<td>▪ Classify quadrilaterals using their defining properties.</td>
<td>SPI 0606.4.2 Find a missing angle measure in problems involving interior/exterior angles and/or their sums.</td>
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<tr>
<td>▪ Apply formulas to determine the area of rectangles and triangles.</td>
<td>✓ 0606.4.1 Investigate the sum of the angles in a triangle and a quadrilateral using various</td>
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<td>▪ Determine the measure of an angle of a triangle, given the measures of the other two angles.</td>
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<td>▪ Classify triangles by angle, size, and length of sides.</td>
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<td>▪ Classify polygons by properties.</td>
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| ✓ 0606.4.2 Relate the sum of the angles in a triangle to the sum of the angles in polygons.  
✓ 0606.4.6 Use the properties of interior and exterior angles of polygons to solve problems. |  
• Estimate length, perimeter, circumference, area, and volume using a variety of strategies.  
• Use strategies to estimate perimeter and area of rectangles.  
• Solve real-world problems involving perimeter and area of rectangles. |  
• Apply formulas to determine the areas of rectangles, triangles, parallelograms, trapezoids, and circles.  
• Find or estimate area of irregular and complex shapes. |

**SPI 0606.4.3 Solve problems using the Triangle Inequality Theorem.**  
✓ 0606.4.5 Model and use the Triangle Inequality Theorem.

**SPI 0606.4.4 Calculate with circumferences and areas of circles.**  
✓ 0606.4.12 Derive the meaning of Pi using concrete models and/or appropriate technology.  
✓ 0606.4.11 Relate the circumference of a circle with the perimeter of a polygonal figure.  
✓ 0606.4.13 Understand the relationships among the radius, diameter, circumference and area of a circle, and that the ratio of the circumference to the diameter is the same as the ratio of the area to the square of the radius, and that this ratio is...
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<tr>
<td>SPI 0606.4.5 Determine the surface area and volume of prisms, pyramids and cylinders.</td>
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<tr>
<td>• Select units of appropriate size and type to measure angles, perimeter, area, capacity, volume, and weight.</td>
<td>• Select units of appropriate size and type to measure angles, perimeter, area, surface area, and volume.</td>
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<tr>
<td>• Use spatial reasoning to identify the three-dimensional figure created from a two-dimensional representation (net) of that figure (i.e., cube, rectangular prism, pyramid, cone, or cylinder).</td>
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<tr>
<td>✓ 0606.4.14 Relate the area of a trapezoid to the area of a parallelogram.</td>
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<tr>
<td>SPI 0606.4.6 Given the volume of a cone/pyramid, find the volume of the related cylinder/prism or vice versa.</td>
<td>✓ 0606.4.17 Use manipulatives to discover the volume of a pyramid is one-third the volume of the related prism (the heights and base areas are equal).</td>
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<tr>
<td></td>
<td>✓ 0606.4.18 Use manipulatives to discover the volume of a cone is one-third the volume of the related cylinder (the heights and base areas are equal).</td>
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<td></td>
<td>✓ 0606.4.15 Find lengths given areas or volumes, and vice versa.</td>
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<td></td>
<td>✓ 0606.4.16 Solve contextual problems involving area and circumference of circles,</td>
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<tr>
<td>surface areas and volumes of prisms, pyramids, cones, and cylinders.</td>
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- Identify the results of transformations of two-dimensional figures (e.g., slides/translations, flips/reflections, and turns/rotations).
  - ✓ 0606.4.7 Work with transformations in a plane and explore their meanings through drawings and manipulatives.
  - ✓ 0606.4.10 Describe the effect of a transformation on a 2-dimensional figure and the resulting symmetry.

- Identify the results of transformations of two-dimensional figures (i.e., turns/rotations, flips/reflections, slides/translations).

- □ 0606.4.9 Analyze the differences between congruence and similarity.

- Determine congruence of line segments, angles, and polygons.

- Determine the distance between two points on the x- or the y-axis in Quadrant I.

- Determine the distance between two points on the x- or the y-axis in Quadrant I.

- Solve real-world problems involving elapsed time.
**Grade 7 – Data Analysis, Probability, and Statistics**

**Former Learning Expectation**

- 5.1 Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer questions.
- 5.2 Select and use appropriate statistical methods to analyze data.
- 5.3 Develop and evaluate inferences and predictions that are based on data.
- 5.4 Understand and apply basic concepts of probability.

**New Grade Level Expectations**

- GLE 0706.5.1 Collect, organize, and analyze both single- and two-variable data.
- GLE 0706.5.2 Select, create, and use appropriate graphical representations of data.
- GLE 0706.5.3 Formulate questions and design studies to collect data about a characteristic shared by two populations, or different characteristics within one population.
- GLE 0706.5.4 Use descriptive statistics to summarize and compare data.
- GLE 0706.5.5 Understand and apply basic concepts of probability.

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<tr>
<td>• Interpret bar and line graphs to answer questions and solve real-world problems.</td>
<td>SPI 0606.5.2 Identify features of graphs that may be misleading. ✓ 0606.5.8 Connect data sets and their graphical representations (e.g., bar graphs, circle graphs, and stem-and-leaf-plots).</td>
<td>• Interpret circle graphs displaying real-world data. • Interpret bar and line graphs to answer questions and solve real-world problems.</td>
<td>SPI 0706.5.1 Interpret and employ various graphs and charts to represent data. ✓ 0706.5.2 Interpret and solve problems using information presented in various visual forms.</td>
</tr>
<tr>
<td>• Connect data sets and their graphical representations (i.e., bar graphs, circle graphs, and stem-and-leaf-plots).</td>
<td></td>
<td>• Connect data sets and their graphical representations (i.e., bar graphs, stem-and-leaf plots, box plots, and scatter plots).</td>
<td>SPI 0706.5.2 Select suitable graph types (such as bar graphs, histograms, line graphs, circle graphs, box-and-whisker plots, and stem-and-leaf plots) and use them to create accurate representations of given data. ✓ 0706.5.1 Create and interpret box-and-whisker plots and stem-and-leaf plots. ✓ 0706.5.5 Apply percentages to make and interpret histograms and circle graphs.</td>
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<td>✓ 0606.5.11 Select the appropriate measure of center to describe a data set.</td>
<td>• Determine the mean for a data set. • Determine the median for a data set. • Make predictions based on</td>
<td>SPI 0706.5.3 Calculate and interpret the mean, median, upper-quartile, lower-quartile, and interquartile range of a set of data.</td>
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<tr>
<td></td>
<td>✓ 0606.5.11 Select the appropriate measure of center to describe a data set.</td>
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<tr>
<td>stem-and-leaf-plot.</td>
<td></td>
<td>0.0606.5.3 Predict and compare the characteristics of two populations based on the analysis of sample data.</td>
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</tr>
<tr>
<td>Use a tree diagram or organized list to determine all possible outcomes of a simple compound event.</td>
<td>SPI 0606.5.1 Determine the theoretical probability of simple and compound events in familiar contexts.</td>
<td>Use proportional thinking to make conjectures about results of experiments and simulations.</td>
<td></td>
</tr>
<tr>
<td>Represent the likelihood of an event using a number from 0-1.</td>
<td>✓ 0606.5.1 Understand that the probability of an event is a number between zero and one that expresses the likelihood of its occurrence.</td>
<td>SPI 0706.5.4 Use theoretical probability to make predictions.</td>
<td></td>
</tr>
<tr>
<td>Make conjectures and predictions based on data (e.g., in a chart, table, or graph).</td>
<td>✓ 0606.5.2 Identify the probability of an event as the ratio of the number of its actual occurrences to the total number of its possible occurrences.</td>
<td>✓ 0706.5.4 Use proportional reasoning to make predictions about results of experiments and simulations.</td>
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</tr>
<tr>
<td>✓ 0606.5.3 Express probabilities in different ways.</td>
<td>✓ 0606.5.4 Understand the difference between probability and odds.</td>
<td>✓ 0706.5.6 Use a tree diagram or organized list to determine all possible outcomes of a simple probability experiment.</td>
<td></td>
</tr>
<tr>
<td>✓ 0606.5.5 Analyze a situation that involves probability of an independent event.</td>
<td>✓ 0606.5.5 Evaluate the design of an experiment.</td>
<td>✓ 0706.5.5 Evaluate the design of an experiment.</td>
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<tr>
<td>Determine if a sample is biased.</td>
<td>SPI 0606.5.3 Determine whether or not a sample is biased.</td>
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<tr>
<td>✓ 0606.5.9 Determine the sample space for a given situation.</td>
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<tr>
<td>✓ 0606.5.10 Distinguish between a random and nonrandom sample.</td>
<td>✓ 0606.5.12 Predict the characteristics of a population based on the analysis of sample data.</td>
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Grade 8 Transition to New TN Mathematics Standards

Grade 8 – Mathematical Processes

New Grade Level Expectations
GLE 0806.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.
GLE 0806.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.
GLE 0806.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.
GLE 0806.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.
GLE 0806.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0806.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.
GLE 0806.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.
GLE 0806.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

Checks for Understanding (Formative/Summative Assessment)
✓ 0806.1.1 Relate nonlinear functions to geometric contexts of length, area, and volume.
✓ 0806.1.2 Draw qualitative graphs (trend graphs) of functions and describe their general shape/trend.
✓ 0806.1.3 Research the contributions of Pythagoras to mathematics.
✓ 0806.1.4 Relate data concepts to relevant concepts in the earth and space, life, and physical sciences.
✓ 0806.1.5 Use age-appropriate books, stories, and videos to convey ideas of mathematics.
✓ 0806.1.6 Use models (such as dynamic geometry software, patty paper and geo boards) to explore relationships among angles (complementary, supplementary, interior, exterior, vertical, and corresponding).
✓ 0806.1.7 Use a graphing calculator or spreadsheet to create scatterplots of data and approximate lines of best fit.
✓ 0806.1.8 Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g., manipulatives, technology, pencil and paper).

State Performance Indicators
SPI 0806.1.1 Solve problems involving rate/time/distance (i.e., d = rt).
SPI 0806.1.2 Interpret a qualitative graph representing a contextual situation.
SPI 0806.1.3 Calculates rates involving cost per unit to determine the best buy.
## Grade 8 – Number and Operation

### Former Learning Expectations

1.1 Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
1.2 Understand operations and how they relate to one another.
1.3 Solve problems, compute fluently, and make reasonable estimates.

### New Grade Level Expectations

- **GLE 0806.2.1** Extend understanding of the real number system to include irrational numbers.
- **GLE 0806.2.2** Solve problems involving exponents and scientific notation using technology appropriately.
- **GLE 0806.2.3** Solve real-world problems using rational and irrational numbers.
- **GLE 0806.2.4** Understand and use the laws of exponents.

### Former Standards 7th Grade Review Material

- Compute efficiently and accurately with whole numbers, fractions, and decimals. **A**
- Apply order of operations when computing with whole numbers (no more than two parentheses and no exponents). **A**

### New Standards 7th Grade Building blocks for new standards

- Recognize the place value of a given digit. **M**
- Compute efficiently and accurately with whole numbers, fractions, decimals, and percents. **A**
- Apply order of operations in computing with rational numbers using no more than two parentheses and exponents 1 and 2. **A**
- Work flexibly with fractions, decimals, and percents to solve one- and two-step word problems. **A**
- Use the associative and commutative properties of addition and multiplication to simplify computations with integers, fractions, and decimals. **M**
- Develop and analyze procedures for computing with fractions, decimals, and integers. **M**
- Understand the meaning and effects of arithmetic operations with fractions, decimals, and integers. **D**
- Use the distributive property to simplify computations with integers, fractions, and decimals.

### Former Standards 8th Grade TCAP 2008-2009

### New Standards 8th Grade TCAP 2009-2010

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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring 2008
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| D  Understand and use the inverse relationships of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and to solve problems. **D**  
| ▪ Select and use appropriate methods and tools for computing with whole numbers, fractions, decimals, percents, and integers in problem-solving situations (e.g., mental computation, estimation, calculators, computers, and paper and pencil). **D**  
| ▪ Develop meaning for percents greater than 100 and less than one and identify examples. **D**  | ▪ Identify the opposite and the reciprocal of a rational number. **A**  | ▪ Identify the opposite and the reciprocal of a rational number. **A**  |  |
| ▪ Select a reasonable solution to a real-world division problem in which the remainder must be considered. **A**  
| ▪ Represent numbers using a variety of equivalent forms (i.e., mixed numbers, fractions, decimals, percents, and integers). **A**  
| ▪ Identify prime and composite numbers up to 50. **A**  | ▪ Apply number theory concepts to solve problems (e.g., divisibility, factors, multiples, composite numbers, prime numbers, prime factorization, and relatively prime). **D**  | ▪ Calculate rates involving cost per unit to determine the best buy. **A**  | SPI 0806.1.3 Calculates rates involving cost per unit to determine the best buy.  |
| ▪ Solve one- and two-step real-world problems involving whole numbers, fractions, and decimals. **A**  | SPI 0706.2.5 Solve contextual problems that involve operations with integers.  
□ 0706.2.4 Understand that a and  | ▪ Use concrete, pictorial, and symbolic representations of integers. **M**  
<p>| ▪ Solve multi-step real-world |  | ▪ Solve multi-step real-world  |  |</p>
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<td>−a are additive inverses and are located the same distance from zero on the number line; relate distance from zero to absolute value. ✓0706.2.5 Understand that −(−a) = a for any number a. 0706.2.6 Use the number line to demonstrate addition and subtraction with integers.</td>
<td>problems involving whole numbers, fractions, decimals, and percents. D</td>
<td>▪ Use a variety of models to demonstrate the relationships within the real number system (e.g., Venn diagrams and webs). D</td>
<td>✓0806.2.4 Use a Venn diagram to represent the subsets of the real number system. ✓0806.2.5 Identify the subset(s) of the real number system to which a number belongs.</td>
</tr>
<tr>
<td>▪ Compare rational numbers using the appropriate symbol (,&lt;, &gt;, and =). A ▪ Connect rational numbers to locations on a number line. A</td>
<td>SPI 0706.2.1 Simplify numerical expressions involving rational numbers. ✓0706.2.1 Understand that the set of rational numbers includes any number that can be written as a ratio of two integers in which the denominator is not zero. ✓0706.2.2 Develop and analyze algorithms and compute efficiently with integers and rational numbers. ✓0706.2.3 Recognize that rational numbers satisfy the commutative and associative laws of addition and multiplication and the distributive law. SPI 0706.2.2 Compare rational numbers using appropriate inequality symbols. ✓0706.2.9 Efficiently compare and order rational numbers [and roots of perfect squares/cubes]; determine their approximate</td>
<td>SPI 0806.2.1 Order and compare rational and irrational numbers and locate on the number line.</td>
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| locations on a number line.  
✓ 0706.2.14 Express numbers in scientific notation and recognize its importance in representing the magnitude of a number.  
✓ 0706.2.29 Efficiently compare and order [rational numbers and roots of perfect squares/cubes]; determine their approximate locations on a number line.  
✓ 0706.2.10 Recognize that when a whole number is not a perfect square, then its square root is not rational and cannot be written as the ratio of two integers.  
✓ 0706.2.11 Estimate square/cube roots and use calculators to find approximations.  
✓ 0706.2.12 Recognize \( \sqrt{mn} = \sqrt{m} \cdot \sqrt{n} \) and \( (\sqrt{m})^2 = m \).  
✓ 0706.2.13 Use the meaning of negative exponents to represent small numbers; translate between scientific and standard notation.  
| **SPI 0706.2.3** Use rational numbers and roots of perfect squares/cubes to solve contextual problems.  
**SPI 0706.2.4** Determine the approximate location of square/cube roots on a number line.  
| ▪ Determine the square roots of perfect squares (<169).  
| **SPI 0806.2.2** Identify numbers and square roots as rational or irrational.  
✓ 0806.2.2 Square numbers and simplify square roots.  
✓ 0806.2.3 Solve contextual problems involving powers and roots.  
| **SPI 0806.2.3** Use scientific notation to compute products and quotients.  
✓ 0806.2.1 Recognize and use exponential, scientific, and calculator notation.  
✓ 0806.2.6 Simplify expressions using the laws of exponents.  
**SPI 0806.2.4** Solve real-world problems requiring scientific notation.  
✓ 0806.2.7 Add, subtract, multiply, and divide numbers  

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<tr>
<td>• Connect percents greater than 100 and percents less than one to real-world situations. <strong>A</strong>&lt;br&gt;• Use ratios to represent quantitative relationships. <strong>A</strong></td>
<td><strong>SPI 0706.1.1 Use proportional reasoning to solve mixture/concentration problems.</strong>&lt;br&gt;<strong>SPI 0706.1.4 Use scales to read maps.</strong>&lt;br&gt;<strong>SPI 0706.2.6 Express the ratio between two quantities as a percent, and a percent as a ratio or fraction.</strong>&lt;br&gt;<strong>SPI 0706.2.7 Use ratios and proportions to solve problems.</strong>&lt;br&gt;✓ 0706.2.7 Write number sentences to solve contextual problems involving ratio and percent.&lt;br&gt;✓ 0706.2.8 Apply ratios, rates, proportions and percents (such as discounts, interest, taxes, tips, distance/rate/time, and percent increase or decrease).</td>
<td><strong>Use ratios and proportions to represent real-world situations (i.e., scale drawings and probability).</strong> <strong>A</strong>&lt;br&gt;<strong>Solve real-world problems involving rate/time/distance (i.e., ( d = rt )).</strong> <strong>A</strong> (formerly Measurement)&lt;br&gt;<strong>Understand and use ratios and proportions to represent quantitative relationships.</strong> <strong>D</strong>&lt;br&gt;<strong>Develop, analyze, explain, and use methods for solving problems involving proportions (e.g., scaling and finding equivalent ratios).</strong> <strong>D</strong>&lt;br&gt;✓ SPI 0706.2.8 Apply ratios, rates, proportions and percents (such as discounts, interest, taxes, tips, distance/rate/time, and percent increase or decrease).&lt;br&gt;✓ SPI 0706.2.15 Report results of calculations appropriately in a given context (i.e. using rules of rounding, degree of accuracy, and/or significant digits).</td>
<td><strong>SPI 0806.1.1 Solve problems involving rate/time/distance (i.e., ( d = rt )).</strong>&lt;br&gt;<strong>Expressed scientific notation.</strong></td>
</tr>
<tr>
<td>• Use estimation strategies to select a reasonable solution to a computation involving rational numbers. <strong>A</strong></td>
<td>✓ 0706.2.15 Report results of calculations appropriately in a given context (i.e. using rules of rounding, degree of accuracy, and/or significant digits).</td>
<td><strong>Use estimation strategies to select a reasonable solution to a real-world problem involving computing with rational numbers.</strong> <strong>A</strong>&lt;br&gt;<strong>Judge the reasonableness of the results of rational number estimates and computations.</strong> <strong>D</strong></td>
<td><strong>SPI 0806.1.1 Solve problems involving rate/time/distance (i.e., ( d = rt )).</strong>&lt;br&gt;<strong>Expressed scientific notation.</strong></td>
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### Grade 8 – Algebra

**Former Learning Expectations**
2.1 Understand patterns, relations, and functions.
2.2 Represent and analyze mathematical situations and structures using algebraic symbols.
2.3 Use mathematical models to represent and understand quantitative relationships.
2.4 Analyze change in various contexts.

**New Grade Level Expectations**
GLE 0806.3.1 Recognize and generate equivalent forms for algebraic expressions.
GLE 0806.3.2 Represent, analyze, and solve problems involving linear equations and inequalities in one and two variables.
GLE 0806.3.3 Solve systems of linear equations in two variables.
GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions.
GLE 0806.3.5 Use slope to analyze situations and solve problems.

### Former Standards 7th Grade Review Material

- Extend geometric and numerical Generalize patterns in data represented in tables and graphs, and patterns. A
- Extend rate charts to solve real-world problems. A
- Apply function rules. A
- Represent mathematical statements and real-world situations using symbols. A

**New Standards 7th Grade Building blocks for new standards**

- SPI 0706.1.2 Generalize a variety of patterns to a symbolic rule from tables, graphs, or words.
- SPI 0706.3.7 Translate between verbal and symbolic representations of real-world phenomena involving linear equations
- 0706.3.2 Represent and analyze mathematical situations using algebraic symbols.

**Former Standards 8th Grade TCAP 2008-2009**

- Generate equivalent forms with symbolic rules. A
- Represent situations and solve real-world problems using symbolic algebra. A
- Apply given formulas to solve real-world problems. A
- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and (when possible) symbolic rules. D
- Develop understanding for arithmetic and geometric sequences. D

**New Standards 8th Grade TCAP 2009-2010**

- 0806.3.2 Represent algebraic relationships with equations and inequalities.
- 0806.3.13 Represent situations and solve real-world problems using symbolic algebra.

### Former Standards 8th Grade TCAP 2008-2009

- 0806.3.1 Perform basic operations on algebraic expressions (including grouping, order of operations, exponents, square/cube roots, simplifying and expanding).

**New Standards 8th Grade TCAP 2009-2010**

- SPI 0806.3.1 Find solutions to systems of two linear equations in two variables.
- SPI 0806.3.2 Solve the linear equation \( f(x) = g(x) \).
- 0806.3.3 Solve systems of linear equations in two

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<tr>
<td>• Solve one-step linear equations. A</td>
<td>SPI 0706.3.6 Solve linear equations with rational coefficients symbolically or graphically. SPI 0706.3.8 Solve contextual problems involving two-step linear equations. 0706.3.6 Understand that the graph of a linear function ( f ) is the set of points on a line representing the ordered pairs ((x, f(x))).</td>
<td>• Solve one- and two-step linear equations involving integers. A • Formulate multi-step equations that represent relationships and real-world situations. A • Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g., manipulatives, technology, and paper and pencil). D</td>
<td>• Solve one-step linear inequalities A • Identify the graphical representation of the solution to a one-variable linear inequality. I</td>
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<tr>
<td>• Identify whole numbers that satisfy a given one-variable inequality. A</td>
<td>SPI 0706.3.9 Solve linear inequalities in one variable with rational coefficients symbolically or graphically. ✓0706.3.14 Understand that when solving linear inequalities, multiplication or division by a negative reverses the inequality symbol.</td>
<td>• Solve one-step linear inequalities A • Identify the graphical representation of the solution to a one-variable linear inequality. I</td>
<td>• SPI 0806.3.3 Solve and graph linear inequalities in two variables. ✓0806.3.4 Understand the relationship between the graph of a linear inequality and its solutions. ✓0806.3.5 Solve linear inequalities in two variables (including those whose solutions require multiplication or division by a negative number). ✓0806.3.8 Recognize a proportion as a special case of a linear equation and understand that the constant of proportionality is the slope, and the resulting graph is a line through the origin.</td>
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<td>• Select a scatterplot to represent data presented in tabular form. A</td>
<td>SPI 0706.3.5 Represent proportional relationships with equations, tables and graphs. 0706.3.10 Solve problems involving unit rates (e.g., miles per hour, words per minute).</td>
<td>• Connect the appropriate graph to a linear equation. A • Connect symbolic expressions and graphs of lines. A • Relate and compare different forms of representation for a relationship. D • Use a variety of representations to solve real-world problems (e.g., graphs, tables, and</td>
<td>• SPI 0806.3.4 Translate between various representations of a linear function. ✓0806.3.9 Given a function rule, create tables of values for ( x ) and ( y ), and plot graphs of nonlinear functions.</td>
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<td>- Interpret graphs which represent rates of change. <strong>A</strong></td>
<td>SPI 0706.3.3 Given a table of inputs x and outputs f(x), identify the function rule and continue the pattern. SPI 0706.3.4 Interpret the slope of a line as a unit rate given the graph of a proportional relationship. ✓0706.3.4 Make tables of inputs x and outputs f(x) for a variety of rules that include rational numbers (including negative numbers) as inputs ✓0706.3.5 Plot points to represent tables of linear function values. ✓0706.3.8 Understand slope as the ratio of vertical change to horizontal change. ✓0706.3.9 Identify a function exhibiting a constant rate of change as a linear function and identify the slope as a unit rate. ✓0706.3.11 Relate the features of a linear equation to a table and/or graph of the equation. ✓0706.3.12 Use linear equations to solve problems and interpret the meaning of slope, m, and the y-intercept, b, in f(x) = mx + b in terms of the context. ✓0706.3.13 Given a graph that exhibits the intersection of a line and the y-axis, write a linear function in slope-intercept form: y = mx + b.</td>
<td>- Interpret graphs which represent rates of change. <strong>A</strong> - Compare and contrast properties of functions from tables, graphs, or equations. <strong>I</strong> - Use a variety of forms to represent linear relationships. <strong>I</strong></td>
<td>SPI 0806.1.2 Interpret a qualitative graph representing a contextual situation. SPI 0806.3.5 Determine the slope of a line from an equation, two given points, a table or a graph. SPI 0806.3.6 Analyze the graph of a linear function to find solutions, roots, and intercepts. ✓0806.3.6 Identify x- and y-intercepts and slope of linear equations from an equation, graph or table. ✓0806.3.7 Analyze situations and solve problems involving constant rate of change.</td>
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| SPI 0706.3.2 Determine functions as linear or nonlinear. **A** | **I** | **I** | SPI 0806.3.7 Identify,
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<td>whether a relation (represented in various ways) is a function. SPI 0706.1.3 Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship. ✓0706.3.3 Identify a function from a written description, table, graph, rule, set of ordered pairs, and/or mapping. ✓0706.3.7 Distinguish proportional relationships ((y/x = k, \text{ or } y = kx)) from other relationships, including inverse proportionality ((xy = k, \text{ or } y = k/x)).</td>
<td>nonlinear. D</td>
<td>compare and contrast functions as linear or nonlinear. ✓0806.3.10 Distinguish quadratic and exponential functions as nonlinear using a graph and/or a table of values. ✓0806.3.11 Distinguish between the equations of linear, quadratic, and exponential functions (e.g. function families such as (y=x^2), (y=2^x), and (y=2x)). ✓0806.3.12 Understand how rates of change of nonlinear functions contrast with constant rates of change of linear functions.</td>
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# Grade 8 – Geometry and Measurement

## Former Learning Expectations

1. Analyze characteristics and properties of two- and three-dimensional geometric figures.
2. Specify locations and describe spatial relationships using coordinate geometry and other representational systems.
3. Apply transformations and use symmetry to analyze mathematical situations.
4. Use visualization, spatial reasoning, and geometric modeling to solve problems.
5. Understand measurable attributes of objects and the units, systems, and processes of measurement.
6. Apply appropriate techniques, tools, and formulas to determine measurements.

## New Grade Level Expectations

- Derive the Pythagorean theorem and understand its applications.
- Understand the relationships among the angles formed by parallel lines cut by transversals.
- Understand the necessary levels of accuracy and precision in measurement.
- Understand both metric and customary units of measurement.
- Use visualization to describe or identify intersections, cross-sections, and various views of geometric figures.

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| ▪ Classify triangles by angle, size, and length of sides. A  
▪ Classify polygons by properties. A | ▪ Apply spatial reasoning and visualization to solve real-world problems. A  
▪ Apply geometric ideas and relationships in areas outside the mathematics classroom (i.e., art, science, and everyday life). A  
▪ Use appropriate tools and methods to draw geometric objects with specified properties, (e.g., side lengths, and angle measure). D  
▪ Use two-dimensional representations of three-dimensional objects to visualize. D | ▪ Classify types of two- and three-dimensional objects using their defining properties. A  
▪ Describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties. D | ▪ Use ordered pairs to describe given points in a coordinate system. A  
▪ Graph points in the coordinate system. D |

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<td>axis in Quadrant I A</td>
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<td>Solve real-world problems using the Pythagorean theorem (no radicals). A</td>
<td>Develop an understanding of the Pythagorean theorem and use it to solve real-world problems. D</td>
<td>SPI 0806.4.1 Use the Pythagorean theorem to solve contextual problems. SPI 0806.4.2 Apply the Pythagorean theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra. ✓0806.4.1 Model the Pythagorean Theorem. ✓0806.4.2 Use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle.</td>
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<td>Identify relationships among the angles (i.e., complementary, supplementary, interior, exterior, vertical, and corresponding). A</td>
<td>Solve problems using angle relationships (i.e., complementary, supplementary, interior, exterior, vertical, and corresponding). A</td>
<td>SPI 0806.4.3 Find measures of the angles formed by parallel lines cut by a transversal. ✓0806.4.5 Analyze the congruent and supplementary relationships of angles formed by parallel lines and transversals (such as alternate interior, alternate exterior, corresponding, and adjacent).</td>
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<td>Convert from one unit to another within the same system. A</td>
<td>Convert from one unit to another within the same system. A</td>
<td>SPI 0806.4.4 Convert between and within the U.S. Customary System and the metric system. ✓0806.4.6 Make within-system and between-system conversions</td>
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<tr>
<td>SPI 0806.4.5 Identify the intersection of two or more geometric figures in the plane.</td>
<td>0806.4.7 Visualize or describe the cross-section resulting from the intersection of a plane with a 3-dimensional figure.</td>
<td>0806.4.8 Build, draw, and work with 2- and 3-dimensional figures by means of orthogonal views, projective views, and/or nets.</td>
<td>of derived quantities (including distance, temperature, money.)</td>
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</table>

- Apply formulas to determine the areas of rectangles, triangles, parallelograms, trapezoids, and circles. **A**
- Find or estimate area of irregular and complex shapes. **A**
- Select units of appropriate size and type to measure angles, perimeter, area, surface area, and volume. **A**

- Estimate length, perimeter, circumference, area, and volume using a variety of strategies. **A**
- Apply formulas to find the circumference and area of circles. **A**
- Apply formulas to find the area of triangles, parallelograms, and trapezoids. **A**
- Estimate or find the area of irregular and complex shapes. **A**
- Select units of appropriate size and type to measure angles, perimeter, area, surface area, and volume. **A**
- Select and apply techniques and tools to accurately measure length, perimeter, area, volume, and angles to appropriate levels of precision. **D**
- Compare and contrast the volumes of a variety of geometric solids. **D**
- Apply given formulas to find volume of selected prisms and cylinders. **I**

- 0806.3 Select or use the appropriate measurement instrument to determine or create a given length, area, volume, angle, weight, or mass.
- 0806.4.4 Understand how the precision of measurement influences accuracy of quantities derived from these measurements.
### Former Standards 7th Grade
**Review Material**

- Solve problems involving scale factors using ratios and proportions.  

### New Standards 7th Grade
**Building blocks for new standards**

**SPI 0706.4.2** Use SSS, SAS, and AA to determine if two triangles are similar.

**SPI 0706.4.1** Solve contextual problems involving similar triangles.

- 0706.4.1 Solve problems involving indirect measurement such as finding the height of a building by comparing its shadow with the height and shadow of a known object.
- 0706.4.2 Use similar triangles and proportionality to find the lengths of unknown line segments in a triangle.
- 0706.4.5 Solve problems using ratio quantities: velocity (measured in units such as miles per hour), density (measured in units such as kilograms per liter), pressure (measured in units such as pounds per square foot), and population density (measured in units such as persons per square mile).

**SPI 0706.4.3** Apply scale factor to solve problems involving area and volume.

- 0706.4.3 Understand that if a scale factor describes how corresponding lengths in two similar objects are related, then the square of the scale factor describes how corresponding areas are related, and the cube of the scale factor describes how corresponding volumes are related.
- 0706.4.4 Compare angles, side lengths, perimeters and areas of similar shapes.

### Former Standards 8th Grade
**TCAP 2008-2009**

- Apply relationships among the angles and side lengths of similar geometric figures.  
- Recognize similar geometric figures.  
- Solve problems involving scale factors using ratios and proportion.  
- Find measures using proportional relationships and properties of similar figures.

### New Standards 8th Grade
**TCAP 2009-2010**

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- Determine the measure of an angle of a triangle, given the measures of the other two angles. **A**
- Determine congruence of line segments, angles, and polygons. **A**
- Identify the results of transformations of two-dimensional figures (i.e., turns/rotations, flips/reflections, slides/translations). **A**

- Determine the measure of an angle of a triangle given the measures of the other two angles. **A**

- Determine congruence of line segments, angles, and polygons by direct comparison of given attributes **D**.
- Describe sizes, positions, and orientations of shapes under transformations (e.g., rotations, translations, reflections, and dilations). **D**
- Relate symmetry and congruence to reflections about a line. **D**
**Former Learning Expectations**

5.1 Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer questions.

5.2 Select and use appropriate statistical methods to analyze data.

5.3 Develop and evaluate inferences and predictions that are based on data.

5.4 Understand and apply basic concepts of probability.

**New Grade Level Expectations**

GLE 0806.5.1 Explore probabilities for compound, independent and/or dependent events.

GLE 0806.5.2 Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures.

GLE 0806.5.3 Evaluate the use of statistics in media reports.

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<td>Use proportional thinking to make conjectures about results of experiments and simulations. A</td>
<td>SPI 0706.5.4 Use theoretical probability to make predictions.</td>
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<tr>
<td></td>
<td>✓ 0706.5.4 Use proportional reasoning to make predictions about results of experiments and simulations.</td>
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<td>✓ 0706.5.6 Use a tree diagram or organized list to determine all possible outcomes of a simple probability experiment.</td>
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<td>Connect the symbolic representation of a probability to an experiment. A</td>
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<td>Identify an appropriate sample to test a given hypothesis. A</td>
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<td>Develop meaning of mutually exclusive events. I</td>
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<td>Distinguish between theoretical and experimental probability. I</td>
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<td>Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, and/or area models). D</td>
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<td>Find the probability of dependent and independent events. D</td>
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<td>Interpret circle graphs displaying real-world data. A</td>
<td>SPI 0706.5.1 Interpret and employ various graphs and charts to represent data.</td>
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<td>✓ 0706.5.2 Interpret and solve problems using information presented in various visual forms.</td>
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<td>Connect data sets and their graphical representations (i.e., histograms, stem-and-leaf plots, box plots, and scatterplots). A</td>
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<td>Make conjectures and predictions based on data. A</td>
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<td>Develop meaning for lines of best fit. I</td>
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<td>SPI 0806.5.1 Calculate probabilities of events for simple experiments with equally probable outcomes.</td>
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<td>SPI 0806.5.2 Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models).</td>
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<td>✓ 0806.5.1 Solve simple problems involving probability and relative frequency.</td>
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<td>✓ 0806.5.2 Compare probabilities of two or more events and recognize when certain events are equally likely.</td>
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<td>✓ 0806.5.3 Recognize common misconceptions associated with dependent/independent events.</td>
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<td>SPI 0806.5.3 Generalize the relationship between two sets of data using scatterplots and lines of best fit.</td>
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<td>✓ 0806.5.5 Create and interpret box-and-whisker plots and scatterplots.</td>
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<td>✓ 0806.5.6 Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken.</td>
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<td>✓ 0806.5.7 Estimate lines of best fit to make and test conjectures.</td>
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| ▪ Connect data sets and their graphical representations (i.e., bar graphs, stem-and-leaf plots, box plots, and scatterplots). **A** | **SPI 0706.5.2 Select suitable graph types (such as bar graphs, histograms, line graphs, circle graphs, box-and-whisker plots, and stem-and-leaf plots) and use them to create accurate representations of given data.**  
  ✓ 0706.5.1 Create and interpret box-and-whisker plots and stem-and-leaf plots.  
  ✓ 0706.5.5 Apply percentages to make and interpret histograms and circle graphs. | ▪ Interpret appropriate graphical representations of data (i.e., histograms, box plots, and scatterplots). **A**  
  ▪ Select, create, and use appropriate graphical representations of real-world data (e.g., histograms, box plots, and scatterplots). **D**  
  ▪ Connect data sets and their graphical representations (e.g., bar graphs, line graphs, and circle graphs). **D** | ✓ 0806.5.4 Explain the benefits and the limitations of various representations of data (i.e., bar graphs, line graphs, circle graphs, histograms, stem-and-leaf plots, box plots, scatterplots).  

| ▪ Recognize misleading presentations of data. **A**  

| SPI 0806.5.4 Recognize misrepresentations of published data in the media.  
  ✓ 0806.5.8 Consider the source, design, analysis, and display of data to evaluate statistics reported in the media. |  |
| ✓ 0706.5.5 Evaluate the design of an experiment. | ▪ Formulate questions, design studies, and collect real-world data for investigations using a variety of collection methods (e.g., random sampling and simulations). **D**  
  ▪ Make conjectures to formulate new questions for future studies. **D** |  |
| ▪ Determine the mean for a data set. **A** Determine the median for a data set. **A** | **SPI 0706.5.3 Calculate and interpret the mean, median, upper-quartile, lower-quartile, and interquartile range of a set of data.**  
  ✓ 0706.5.3 Predict and compare the characteristics of two populations based on the analysis of sample data. | ▪ Determine the mean of a given set of real-world data. **A**  
  ▪ Determine the median of a given set of real-world data (even number of data). **A**  
  ▪ Determine and interpret measures of center and spread (e.g., mean, median, and interquartile range). **D**  
  ▪ Develop meaning for frequency, distribution, and outliers. **I** |  |
Algebra I Transition to New TN Mathematics Standards

Algebra I – Mathematical Processes

New Course Level Expectations

CLE 3102.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.
CLE 3102.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.
CLE 3102.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.
CLE 3102.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.
CLE 3102.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.
CLE 3102.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
CLE 3102.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models

Checks for Understanding (Formative/Summative Assessment)

✓ 3102.1.1 Develop meaning for mathematical vocabulary.
✓ 3102.1.2 Use the terminology of mathematics correctly.
✓ 3102.1.3 Understand and use mathematical symbols, notation, and common mathematical abbreviations correctly.
✓ 3102.1.4 Write a rule with variables that expresses a pattern.
✓ 3102.1.5 Use formulas, equations, and inequalities to solve real-world problems including time/rate/distance, percent increase/decrease, ratio/proportion, and mixture problems.
✓ 3102.1.6 Use a variety of strategies to estimate and compute solutions, including real-world problems.
✓ 3102.1.7 Identify missing or irrelevant information in problems.
✓ 3102.1.8 Recognize and perform multiple steps in problem solving when necessary.
✓ 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure, reflexive, symmetric, transitive, operation properties of equality).
✓ 3102.1.10 Use algebraic properties to develop a valid mathematical argument.
✓ 3102.1.11 Use manipulatives to model algebraic concepts.
✓ 3102.1.12 Create and work flexibly among representations of relations (including verbal, equations, tables, mappings, graphs).
✓ 3102.1.13 Change from one representation of a relation to another representation, i.e., change from a verbal description to a graph.
✓ 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients and constants in functions.
✓ 3102.1.15 Apply arithmetic concepts in algebraic contexts.
✓ 3102.1.16 Understand and express the meaning of the slope and y-intercept of linear functions in real-world contexts.
✓ 3102.1.17 Connect the study of algebra to the historical development of algebra.
✓ 3102.1.18 Translate syntax of technology to appropriate mathematical notation.
✓ 3102.1.19 Recognize and practice appropriate use of technology in representations and in problem solving.
✓ 3102.1.20 Estimate solutions to evaluate the reasonableness of results and to check technological computation.

State Performance Indicators

SPI 3102.1.1 Interpret patterns found in sequences, tables, and other forms of quantitative information using variables or function notation.
SPI 3102.1.2 Write an equation symbolically to express a contextual problem.
SPI 3102.1.3 Apply properties to evaluate expressions, simplify expressions, and justify solutions to problems.
SPI 3102.1.4 Translate between representations of functions that depict real-world situations.
SPI 3102.1.5 Recognize and express the effect of changing constants and/or coefficients in problem solving.
SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems.
Algebra I – Number and Operation

Former Learning Expectations
1.1 Demonstrate an understanding of the subsets, properties, and operations of the real number system.
1.2 Demonstrate an understanding of the relative size of rational and irrational numbers.
1.3 Articulate, model, and apply the concept of inverse (e.g., opposites, reciprocals, and powers and roots).
1.4 Describe, model, and apply inverse operations.
1.5 Apply number theory concepts (e.g., primes, factors, divisibility and multiples) in mathematical problem solving.
1.6 Connect graphical and symbolic representations of absolute value.
1.7 Use real numbers to represent real-world applications (e.g., slope, rate of change, probability, and proportionality).

New Course Level Expectations
CLE 3102.2.1 Understand computational results and operations involving real numbers in multiple representations.
CLE 3102.2.2 Understand properties of and relationships between subsets and elements of the real number system.

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<td>▪ Compute efficiently and accurately with whole numbers, fractions, decimals, and percents. A</td>
<td>▪ Select a reasonable solution for a real-world division problem in which the remainder must be considered. A</td>
<td>▪ Identify the opposite of a rational number. A</td>
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<td>▪ Work flexibly with fractions, decimals, and percents to solve one- and two-step word problems. A</td>
<td>▪ Use exponents to simplify a monomial written in expanded form. A</td>
<td>▪ Identify the reciprocal of a rational number. A</td>
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<tr>
<td>▪ Identify the opposite and the reciprocal of a rational number. A</td>
<td>▪ Identify the opposite of a rational number. A</td>
<td>▪ Use estimation to determine a reasonable solution for a tedious arithmetic computation. A</td>
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<td>▪ Apply order of operations in computing with rational numbers, no more than two parentheses, and exponents 1 or 2. A</td>
<td>▪ Apply order of operations when computing with integers, no more than two sets of grouping symbols, exponents 1 and 2. A</td>
<td>▪ 3102.2.1 Recognize and use like terms to simplify expressions. 3102.2.2 Apply the order of</td>
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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring 2008
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| ▪ Determine the square roots of perfect squares (<169). **A** | SPI 0806.2.2 Identify numbers and square roots as rational or irrational.  
✓ 0806.2.2 Square numbers and simplify square roots.  
✓ 0806.2.3 Solve contextual problems involving powers and roots. | ▪ Determine the square root of a perfect square less than 169.  
▪ Add and subtract algebraic expressions. **A** | SPI 3102.2.1 Operate (add, subtract, multiply, divide, simplify, powers) with radicals and radical expressions including radicands involving rational numbers and algebraic expressions.  
✓ 3102.2.3 Operate with and simplify radicals (index 2, 3, n) and radical expressions including rational numbers and variables in the radicand.  
✓ 3102.2.4 Operate efficiently with both rational and irrational numbers. |
| ▪ Use exponential, scientific, and calculator notation to represent large numbers in real-world situations. | SPI 0806.2.3 Use scientific notation to compute products and quotients.  
✓ 0806.2.1 Recognize and use exponential, scientific, and calculator notation.  
✓ 0806.2.6 Simplify expressions using the laws of exponents.  
SPI 0806.2.4 Solve real-world problems requiring scientific notation.  
✓ 0806.2.7 Add, subtract, multiply, and divide numbers expressed scientific notation. | SPI 3102.2.2 Multiply, divide, and square numbers expressed in scientific notation.  
✓ 3102.2.5 Perform operations with numbers in scientific notation (multiply, divide, powers).  
✓ 3102.2.6 Use appropriate technologies to apply scientific notation to real-world problems. | |
| ▪ Compare rational numbers using the appropriate symbol (<, >,=).  
▪ Determine the approximate locations of rational numbers on a number line. **A** | SPI 0806.2.1 Order and compare rational and irrational numbers and locate on the number line.  
✓ 0806.2.4 Use a Venn diagram to represent the subsets of the real number system.  
✓ 0806.2.5 Identify the subset(s) of the real number system to which a number belongs. | ▪ Order a given set of rational numbers (both fraction and decimal notations).  
▪ Select the best estimate for the coordinate of a given point on a number line (only rational). **A** (formerly in Algebra) | SPI 3102.2.3 Describe and/or order a given set of real numbers including both rational and irrational numbers.  
✓ 3102.2.7 Identify the subsets in the real number system and understand their relationships.  
✓ 3102.2.8 Use multiple strategies to approximate the value of an irrational number including irrational square roots and...
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<td>including location on the real number line</td>
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- Use estimation strategies to select a reasonable solution to a real-world problem involving computing with rational numbers.
Algebra I – Algebra

**Former Learning Expectations**

2.1 Recognize, analyze, extend, and create a variety of patterns.
2.2 Use algebraic thinking to generalize a pattern by expressing the pattern in functional notation.
2.3 Solve linear systems using a variety of techniques.
2.4 Communicate the meaning of variables in algebraic expressions, equations, and inequalities.
2.5 Identify and represent a variety of functions.
2.6 Apply and interpret rates of change from graphical and numerical data.
2.7 Analyze graphs to describe the behavior of functions.
2.8 Interpret results of algebraic procedures.
2.9 Apply the concept of variable in simplifying algebraic expressions, solving equations, and solving inequalities.
2.10 Interpret graphs that depict real-world phenomena.
2.11 Model real-world phenomena using functions and graphs.
2.12 Articulate and apply algebraic properties in symbolic manipulation.
2.13 Analyze relationships which can and which cannot be represented by a function.
2.14 Graph inequalities and interpret graphs of inequalities.
2.15 Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the real-life situations which the functions represent.
2.16 Describe the transformation of the graph that occurs when coefficients and/or constants of the corresponding linear equations are changed.
2.17 Find and represent solutions of quadratic equations.

**New Course Level Expectations**

CLE 3102.3.1 Use algebraic thinking to analyze and generalize patterns.
CLE 3102.3.2 Understand and apply properties in order to perform operations with, evaluate, simplify, and factor expressions and polynomials.
CLE 3102.3.3 Understand and apply operations with rational expressions and equations.
CLE 3102.3.4 Solve problems involving linear equations and linear inequalities.
CLE 3102.3.5 Manipulate formulas and solve literal equations.
CLE 3102.3.6 Understand and use relations and functions in various representations to solve contextual problems.
CLE 3102.3.7 Construct and solve systems of linear equations and inequalities in two variables by various methods.
CLE 3102.3.8 Solve and understand solutions of quadratic equations with real roots.
CLE 3102.3.9 Understand and use exponential functions to solve contextual problems.

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<tr>
<td>▪ Generalize a variety of patterns with symbolic rules. A</td>
<td>▪ Evaluate a first degree algebraic expression given values for one or more variables. A</td>
<td>▪ Extend a geometric pattern. A</td>
<td>SPI 3102.1.1 Interpret patterns found in sequences, tables, and other forms of quantitative information using variables or function notation. ✓ 3102.1.4 Write a rule with</td>
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<td>▪ Evaluate an algebraic expression given values for one or more variables using grouping symbols and/or exponents less than four. A</td>
<td>▪ Extend a numerical pattern. A</td>
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<td>Generate equivalent forms for simple algebraic expressions. <strong>A</strong></td>
<td><strong>0806.3.1</strong> Perform basic operations on algebraic expressions (including grouping, order of operations, exponents, square/cube roots, simplifying and expanding). <strong>A</strong></td>
<td>**Multiply two polynomials with each factor having no more than two terms. <strong>A</strong> (formerly in Number &amp; Operations)</td>
<td><strong>3102.1.9</strong> Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure, reflexive, symmetric, transitive, operation properties of equality). <strong>3102.1.10</strong> Use algebraic properties to develop a valid mathematical argument. <strong>SPI 3102.3.2</strong> Operate with polynomials and simplify results. <strong>3102.2.1</strong> Recognize and use like terms to simplify expressions. <strong>3102.2.2</strong> Apply the order of operations to simplify and evaluate algebraic expressions. <strong>3102.3.3</strong> Justify correct results of algebraic procedures using extension of properties of real numbers to algebraic expressions. <strong>3102.3.5</strong> Add, subtract, and multiply polynomials including squaring a binomial. <strong>3102.3.6</strong> Find the quotient of a polynomial and a monomial. <strong>3102.3.7</strong> Use various models (including area models) to</td>
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<td>Represent products of polynomials.</td>
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<td><strong>SPI 3102.3.3 Factor polynomials.</strong></td>
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<td>✓ 3102.3.8 Find the GCF of the terms in a polynomial.</td>
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<td>✓ 3102.3.9 Find two binomial factors of a quadratic expression.</td>
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<td><strong>SPI 3102.3.4 Operate with, evaluate, and simplify rational expressions including determining restrictions on the domain of the variables.</strong></td>
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<td>✓ 3102.3.4 Simplify expressions using exponent rules including negative exponents and zero exponents.</td>
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<td>✓ 3102.3.10 Add, subtract, multiply, and divide rational expressions and simplify results.</td>
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- Solve one- and two-step linear equations involving integers. A
- Formulate multi-step equations that represent relationships and real-world situations. A
- Represent situations and solve real-world problems using symbolic algebra. A
- Apply given formulas to solve real-world problems.
- Solve one-step linear inequalities. A

**SPI 0806.3.2 Solve the linear equation f(x) = g(x).**
✓ 0806.3.2 Represent algebraic relationships with equations and inequalities.
✓ 0806.3.13 Represent situations and solve real-world problems using symbolic algebra.

**SPI 0806.3.3 Solve and graph linear inequalities in two variables.**
✓ 0806.3.4 Understand the relationship between the graph of a linear inequality and its solutions.
✓ 0806.3.5 Solve linear inequalities in two variables (including those whose solutions require multiplication or division by a negative number).
✓ 0806.3.8 Recognize a proportion as a special case of a linear equation and understand that the

- Translate a verbal expression into an algebraic expression. A
- Translate a verbal sentence into an algebraic equation. A
- Solve one- and two-step linear equations using integers (with integral coefficients and constants). A
- Solve multi-step linear equations (more than two steps, variables on only one side of the equation). A
- Solve multi-step linear equations (more than two steps, with variables on both sides of the equation). A
- Solve multi-step linear equations (more than two steps, with one set of parentheses on each side of the equation). A
- Identify the graphical representation of the solution to a one-variable inequality on a

**SPI 3102.1.2 Write an equation symbolically to express a contextual problem.**
✓ 3102.1.5 Use formulas, equations, and inequalities to solve real-world problems including time/rate/distance, percent increase/decrease, ratio/proportion, and mixture problems.

**SPI 3102.3.5 Write and/or solve linear equations, inequalities, and compound inequalities including those containing absolute value.**
✓ 3102.3.11 Solve multi-step linear equations with one variable.
✓ 3102.3.12 Recognize and articulate when an equation has no solution, a single solution, or all real numbers as solutions.
✓ 3102.3.13 Solve multi-step linear inequalities with one variable and
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| constant of proportionality is the slope, and the resulting graph is a line through the origin. | number line. A  
- Solve multi-step linear inequalities in real-world situations. A  
- Select the appropriate graphical representation of a given linear inequality. A | graph the solution on a number line.  
- 3102.3.14 Solve absolute value equations and inequalities (including compound inequalities) with one variable and graph their solutions on a number line.  
- 3102.3.15 Determine domain and range of a relation and articulate restrictions imposed either by the operations or by the real life situation that the function represents.  
- 3102.3.25 Find function values using f(x) notation or graphs.  
- 3102.3.26 Graph linear inequalities on the coordinate plane and identify regions of the graph containing ordered pairs in the solution.  
**SPI 3102.1.5** Recognize and express the effect of changing constants and/or coefficients in problem solving.  
- 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients and constants in functions. |  
- Select the nonlinear graph that models the given real-world situation or vice versa. A |  
**SPI 3102.1.4** Translate between representations of functions that depict real-world situations.  
**SPI 3102.3.6** Interpret various relations in multiple representations.  
- 3102.1.12 Create and work flexibly among representations of relations (including verbal, equations, tables, mappings, graphs).  
- 3102.1.13 Change from one representation of a relation to
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<td>‣ Determine the domain and/or range of a function represented by the graph of real-world situation. <strong>A</strong></td>
<td>SPI 3102.3.7 Determine domain and range of a relation, determine whether a relation is a function and/or evaluate a function at a specified rational value. 3102.3.16 Determine if a relation is a function from its graph or from a set of ordered pairs.</td>
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<td><strong>SPI 0806.3.4 Translate between various representations of a linear function.</strong> ✓0806.3.9 Given a function rule, create tables of values for x and y, and plot graphs of nonlinear functions. <strong>SPI 0806.3.5 Determine the slope of a line from an equation, two given points, a table or a graph.</strong> <strong>SPI 0806.3.6 Analyze the graph of a linear function to find solutions, roots, and intercepts.</strong> ✓0806.3.6 Identify x- and y-intercepts and slope of linear equations from an equation, graph or table. ✓0806.3.7 Analyze situations and solve problems involving constant rate of change.</td>
<td><strong>SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems.</strong> ✓3102.1.16 Understand and express the meaning of the slope and y-intercept of linear functions in real-world contexts. <strong>SPI 3102.3.8 Determine the equation of a line and/or graph a linear equation.</strong> ✓3102.3.18 Analyze the characteristics of graphs of basic linear relations and linear functions including constant function, direct variation, identity function, vertical lines, absolute value of linear functions. Use technology where appropriate. ✓3102.3.20 Understand that a linear equation has a constant rate of change called slope and represent slope in various forms. ✓3102.3.21 Determine the equation of a line using given information including a point and slope, two points, a point and a line parallel or perpendicular, graph, intercepts. ✓3102.3.22 Express the equation of a line in standard form, slope-</td>
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<td><strong>A</strong> Connect the appropriate graph to a linear equation. <strong>A</strong> Connect symbolic expressions and graphs of lines. <strong>A</strong></td>
<td><strong>A</strong> Select the graph that represents a given linear function expressed in slope-intercept form. <strong>A</strong></td>
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<td><strong>A</strong> Interpret graphs which represent rates of change. <strong>A</strong></td>
<td>**SPI 3102.3.7 Determine domain and range of a relation, determine whether a relation is a function and/or evaluate a function at a specified rational value. 3102.3.16 Determine if a relation is a function from its graph or from a set of ordered pairs.</td>
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<td>intercept, and point-slope form.</td>
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<td>✓ 3102.3.23 Determine the graph of a linear equation including those that depict contextual situations.</td>
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<td>✓ 3102.3.24 Interpret the changes in the slope-intercept form and graph of a linear equation by looking at different values of the parameters, m and b.</td>
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<td>SPI 0806.3.1 Find solutions to systems of two linear equations in two variables. ✓ 0806.3.3 Solve systems of linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line.</td>
<td>✓ Select the system of equations that could be used to solve a given real-world problem. A</td>
<td>SPI 3102.3.9 Solve systems of linear equation/inequalities in two variables. ✓ 3102.3.27 Determine the number of solutions for a system of linear equations (0, 1, or infinitely many solutions). ✓ 3102.3.28 Solve systems of linear equations graphically, algebraically, and with technology. ✓ 3102.3.29 Solve contextual problems involving systems of linear equations or inequalities and interpret solutions in context.</td>
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<td>• Find the solution to a quadratic equation given in standard form (integral solutions and a leading coefficient of one) A • Select the solution to a quadratic equation given solutions represented in graphical form (integral solutions and a leading coefficient of one). A • Select one of the factors (x + 3) of a quadratic equation (integral solutions and a leading coefficient of one). A • Select the discriminant of a quadratic equation (integral solutions and a leading coefficient of one). A</td>
<td>SPI 3102.3.10 Find the solution of a quadratic equation and/or zeros of a quadratic function. ✓ 3102.3.30 Solve quadratic equations using multiple methods: factoring, graphing, quadratic formula, or square root principle. ✓ 3102.3.31 Determine the number of real solutions for a quadratic equation including using the discriminant and its graph. ✓ 3102.3.32 Recognize the connection among factors, solutions (roots), zeros of related functions, and x-intercepts in</td>
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<tr>
<td>Former Standards 8th Grade Review Material</td>
<td>New Standards 8th Grade Building blocks for new standards</td>
<td>Former Standards Algebra I Gateway 2008-2009</td>
<td>New Standards Algebra I New End of Course 2009-2010</td>
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<tr>
<td><strong>SPI 0806.3.7 Identify, compare and contrast functions as linear or nonlinear.</strong>&lt;br&gt;0806.3.10 Distinguish quadratic and exponential functions as nonlinear using a graph and/or a table of values.&lt;br&gt;0806.3.11 Distinguish between the equations of linear, quadratic, and exponential functions (e.g. function families such as y=x^2, y=2^x, and y=2x).&lt;br&gt;0806.3.12 Understand how rates of change of nonlinear functions contrast with constant rates of change of linear functions.</td>
<td><strong>SPI 3102.3.11 Analyze nonlinear graphs including quadratic and exponential functions that model a contextual situation.</strong>&lt;br&gt;3102.3.17 Recognize “families” of functions.&lt;br&gt;3102.3.19 Explore the characteristics of graphs of various nonlinear relations and functions including inverse variation, quadratic, and square root function. Use technology where appropriate.&lt;br&gt;3102.3.33 Recognize data that can be modeled by an exponential function.&lt;br&gt;3102.3.34 Graph exponential functions in the form y = a(b^x) where b ≠ 0.&lt;br&gt;3102.3.35 Apply growth/decay and simple/compound interest formulas to solve contextual problems.</td>
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</table>
## Algebra I – Geometry and Measurement

### Former Learning Expectations

3.1 Apply geometric properties, formulas, and relationships to solve real-world problems.
3.2 Solve problems using the midpoint formula.
3.3 Apply right triangle relationships including the Pythagorean Theorem and the distance formula.
4.1 Use concepts of length, area, and volume to estimate and solve real-world problems.
4.2 Apply and communicate measurement concepts and relationships in algebraic and geometric problem-solving situations.

### New Course Level Expectations

CLE 3102.4.1 Use algebraic reasoning in applications involving geometric formulas and contextual problems.
CLE 3102.4.2 Apply appropriate units of measure and convert measures in problem solving situations.

### Formaer Standards 8th Grade

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<tr>
<th>Former Standards 8th Grade Review Material</th>
<th>New Standards 8th Grade Building blocks for new standards</th>
<th>Former Standards Algebra I Gateway 2008-2009</th>
<th>New Standards Algebra I New End of Course 2009-2010</th>
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</thead>
<tbody>
<tr>
<td>• Use ordered pairs to describe given points in a coordinate system. A</td>
<td>• Use ratios and proportions to represent real-world situations (i.e., scale drawings and probability). A</td>
<td>• Use ordered pairs to describe given points in a coordinate system. A</td>
<td>• Use ordered pairs to describe given points in a coordinate system. A</td>
</tr>
<tr>
<td>• Use ratios and proportions to represent real-world situations (i.e., scale drawings and probability). A</td>
<td></td>
<td>• Apply proportion and the concepts of similar triangles to find the length of a missing side of a triangle. A</td>
<td>• Apply proportion and the concepts of similar triangles to find the length of a missing side of a triangle. A</td>
</tr>
<tr>
<td>• Solve real-world problems involving rate/time/distance (i.e., (d = rt)). A</td>
<td>• Solve problems involving scale factors using ratios and proportion. A</td>
<td>• Solve real-world problems involving rate/time/distance (i.e., (d = rt)). A</td>
<td>• Solve problems involving scale factors using ratios and proportion. A</td>
</tr>
<tr>
<td>• Recognize similar geometric figures. A</td>
<td>• Calculate rates involving cost per unit to determine the best buy. A</td>
<td>• Calculate rates involving cost per unit to determine the best buy (no more than three samples). A</td>
<td>• Calculate rates involving cost per unit to determine the best buy (no more than three samples). A</td>
</tr>
<tr>
<td>• Estimate length, perimeter, circumference, area, and volume using a variety of strategies. A</td>
<td>• Apply formulas to find the circumference and area of circles. A</td>
<td>• Estimate the area of irregular geometric figures on a grid. A</td>
<td>• Estimate the area of irregular geometric figures on a grid. A</td>
</tr>
<tr>
<td>• Apply formulas to find the circumference and area of circles. A</td>
<td>• Apply formulas to find the area of triangles, parallelograms, and trapezoids. A</td>
<td>• Apply the given formula to determine the area or perimeter of a rectangle. A</td>
<td>• Apply the given formula to determine the area or perimeter of a rectangle. A</td>
</tr>
<tr>
<td>• Apply formulas to find the area of triangles, parallelograms, and trapezoids. A</td>
<td>• Estimate or find the area of irregular and complex shapes. A</td>
<td>• Apply the given formula to find the area of a circle, the circumference of a circle, or the volume of a rectangular solid. A</td>
<td>• Apply the given formula to find the area of a circle, the circumference of a circle, or the volume of a rectangular solid. A</td>
</tr>
<tr>
<td>• Estimate or find the area of irregular and complex shapes. A</td>
<td></td>
<td>• Select the area representation for a given product of two one-variable binomials with positive coefficients. A</td>
<td>• Select the area representation for a given product of two one-variable binomials with positive coefficients. A</td>
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### Former Standards Algebra I Gateway 2008-2009

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<tr>
<td>• Identify ordered pairs in the coordinate plane. A</td>
<td>• Identify ordered pairs in the coordinate plane. A</td>
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<td>• Identify ordered pairs in the coordinate plane. A</td>
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<td>• Identify ordered pairs in the coordinate plane. A</td>
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### New Standards Algebra I New End of Course 2009-2010

<table>
<thead>
<tr>
<th>New Standards Algebra I New End of Course 2009-2010</th>
<th>SPI 3102.4.1 Develop and apply strategies to estimate the area of any shape on a plane grid.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Calculate rates involving cost per unit to determine the best buy (no more than three samples). A</td>
<td>✓3102.4.1 Using algebraic expressions solve for measures in geometric figures as well as for perimeter, area, and volume.</td>
</tr>
</tbody>
</table>

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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring 2008
| **Solve real-world problems using the Pythagorean theorem (no radicals). A** | **SPI 0806.4.1 Use the Pythagorean theorem to solve contextual problems.**  
✓ 0806.4.1 Model the Pythagorean Theorem.  
✓ 0806.4.2 Use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle. | **Apply the given Pythagorean Theorem to a real life problem illustrated by a diagram (no radicals in answer). A** | **SPI 3102.4.2 Solve contextual problems using the Pythagorean Theorem.**  
✓ 3102.4.2 Use the Pythagorean Theorem to find the missing measure in a right triangle including those from real-world situations. |
| **SPI 0806.4.2 Apply the Pythagorean theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra.** | **Calculate the distance between two points given the Pythagorean Theorem and the distance formula. A** | **SPI 3102.4.3 Solve problems involving the distance between points or midpoint of a segment.**  
✓ 3102.4.3 Understand horizontal/vertical distance in a coordinate system as absolute value of the difference between coordinates; develop the distance formula for a coordinate plane using the Pythagorean Theorem.  
✓ 3102.4.4 Develop the midpoint formula for segments on a number line or in the coordinate plane. |
| **Convert from one unit to another within the same system. A** | **SPI 0806.4.4 Convert between and within the U.S. Customary System and the metric system.**  
✓ 0806.4.6 Make within-system and between-system conversions of derived quantities including distance, temperature, and money. | **SPI 3102.4.4 Convert rates and measurements.**  
✓ 3102.4.5 Use dimensional analysis to convert rates and measurements both within a system and between systems and check the appropriateness of the solution. |
| **Apply spatial reasoning and visualization to solve real-world problems. A**  
**Apply geometric ideas and relationships in areas outside the mathematics classroom (i.e., art, science, and everyday life). A** | | | |
### SPI 0806.4.3 Find measures of the angles formed by parallel lines cut by a transversal.

- 0806.4.5 Analyze the congruent and supplementary relationships of angles formed by parallel lines and transversals (such as alternate interior, alternate exterior, corresponding, and adjacent).

### SPI 0806.4.5 Identify the intersection of two or more geometric figures in the plane.

- 0806.4.7 Visualize or describe the cross-section resulting from the intersection of a plane with a 3-dimensional figure.
- 0806.4.8 Build, draw, and work with 2- and 3-dimensional figures by means of orthogonal views, projective views, and/or nets.

### Select units of appropriate size and type to measure angles, perimeter, area, surface area, and volume. **A**

- 0806.4.3 Select or use the appropriate measurement instrument to determine or create a given length, area, volume, angle, weight, or mass.
- 0806.4.4 Understand how the precision of measurement influences accuracy of quantities derived from these measurements.

### Apply relationships among the angles and side lengths of similar geometric figures. **A**

### Classify types of two- and three-dimensional objects using their defining properties. **A**
Algebra I – Data Analysis, Probability, and Statistics

Former Learning Expectations
5.1 Collect, represent, and describe linear and nonlinear data sets developed from the real world.
5.2 Make predictions from a linear data set using a line of best fit.
5.3 Interpret a set of data using the appropriate measure of central tendency.
5.4 Choose, construct, and analyze appropriate graphical representations for a data set.
5.5 Demonstrate an understanding of the concept of random sampling.

5.6 Apply counting principles of permutations and combinations using appropriate technology.
5.7 Model situations to determine theoretical and experimental probabilities.

New Course Level Expectations
CLE 3102.5.1 Describe and interpret quantitative information.
CLE 3102.5.2 Use statistical thinking to draw conclusions and make predictions.
CLE 3102.5.3 Understand basic counting procedures and concepts of probability.

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<tbody>
<tr>
<td>• Interpret appropriate graphical representations of data (i.e., histograms, box plots, and scatterplots). A</td>
<td>SPI 0806.5.4 Recognize misrepresentations of published data in the media. ✓0806.5.8 Consider the source, design, analysis, and display of data to evaluate statistics reported in the media. ✓0806.5.4 Explain the benefits and the limitations of various representations of data (i.e., bar graphs, line graphs, circle graphs, histograms, stem-and-leaf plots, box plots, scatterplots).</td>
<td>• Interpret bar graphs representing real-world data. A • Interpret circle graphs (pie charts) representing real-world data. A</td>
<td>SPI 3102.5.1 Interpret displays of data to answer questions about the data set(s) (e.g., identify pattern, trends, and/or outliers in a data set). ✓3102.5.1 Identify patterns or trends in data. ✓3102.5.2 Develop a meaning for and identify outliers in a data set and verify. ✓3102.5.5 Construct and interpret various forms of data representations, (including line graphs, bar graphs, circle graphs, histograms, scatterplots, box-and-whiskers, stem-and-leaf, and frequency tables). ✓3102.5.6 Draw qualitative graphs of functions and describe a general trend or shape. ✓3102.5.7 Compare two data sets using graphs and descriptive statistics.</td>
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</tbody>
</table>
| • Determine the mean of a given set of real-world data. A • Determine the median of a given set of real-world data (even number of data). A | • Determine the mean (average) of a given set of real-world data (no more than five two-digit numbers). A • Determine the median for a given set of real-world data (even number of data). A | | SPI 3102.5.2 Identify the effect on mean, median, mode, and range when values in the data set are changed. ✓3102.53 When a set of data is changed, identify effects on measures of central tendency, range, and inter-quartile range. ✓3102.5.4 Explore quartiles,
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<tbody>
<tr>
<td>▪ Connect data sets and their graphical representations (i.e., histograms, stem-and-leaf plots, box plots, and scatterplots). A Make conjectures and predictions based on data. A</td>
<td>SPI 0806.5.3 Generalize the relationship between two sets of data using scatterplots and lines of best fit. ✓0806.5.5 Create and interpret box-and-whisker plots and scatterplots. ✓0806.5.6 Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken. ✓0806.5.7 Estimate lines of best fit to make and test conjectures.</td>
<td>▪ Choose the matching linear graph given a set of ordered pairs. A ▪ Make a prediction from the graph of a real-world linear data set. A</td>
<td>SPI 3102.5.3 Using a scatter-plot, determine if a linear relationship exists and describe the association between variables.</td>
</tr>
<tr>
<td>▪ Connect the symbolic representation of a probability to an experiment. A ▪ Identify an appropriate sample to test a given hypothesis. A</td>
<td>SPI 0806.5.1 Calculate probabilities of events for simple experiments with equally probable outcomes. SPI 0806.5.2 Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models). ✓0806.5.1 Solve simple problems</td>
<td>▪ Apply counting principles of permutations or combinations in real-world situations. A</td>
<td>SPI 3102.5.5 Determine theoretical and/or experimental probability of an event and/or its complement including using relative frequency. ✓3102.5.12 Use techniques (Venn Diagrams, tree diagrams, or counting procedures) to identify the possible outcomes of an experiment or sample</td>
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<td>Former Standards 8th Grade</td>
<td>New Standards 8th Grade</td>
<td>Former Standards Algebra I</td>
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- Involving probability and relative frequency.
- **0806.5.2** Compare probabilities of two or more events and recognize when certain events are equally likely.
- **0806.5.3** Recognize common misconceptions associated with dependent and independent events.

- Space and compute the probability of an event.
- **3102.5.13** Determine the complement of an event and the probability of that complement.
- **3102.5.15** Explore joint and conditional probability.
- **3102.5.14** Determine if two events are independent or dependent.
- **3102.5.16** Identify situations for which the Law of Large Numbers applies.
- **3102.5.17** Perform simulations to estimate probabilities.
- **3102.5.18** Make informed decisions about practical situations using probability concepts.
Geometry Transition to New TN Mathematics Standards

Geometry – Mathematical Processes

New Course Level Expectations

CLE 3108.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.
CLE 3108.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.
CLE 3108.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.
CLE 3108.1.4 Move flexibly between multiple representations (contextual, physical written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.
CLE 3108.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.
CLE 3108.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
CLE 3108.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Checks for Understanding (Formative/Summative Assessment)

✓ 3108.1.1 Check solutions after making reasonable estimates in appropriate units of quantities encountered in contextual situations.
✓ 3108.1.2 Determine position using spatial sense with two and three-dimensional coordinate systems.
✓ 3108.1.3 Comprehend the concept of length on the number line.
✓ 3108.1.4 Recognize that a definition depends on undefined terms and on previous definitions.
✓ 3108.1.5 Use technology, hands-on activities, and manipulatives to develop the language and the concepts of geometry, including specialized vocabulary (e.g. graphing calculators, interactive geometry software such as Geometer's Sketchpad and Cabri, algebra tiles, pattern blocks, tessellation tiles, MIRAs, mirrors, spinners, geoboards, conic section models, volume demonstration kits, Polydrons, measurement tools, compasses, Pentablocks, pentominoes, cubes, tangrams).
✓ 3108.1.6 Use inductive reasoning to write conjectures and/or conditional statements.
✓ 3108.1.7 Recognize the capabilities and the limitations of calculators and computers in solving problems.
✓ 3108.1.8 Understand how the similarity of right triangles allows the trigonometric functions sine, cosine, and tangent to be defined as ratio of sides.
✓ 3108.1.9 Expand analysis of units of measure to include area and volume.
✓ 3108.1.10 Use visualization, spatial reasoning, and geometric modeling to solve problems.
✓ 3108.1.11 Identify and sketch solids formed by revolving two-dimensional figures around lines.
✓ 3108.1.12 Connect the study of geometry to the historical development of geometry.
✓ 3108.1.13 Use proofs to further develop and deepen the understanding of the study of geometry (e.g. two-column, paragraph, flow, indirect, coordinate).
✓ 3108.1.14 Identify and explain the necessity of postulates, theorems, and corollaries in a mathematical system.

State Performance Indicators

SPI 3108.1.1 Give precise mathematical descriptions or definitions of geometric shapes in the plane and space.
SPI 3108.1.2 Determine areas of planar figures by decomposing them into simpler figures without a grid.
SPI 3108.1.3 Use geometric understanding and spatial visualization of geometric solids to solve problems and/or create drawings.
SPI 3108.1.4 Use definitions, basic postulates, and theorems about points, lines, angles, and planes to write/complete proofs and/or to solve problems.
### Geometry – Number and Operation

#### Former Learning Expectations
1.1 Demonstrate an understanding of the relative size of rational and irrational numbers.
1.2 Choose and use appropriate notations for rational and irrational numbers, including graphic representations.
1.3 Demonstrate an understanding of absolute value.

#### New Course Level Expectations
- CLE3108.2.1 Establish the relationships between the real numbers and geometry; explore the importance of irrational numbers to geometry.
- CLE3108.2.2 Explore vectors as a numeric system, focusing on graphic representations and the properties of the operation.
- CLE3108.2.3 Establish an ability to estimate, select appropriate units, evaluate accuracy of calculations and approximate error in measurement in geometric settings.

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<tbody>
<tr>
<td>▪ Determine the square root of a perfect square less than 169.</td>
<td>SPI 3102.2.1 Operate (add, subtract, multiply, divide, simplify, powers) with radicals and radical expressions including radicands involving rational numbers and algebraic expressions.</td>
<td></td>
<td>SPI 3108.2.1 Analyze, apply, or interpret the relationships between basic number concepts and geometry (e.g. rounding and pattern identification in measurement, the relationship of pi to other rational and irrational numbers)</td>
</tr>
<tr>
<td>▪ Add and subtract algebraic expressions.</td>
<td>✓ 3102.2.3 Operate with and simplify radicals (index 2, 3, n) and radical expressions including rational numbers and variables in the radicand.</td>
<td>✓ 3108.2.2 Approximate pi from a table of values for the circumference and diameter of circles using various methods (e.g. line of best fit).</td>
<td>✓ 3108.2.2 Perform operations on vectors in various representations.</td>
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<td>✓ 3102.2.4 Operate efficiently with both rational and irrational numbers.</td>
<td>✓ 3108.2.6 Analyze precision, accuracy, and approximate error in measurement situations.</td>
<td>✓ 3108.2.3 Recognize and apply real number properties to vector</td>
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<td>✓ 3102.2.7 Identify the subsets in the real number system and understand their relationships.</td>
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<td>✓ 3102.2.8 Use multiple strategies to approximate the value of an irrational number including irrational square roots including location on the real number line.</td>
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<td>Former Standards Algebra I</td>
<td>New Standards Algebra I</td>
<td>Former Standards Geometry</td>
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<td>▪ Use exponents to simplify a monomial written in expanded form.</td>
<td>SPI 3102.2.2 Multiply, divide, and square numbers expressed in scientific notation.</td>
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<td>3102.5 Perform operations with numbers in scientific notation (multiply, divide, powers).</td>
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<td></td>
<td>3102.6 Use appropriate technologies to apply scientific notation to real-world problems.</td>
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<td>▪ find an integral power of a positive rational number (exponents 1-3).</td>
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<td>▪ Order a set of rational and irrational numbers.</td>
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<td>▪ Match a given irrational number to the appropriate point on a number line and vice versa (e.g., (\sqrt{2}, \sqrt{30}, \pi)).</td>
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<td>▪ Simplify a radical (radicand less than 1000).</td>
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<td></td>
<td>▪ Use absolute value to express the distance between two points on a number line and vice versa.</td>
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<td>▪ Select the best estimate for the coordinate of a given point on a number line (only rational). (formerly in Algebra)</td>
<td>SPI 3102.2.3 Describe and/or order a given set of real numbers including both rational and irrational numbers.</td>
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<tr>
<td>▪ Order a given set of rational numbers (both fraction and decimal notations).</td>
<td>▪ Order a set of rational and irrational numbers.</td>
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<tr>
<td>▪ Identify the opposite of a rational number.</td>
<td>▪ Identify the reciprocal of a rational number.</td>
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<tr>
<td>▪ Identify the reciprocal of a rational number.</td>
<td>▪ Select a reasonable solution for a real-world division problem in which the remainder must be considered.</td>
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<tr>
<td>▪ Select a reasonable solution for a real-world division problem in which the remainder must be considered.</td>
<td>▪ Use estimation to determine a reasonable solution for a tedious</td>
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Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey  Spring 2008
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<td>arithmetic computation.</td>
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<tr>
<td>▪ Select ratios and proportions to represent real-world problems (e.g., scale drawings, sampling, etc.).</td>
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<tr>
<td>▪ Apply order of operations when computing with integers using no more than two sets of grouping symbols and exponents 1 and 2.</td>
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## Geometry – Algebra

### Former Learning Expectations

1. **2.1** recognize, extend, and create geometric, spatial, and numerical patterns;
2. **2.2** analyze mathematical patterns related to algebra and geometry in real-world problem solving;
3. **2.3** solve problems connecting geometry with number theory, probability and statistics, and measurement and estimation using algebraic thinking and symbolism;
4. **2.4** apply coordinate geometry to analyze and solve problems;

### New Course Level Expectations

- **CLE 3108.3.1** Use analytic geometry tools to explore geometric problems involving parallel and perpendicular lines, circles, and special points of polygons.
- **CLE 3108.3.2** Explore the effect of transformations on geometric figures and shapes in the coordinate plane.

### Former Standards Algebra I Review Material

- Calculate the distance between two points given the Pythagorean Theorem and the distance formula.
- Identify ordered pairs in the coordinate plane.

### New Standards Algebra I Building blocks for new standards

- SPI 3102.4.3 Solve problems involving the distance between points or midpoint of a segment.
  - 3102.4.3 Understand horizontal/vertical distance in a coordinate system as absolute value of the difference between coordinates. Develop the distance formula for a coordinate plane using the Pythagorean Theorem.
  - 3102.4.4 Develop the midpoint formula for segments on a number line or in the coordinate plane.

### Former Standards Geometry Curriculum for 2008-2009

- Determine the distance, midpoint, or slope when given the coordinates of two points (answers must be given as decimals to the nearest hundredth).
- Determine the equation of a circle given coordinates or the graph of the circle (e.g., the center, the endpoints of the diameter).

### New Standards Geometry new End of Course 2009-2010

- SPI 3108.3.1 Use algebra and coordinate geometry to analyze and solve problems about geometric figures (including circles).
- SPI 3108.3.2 Use coordinate geometry to prove characteristics of polygonal figures.
  - 3108.3.1 Prove two lines are parallel, perpendicular, or oblique using coordinate geometry.
  - 3108.3.2 Connect coordinate geometry to geometric figures in the plane (e.g. midpoints, distance formula, slope, and polygons).
  - 3108.3.3 Find the equation of a circle given its center and radius and vice versa.
  - 3108.3.4 Apply the midpoint and distance formulas to points and segments to find midpoints, distances, and missing information in two and three dimensions.

### SPI 3102.1.14 Apply graphical

### SPI 3102.1.5 Recognize and express the effect of changing constants and/or coefficients in problem solving.

### SPI 3108.3.3 Describe algebraically the effect of a single transformation (reflections in the x- or y-axis, rotations, translations, and...
<table>
<thead>
<tr>
<th>Transformations that occur when changes are made to coefficients and constants in functions.</th>
<th>dilations) on two-dimensional geometric shapes in the coordinate plane.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformations that occur when changes are made to coefficients and constants in functions.</td>
<td>3108.3.5 Use mapping notation to identify the image of a transformation given the coordinates of the pre-image.</td>
</tr>
<tr>
<td>3108.3.6 Identify a transformation given its mapping notation.</td>
<td></td>
</tr>
</tbody>
</table>

- Evaluate a first degree algebraic expression given values for one or more variables.
- Evaluate an algebraic expression given values for one or more variables using grouping symbols and/or exponents less than four.

- SPI 3102.1.3 Apply properties to evaluate expressions, simplify expressions, and justify solutions to problems.

- SPI 3102.1.1 Interpret patterns found in sequences, tables, and other forms of quantitative information using variables or function notation.
  - 3102.1.4 Write a rule with variables that expresses a pattern.

- SPI 3102.3.1 Express a generalization of a pattern in various representations including algebraic and function notation.
  - 3102.3.1 Recognize and extend arithmetic and geometric sequences.
  - 3102.3.2 Explore patterns including Pascal’s Triangle and the Fibonacci sequence.

- Multiply two polynomials with each factor having no more than two terms. (formerly in Number & Operations)

- SPI 3102.3.2 Operate with polynomials and simplify results.
  - 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure,
  - apply the Triangle Sum Theorem or Exterior Angle Theorem to determine the measures of the angles of a given triangle with the angle measures expressed algebraically.

- Extend a geometric pattern.
- Extend a numerical pattern.
- Select the algebraic notation which generalizes the pattern represented by data in a given table.

- SPI 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure,

- extend or find missing element(s) in a geometric pattern.

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reflexive, symmetric, transitive, operation properties of equality).
✓ 3102.1.10 Use algebraic properties to develop a valid mathematical argument.
✓ 3102.2.1 Recognize and use like terms to simplify expressions.
✓ 3102.2.2 Apply the order of operations to simplify and evaluate algebraic expressions.
✓ 3102.3.3 Justify correct results of algebraic procedures using extension of properties of real numbers to algebraic expressions.
✓ 3102.3.5 Add, subtract, and multiply polynomials including squaring a binomial. 3102.3.6 Find the quotient of a polynomial and a monomial.
✓ 3102.3.7 Use various models (including area models) to represent products of polynomials.

**SPI 3102.3.3 Factor polynomials.**
- 3102.3.8 Find the GCF of the terms in a polynomial.
- 3102.3.9 Find two binomial factors of a quadratic expression.

**SPI 3102.3.4 Operate with, evaluate, and simplify rational expressions including determining restrictions on the domain of the variables.**
- 3102.3.4 Simplify expressions using exponent rules including negative exponents and zero exponents.
- 3102.3.10 Add, subtract, multiply, and divide rational expressions and simplify results.

- **Translate a verbal expression into an algebraic expression.**
- **SPI 3102.1.2 Write an equation symbolically to**
  - solve multistep linear equations to find length, width, perimeter,
- Translate a verbal sentence into an algebraic equation.
- Solve one- and two-step linear equations using integers (with integral coefficients and constants).
- Solve multi-step linear equations (more than two steps, variables on only one side of the equation).
- Solve multi-step linear equations (more than two steps, with variables on both sides of the equation).
- Solve multi-step linear equations (more than two steps, with one set of parentheses on each side of the equation).
- Identify the graphical representation of the solution to a one-variable inequality on a number line.
- Solve multi-step linear inequalities in real-world situations.
- Select the appropriate graphical representation of a given linear inequality.

**express a contextual problem.**

- SPI 3102.1.5 Use formulas, equations, and inequalities to solve real-world problems including time/rate/distance, percent increase/decrease, ratio/proportion, and mixture problems.

**SPI 3102.3.5 Write and/or solve linear equations, inequalities, and compound inequalities including those containing absolute value.**

- SPI 3102.3.11 Solve multi-step linear equations with one variable.
- SPI 3102.3.12 Recognize and articulate when an equation has no solution, a single solution, or all real numbers as solutions.
- SPI 3102.3.13 Solve multi-step linear inequalities with one variable and graph the solution on a number line.
- SPI 3102.3.14 Solve absolute value equations and inequalities (including compound inequalities) with one variable and graph their solutions on a number line.
- SPI 3102.3.15 Determine domain and range of a relation and articulate restrictions imposed either by the operations or by the real life situation that the function represents.
- SPI 3102.3.25 Find function values using f(x) notation or graphs.
- SPI 3102.3.26 Graph linear inequalities on the coordinate plane and identify regions of the graph containing ordered pairs in the solution.

**Select the nonlinear graph that**

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<table>
<thead>
<tr>
<th>SPI 3102.3.6 Interpret various relations in multiple representations.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3102.1.12</strong> Create and work flexibly among representations of relations (including verbal, equations, tables, mappings, graphs).</td>
</tr>
<tr>
<td><strong>3102.1.13</strong> Change from one representation of a relation to another representation, for example, change from a verbal description to a graph.</td>
</tr>
</tbody>
</table>

- Determine the domain and/or range of a function represented by the graph of real-world situation.
- Select the graph that represents a given linear function expressed in slope-intercept form.
- Select the linear graphs that models the given real-world situation described in a narrative (no data set given).
- Select the linear graph that models the given real-world situation described in a tabular set of data.
- Determine the slope from the graph of a linear equation (no labeled points).
- Apply the concept of rate of change to solve real-world problems.
- Recognize the graphical transformation that occurs when

<table>
<thead>
<tr>
<th>SPI 3102.3.7 Determine domain and range of a relation, determine whether a relation is a function and/or evaluate a function at a specified rational value.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3102.3.16</strong> Determine if a relation is a function from its graph or from a set of ordered pairs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3102.1.16</strong> Understand and express the meaning of the slope and y-intercept of linear functions in real-world contexts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPI 3102.3.8 Determine the equation of a line and/or graph a linear equation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3102.3.18</strong> Analyze the characteristics of graphs of basic linear relations and linear functions including constant function, direct variation, identity function, vertical lines, absolute value of linear functions. Use technology where appropriate.</td>
</tr>
</tbody>
</table>

- determine the slope given a graph of a linear equation and vice versa.
- determine the equation of a line parallel or perpendicular to a given line, from given information (e.g., equations of lines, graphs of lines, or two points).
- apply the concept of rate of change to solve a real-world problem given a pattern of data.

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- Apply the concept of slope to represent rate of change in a real-world situation. (formerly in Number & Operations)

- Select the system of equations that could be used to solve a given real-world problem.

- Find the solution to a quadratic equation given in standard form (integral solutions and a leading coefficient of one)

- Select the solution to a quadratic

| 3102.3.20 Understand that a linear equation has a constant rate of change called slope and represent slope in various forms. |
| 3102.3.21 Determine the equation of a line using given information including a point and slope, two points, a point and a line parallel or perpendicular, graph, intercepts. |
| 3102.3.22 Express the equation of a line in standard form, slope-intercept, and point-slope form. |
| 3102.3.23 Determine the graph of a linear equation including those that depict contextual situations. |
| 3102.3.24 Interpret the changes in the slope-intercept form and graph of a linear equation by looking at different parameters, m and b in the slope-intercept form. |

SPI 3102.3.9 Solve systems of linear equation/inequalities in two variables.

- 3102.3.27 Determine the number of solutions for a system of linear equations (0, 1, or infinitely many solutions).
- 3102.3.28 Solve systems of linear equations graphically, algebraically, and with technology.
- 3102.3.29 Solve contextual problems involving systems of linear equations or inequalities and interpret solutions in context.

SPI 3102.3.10 Find the solution of a quadratic equation and/or zeros of a quadratic function.

- 3102.3.30 Solve quadratic equations using multiple
equation given solutions represented in graphical form (integral solutions and a leading coefficient of one).
- Select one of the factors \((x + 3)\) of a quadratic equation (integral solutions and a leading coefficient of one).
- Select the discriminant of a quadratic equation (integral solutions and a leading coefficient of one).

<table>
<thead>
<tr>
<th>methods: factoring, graphing, quadratic formula, or square root principle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ 3102.3.31 Determine the number of real solutions for a quadratic equation including using the discriminant and its graph.</td>
</tr>
<tr>
<td>✓ 3102.3.32 Recognize the connection among factors, solutions (roots), zeros of related functions, and x-intercepts in equations that arise from quadratic functions.</td>
</tr>
</tbody>
</table>

**SPI 3102.3.11 Analyze nonlinear graphs including quadratic and exponential functions that model a contextual situation.**

| ✓ 3102.3.17 Recognize “families” of functions. |
| ✓ 3102.3.19 Explore the characteristics of graphs of various nonlinear relations and functions including inverse variation, quadratic, and square root function. Use technology where appropriate. |
| ✓ 3102.3.33 Recognize data that can be modeled by an exponential function. |
| ✓ 3102.3.34 Graph exponential functions in the form \(y = a(b^x)\) where \(b \neq 0\). |
| ✓ 3102.3.35 Apply growth/decay and simple/compound interest formulas to solve contextual problems. |
**Former Learning Expectations**

3.1 Analyze relationships among corresponding parts of similar or congruent geometric figures.

3.2 Apply geometric properties of solids, polygons, and circles to solve real-world problems.

3.3 Justify conclusions and solve problems using deductive reasoning.

3.4 Use inductive reasoning to make conjectures and solve problems.

3.5 Communicate position using spatial sense with two- and three-dimensional coordinate systems.

3.6 Demonstrate an understanding of transformations of geometric figures (i.e., translations, rotations, dilations, and reflections).

3.7 Apply right triangle relationships including the Pythagorean Theorem, the distance formula, and trigonometric ratios.

3.8 Describe geometric objects and recognize minimal conditions necessary to define the geometric objects.

3.9 Apply reflexive, transitive, and symmetric properties when appropriate.

3.10 Demonstrate understanding of geometric properties of congruence, similarity, perpendicularity, and parallelism.

3.11 Recognize and articulate relationships among families of geometric figures (e.g., quadrilaterals, prisms).

3.12 Use logic and proof to establish the validity of conjectures and theorems.

3.13 Use concepts of length, area, and volume to estimate and solve real-world problems.

3.14 Apply measurement concepts and relationships in algebraic and geometric problem-solving situations.

3.15 Choose appropriate techniques and tools to measure quantities in order to meet specifications for precision, accuracy, and tolerance.

**New Course Level Expectations**

**CLE 3108.4.1** Develop the structures of geometry, such as lines, angles, planes, and planar figures, and explore their properties and relationships.

**CLE 3108.4.2** Describe the properties of regular polygons, including comparative classification of them and special points and segments.

**CLE 3108.4.3** Develop an understanding of the tools of logic and proof, including aspects of formal logic as well as construction of proofs.

**CLE 3108.4.4** Develop geometric intuition and visualization through performing geometric constructions with straightedge/compass and with technology.

**CLE 3108.4.5** Extend the study of planar figures to three-dimensions, including the classical solid figures, and develop analysis through cross-sections.

**CLE 3108.4.6** Generate formulas for perimeter, area, and volume, including their use, dimensional analysis, and applications.

**CLE 3108.4.7** Apply the major concepts of transformation geometry to analyzing geometric objects and symmetry.

**CLE 3108.4.8** Establish processes for determining congruence and similarity of figures, especially as related to scale factor, contextual applications, and transformations.

**CLE 3108.4.9** Develop the role of circles in geometry, including angle measurement, properties as a geometric figure, and aspects relating to the coordinate plane.

**CLE 3108.4.10** Develop the tools of right triangle trigonometry in the contextual applications, including the Pythagorean Theorem, Law of Sines and Law of Cosines.

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<tr>
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</thead>
<tbody>
<tr>
<td><strong>SPI 3108.4.1 Differentiate between Euclidean and non-Euclidean geometries.</strong></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- 3108.4.1 Recognize there are geometries other than Euclidean geometry in which the parallel postulate is not true; discuss unique properties of each.
- Identify properties of plane figures from information given in a diagram.
- Solve problems involving complementary, supplementary, congruent, vertical, or adjacent angles given angle measures expressed algebraically.

SPI 3108.4.2 Define, identify, describe, and/or model plane figures using appropriate mathematical symbols (including collinear and non-collinear points, lines, segments, rays, angles, triangles, quadrilaterals, and other polygons).

- 3108.4.3 Solve problems involving betweeness of points and distance between points (including segment addition).
- 3108.4.4 Describe and recognize minimal conditions necessary to define geometric objects.
- 3108.4.5 Use vertical, adjacent, complementary, and supplementary angle pairs to solve problems and write proofs.
- 3108.4.6 Describe the intersection of lines (in the plane and in space), a line and a plane, or of two planes.
- 3108.4.7 Identify perpendicular planes, parallel planes, line parallel to a plane, skew lines, and a line perpendicular to a plane.
- 3108.4.8 Apply properties and theorems about angles associated with parallel and perpendicular lines to solve problems.
- 3108.4.21 Use properties of and theorems about parallel lines, perpendicular lines, and angles to prove basic theorems in Euclidean geometry (e.g., two lines parallel to a third line are parallel to each other, the perpendicular bisectors of line segments are the set of all points equidistant from the endpoints, and two lines are parallel when...
- Apply the triangle inequality property to determine which sets of side lengths determine a triangle.
- Solve real-world problems involving measures of interior or exterior angles of regular polygons.
- Identify the appropriate segment of a triangle given a diagram and vice versa (i.e. median, altitude, angle bisector, perpendicular bisector).
- Apply properties of quadrilaterals to solve a real-world problem given a diagram (opposite sides and angles, consecutive sides and angles, or diagonals).

**SPI 3108.4.3** Identify, describe and/or apply the relationships and theorems involving different types of triangles, quadrilaterals and other polygons.

- 3108.4.9 Classify triangles, quadrilaterals, and polygons (regular, non-regular, convex and concave) using their properties.
- 3108.4.10 Identify and apply properties and relationships of special figures (e.g., isosceles and equilateral triangles, family of quadrilaterals, polygons, and solids).
- 3108.4.11 Use the triangle inequality theorems (e.g., Exterior Angle Inequality Theorem, Hinge Theorem, SSS Inequality Theorem, Triangle Inequality Theorem) to solve problems.
- 3108.4.12 Apply the Angle Sum Theorem for polygons; find interior and exterior angle measures given the number of sides; find the number of sides...
<table>
<thead>
<tr>
<th>Given angle measures, solve contextual problems.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3108.4.14 Identify and use medians, midsegments, altitudes, angle bisectors, and perpendicular bisectors of triangles to solve problems (e.g., find segment lengths, angle measures, points of concurrency).</td>
</tr>
</tbody>
</table>

**SPI 3108.4.4 Analyze different types and formats of proofs.**

- 3108.4.2 Compare and contrast inductive reasoning and deductive reasoning for making predictions and valid conclusions based on contextual situations.
- 3108.4.15 Identify, write, and interpret conditional and bi-conditional statements along with the converse, inverse, and contra-positive of a conditional statement.
- 3108.4.16 Analyze and create truth tables to evaluate conjunctions, disjunctions, conditionals, inverses, contra-positives, and bi-conditionals.
- 3108.4.17 Use the Law of Detachment, Law of Syllogism, conditional statements, and bi-conditional statements to draw conclusions.
- 3108.4.18 Use counterexamples, when appropriate, to disprove a statement.
- 3108.4.19 Use coordinate geometry to prove properties of plane figures.
- 3108.4.20 Prove key basic theorems in geometry (i.e., Pythagorean Theorem, the sum of the angles of a triangle is 180°).
<table>
<thead>
<tr>
<th><strong>SPI 3108.4.1</strong> Develop and apply strategies to estimate the area of any shape on a grid.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPI 3102.4.1</strong> Develop and apply strategies to estimate the area of any shape on a grid.</td>
</tr>
<tr>
<td><strong>SPI 3108.4.2</strong> Develop and use special formulas relating to polyhedra (e.g., Euler’s Formula).</td>
</tr>
<tr>
<td><strong>SPI 3108.4.3</strong> Use properties of prisms, pyramids, cylinders, cones, spheres, and hemispheres to solve problems.</td>
</tr>
<tr>
<td><strong>SPI 3108.4.4</strong> Use various area of triangle formulas to solve contextual problems (e.g., Heron’s formula, the area formula for an equilateral triangle and ( A = \frac{1}{2} ab \sin C )).</td>
</tr>
<tr>
<td><strong>SPI 3108.4.5</strong> Describe solids and/or surfaces in three-dimensional space, when given two-dimensional representations for the surfaces of three-dimensional objects.</td>
</tr>
<tr>
<td><strong>SPI 3108.4.6</strong> Use various area of triangle formulas to solve contextual problems (e.g., Heron’s formula, the area formula for an equilateral triangle and ( A = \frac{1}{2} ab \sin C )).</td>
</tr>
<tr>
<td><strong>SPI 3108.4.7</strong> Compute the area and/or perimeter of triangles, quadrilaterals and other polygons.</td>
</tr>
</tbody>
</table>

- Determine which three-dimensional solid is represented by a given net and vice versa (two-dimensional drawing).
- Determine the area of indicated regions involving circles, squares, rectangles, and/or triangles.
- Estimate the area of irregular geometric figures on a grid.
- Apply the given formula to...

degrees, characteristics of quadrilaterals, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length.

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<table>
<thead>
<tr>
<th>Planning Statements</th>
<th>SPI Standards</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| determine the area or perimeter of a rectangle.  
- Apply the given formula to find the area of a circle, the circumference of a circle, or the volume of a rectangular solid.  
- Select the area representation for a given product of two one-variable binomials with positive constants and coefficients. | 3102.4.1 Using algebraic expressions solve for measures in geometric figures as well as for perimeter, area, and volume. | 3108.4.1 Derive and use the formulas for the area and perimeter of a regular polygon. (A=1/2 ap) | Select the area representation for a given product of two one-variable binomials with positive constants and coefficients. |
| plane grid. | | | |
| Identify chords, inscribed angles, or central angles of circles given a diagram.  
- Solve problems involving the properties of arcs, chords, tangents, or secants.  
- Find the area of a sector of a circle given a diagram.  
- Determine the area of indicated regions involving circles, squares, rectangles, and/or triangles. | SPI 3108.4.8 Solve problems involving area, circumference, area of a sector, and/or arc length of a circle. | |
| SPI 3108.9 Use right triangle trigonometry and cross-sections to solve problems involving surface areas and/or volumes of solids.  
- 3108.4.26 Describe and draw cross-sections (including the conic sections) of prisms, cylinders, pyramids, spheres, and cones.  
- 3108.4.27 Use right triangle trigonometry to find the area and perimeter of quadrilaterals (e.g. square, rectangle, rhombus, parallelogram, trapezoid, and kite).  
- 3108.4.30 Use right triangle trigonometry to find the lateral area (if possible), surface area, and volume of prisms, cylinders, cones, pyramids, spheres, and hemispheres. | | | |

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<table>
<thead>
<tr>
<th></th>
<th>Determine whether a plane figure has been translated, dilated, reflected, or rotated given a diagram and vice versa.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI 3108.4.10 Identify, describe, and/or apply transformations on two and three dimensional geometric shapes.</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.31 Use properties of single transformations and compositions of transformations to determine their effect on geometric figures (e.g. reflections across lines of symmetry, rotations, translations, glide reflections, and dilations).</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.32 Recognize, identify and apply types of symmetries (point, line, rotational) of two- and three- dimensional figures.</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.33 Use transformations to create and analyze tessellations and investigate the use of tessellations in architecture, mosaics, and artwork.</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.34 Create and analyze geometric designs using rigid motions (compositions of reflections, translations, and rotations).</td>
<td></td>
</tr>
<tr>
<td>SPI 3108.4.11 Use basic theorems about similar and congruent triangles to solve problems.</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.35 Prove that two triangles are congruent by applying the SSS, SAS, ASA, AAS, and HL congruence statements.</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.36 Use several methods, including AA, SSS, and SAS, to prove that two triangles are similar.</td>
<td></td>
</tr>
<tr>
<td>✓ 3108.4.37 Identify similar figures and use ratios and</td>
<td></td>
</tr>
<tr>
<td><strong>Apply proportion and the concepts of similar triangles to find the length of a missing side of a triangle.</strong></td>
<td><strong>Determine the perimeter, area, or volume given the ratio of two similar polygons or rectangular solids.</strong></td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td><strong>Determine the length of a missing side in a right triangle when given two sides (answers must be given as simplified radicals).</strong></td>
<td><strong>Find a missing side length in a 30-60-90 or 45-45-90 degree triangle without rationalizing the</strong></td>
</tr>
</tbody>
</table>
| **Apply the given Pythagorean Theorem to a real life problem illustrated by a diagram (no radicals in answer).** | **SPI 3102.4.2 Solve contextual problems using the Pythagorean Theorem.**
- **3102.4.2 Use the Pythagorean Theorem to find the missing measure in a right triangle including those from real-world situations.** | **SPI 3108.4.14 Use properties of right triangles to solve problems (such as involving the relationship formed when the altitude to the hypotenuse of a right triangle is drawn).**
- **3108.4.29 Extend the effect of a scale factor k in similar objects to include the impact on volume calculations and transformations.** |

SPI 3108.4.38 Use the principle that corresponding parts of congruent triangles are congruent to solve problems.
| 9.3108.4.43 | Apply the Pythagorean Theorem and its converse to triangles to solve mathematical and contextual problems in two- or three-dimensional situations. |
| 9.3108.4.44 | Identify and use Pythagorean triples in right triangles to find lengths of an unknown side in two- or three-dimensional situations. |
| 9.3108.4.45 | Use the converse of the Pythagorean Theorem to classify a triangle by its angles (right, acute, or obtuse). |
| 9.3108.4.46 | Apply properties of 30° - 60° - 90° and 45° - 45° - 90° to determine side lengths of triangles. |

**Determine if a triangle is a right triangle given the length of all the sides of a triangle.**

- **Determine the trigonometric ratio for a right triangle needed to solve a real-world problem given a diagram.**

- **Calculate rates involving cost per unit to determine the best buy (no more than three samples).**

**SPI 3102.4.4 Convert rates and measurements.**

- **3102.4.5 Use dimensional relationships that exist when the altitude is drawn to the hypotenuse of a right triangle.**

**SPI 3108.4.15 Determine and use the appropriate trigonometric ratio for a right triangle to solve a contextual problem.**

- **3108.4.47 Find the sine, cosine and tangent ratios of an acute angle of a right triangle given the side lengths.**

- **3108.4.48 Define, illustrate, and apply angles of elevation and angles of depression in real-world situations.**

- **3108.4.49 Use the Law of Sines (excluding the ambiguous case) and the Law of Cosines to find missing side lengths and/or angle measures in non-right triangles.**

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<table>
<thead>
<tr>
<th>Analysis to convert rates and measurements both within a system and between systems and check the appropriateness of the solution.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Determine whether a reading falls within an acceptable tolerance range.</td>
</tr>
</tbody>
</table>
## Geometry – Data Analysis, Probability, and Statistics

### Former Learning Expectations

5.1 Apply geometric representations to calculate theoretical probability.

5.2 Use data analysis to investigate geometric relationships.

### New Course Level Expectations

CLE 3108.5.1 Analyze, interpret, employ and construct accurate statistical graphs.

CLE 3108.5.2 Develop the basic principles of geometric probability.

### Former Standards Algebra I Review Material

- Apply counting principles of permutations or combinations in real-world situations.
- Interpret bar graphs representing real-world data.
- Interpret circle graphs (pie charts) representing real-world data.

### New Standards Algebra I Building blocks for new standards

- **SPI 3102.5.5** Determine theoretical and/or experimental probability of an event and/or its complement including using relative frequency.
  - 3102.5.12 Use techniques (Venn Diagrams, tree diagrams, or counting procedures) to identify the possible outcomes of an experiment or sample space and compute the probability of an event.
  - 3102.5.13 Determine the complement of an event and the probability of that complement.
  - 3102.5.15 Explore joint and conditional probability.
  - 3102.5.14 Determine if two events are independent or dependent.
  - 3102.5.16 Identify situations for which the Law of Large Numbers applies.
  - 3102.5.17 Perform simulations to estimate probabilities.
  - 3102.5.18 Make informed decisions about practical situations using probability concepts.

### Former Standards Geometry Curriculum for 2008-2009

- **SPI 3108.5.1** Use area to solve problems involving geometric probability (e.g. dartboard problem, shaded sector of a circle, shaded region of a geometric figure).
  - 3108.5.3 Estimate or calculate simple geometric probabilities (e.g., number line, area model, using length, circles).

### New Standards Geometry new End of Course 2009-2010

- **SPI 3108.5.1** Interpret displays of data to answer questions about the data set(s) (e.g., identify pattern, trends, and/or outliers in a data set).
  - 3102.5.1 Identify patterns or make a prediction from a geometric representation of a real-world data set.
  - 3102.5.1 Determine the area of each sector and the degree measure of each intercepted arc in a pie chart.
  - 3102.5.2 Translate from one representation of data to another.

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| SPI 3102.5.2 Identify the effect on mean, median, mode, and range when values in the data set are changed. |
| SPI 3102.5.3 Using a scatter-plot, determine if a linear relationship exists and describe the association between variables. |
| SPI 3102.5.4 Generate the equation of a line that fits linear data and use it to make a prediction. |

- Determine the mean (average) of a given set of real-world data (no more than five two-digit numbers).
- Determine the median for a given set of real-world data (even number of data).
- Choose the matching linear graph given a set of ordered pairs.
- Make a prediction from the graph of a real-world linear data set.

- 3102.5.2 Develop a meaning for and identify outliers in a data set and verify.
- 3102.5.5 Construct and interpret various forms of data representations, (including line graphs, bar graphs, circle graphs, histograms, scatter-plots, box-and-whiskers, stem-and-leaf, and frequency tables).
- 3102.5.6 Draw qualitative graphs of functions and describe a general trend or shape.
- 3102.5.7 Compare two data sets using graphs and descriptive statistics.

(e.g., bar graph to pie graph, pie graph to bar graph, table to pie graph, pie graph to chart) accurately using the area of a sector.

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between the variables of the data set.

✓ 3102.5.9 Determine an equation for a line that fits real-world linear data. Interpret the meaning of the slope and y-intercept in context of the data.

✓ 3102.5.10 Using technology with a set of contextual linear data to examine the line of best fit. Determine and interpret the correlation coefficient.

✓ 3102.5.11 Use an equation that fits data to make a prediction.
New Course Level Expectations
CLE 3103.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.
CLE 3103.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.
CLE 3103.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.
CLE 3103.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.
CLE 3103.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.
CLE 3103.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.
CLE 3103.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Checks for Understanding (Formative/Summative Assessment)
✓ 3103.1.1 Create and analyze scatter-plots of non-linear and transcendental functions.
✓ 3103.1.2 Compare and contrast sampling techniques and identify the best technique for a given situation.
✓ 3103.1.3 Use calculators to identify regression equations for nonlinear data.
✓ 3103.1.4 Identify the weaknesses of calculators and other technologies in representing non-linear data, such as graphs approaching vertical asymptotes, and use alternative techniques to identify these issues and correctly solve problems.
✓ 3103.1.5 Determine the accuracy and reliability of a mathematical model.
✓ 3103.1.6 Use graphical representations to perform operations on complex numbers.
✓ 3103.1.7 Use the unit circle to determine the exact value of trigonometric functions for commonly used angles (0°, 30°, 45°, 60°...).
✓ 3103.1.8 Understand and describe the inverse relationship between exponential and logarithmic functions.
✓ 3103.1.9 Translate the syntax of technology to appropriate mathematical notation for non-linear and transcendental functions.
✓ 3103.1.10 Interpret the results of mathematical modeling in various contexts to answer questions.

State Performance Indicators
SPI 3103.1.1 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic) of non-linear and transcendental functions to solve problems, to model mathematical ideas, and to communicate solution strategies.
SPI 3103.1.2 Recognize and describe errors in data collection and analysis as well as identifying representations of data as being accurate or misleading.
SPI 3103.1.3 Use technology tools to identify and describe patterns in data using non-linear and transcendental functions that approximate data as well as using those functions to solve contextual problems.
SPI 3103.1.4 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely to effectively communicate reasoning in the process of solving problems via mathematical modeling with both linear and non-linear functions.

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## Algebra II – Number and Operation

### Former Learning Expectations

1. Demonstrate an understanding of the subsets, elements, properties, and operations of the complex number system.
   - 1.1 Demonstrate an understanding of the subsets, elements, properties, and operations of the complex number system.
   - 1.2 Connect physical, graphical, verbal, and symbolic representations of real numbers.
   - 1.3 Articulate, model, and apply the concept of inverse (e.g. opposites, reciprocals, and powers and roots).
   - 1.4 Describe, model, and apply inverse operations.
   - 1.5 Connect physical, graphical, verbal, and symbolic representations of absolute value.
   - 1.6 Use a variety of notations appropriately (e.g. logarithmic, factorial, sigma, delta, radical).
   - 1.7 Perform operations on algebraic expressions and informally justify the procedures chosen.

### New Course Level Expectations

CLE 3103.2.1 Understand the hierarchy of the complex number system and relationships between the elements, properties and operations.
   - 3103.2.2 Connect numeric, analytic, graphical and verbal representations of both real and complex numbers.
   - 3103.2.3 Use appropriate technology (including graphing calculators and computer spreadsheets) to solve problems, recognize patterns and collect and analyze data.
   - 3103.2.4 Understand the capabilities and limitations of technology when performing operations, graphing, and solving equations involving complex numbers.

### Former Standards Algebra I

- Review Material

### New Standards Algebra I

- Building blocks for new standards

### Former Standards Algebra II

- Curriculum for 2008-2009

### New Standards Algebra II

- New End of Course 2009-2010

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>SPI 3102.2.3 Describe and/or order a given set of real numbers including both rational and irrational numbers.</td>
<td>Order a given set ofreal numbers.</td>
<td>SPI 3103.2.1 Describe any number in the complex number system.</td>
<td></td>
</tr>
<tr>
<td>Select the best estimate for the coordinate of a given point on a number line (only rational). (formerly in Algebra)</td>
<td>Identify the reciprocal of a real number.</td>
<td>✓ 3103.2.1 Understand that to solve certain problems and equations, the real number system needs to be extended from real numbers to complex numbers.</td>
<td></td>
</tr>
<tr>
<td>Order a given set of rational numbers (both fraction and decimal notations).</td>
<td>✓ 3103.2.2 Define and give examples of each of the types of numbers in the complex number system.</td>
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</tr>
<tr>
<td>Identify the opposite of a rational number.</td>
<td>✓ 3103.2.7 Graph complex numbers in the complex plane and recognize differences and similarities with the graphical representations of real numbers graphed on the number line.</td>
<td></td>
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</tr>
<tr>
<td>Identify the reciprocal of a rational number.</td>
<td>✓ 3103.2.9 Find and describe geometrically the absolute value of a complex number.</td>
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</tbody>
</table>

- Apply order of operations when computing with integers using no more than two sets of

- SPI 3102.2.1 Operate (add, subtract, multiply, divide, simplify, powers) with radicals

- SPI 3103.2.1 Operate (add, subtract, multiply, divide, simplify, powers) with radicals

- Perform basic operations using complex numbers (i.e., addition, subtraction, and multiplication).

- SPI 3103.2.2 Compute with all real and complex numbers.

- ✓ 3103.2.3 Identify and apply
|------------------------------------------|----------------------------------------------------------|------------------------------------------------------|--------------------------------------------------|
| grouping symbols and exponents 1 and 2.  
- Determine the square root of a perfect square less than 169.  
- Add and subtract algebraic expressions.  
- Use exponents to simplify a monomial written in expanded form. | and radical expressions including radicands involving rational numbers and algebraic expressions.  
✓ 3102.2.3 Operate with and simplify radicals (index 2, 3, n) and radical expressions including rational numbers and variables in the radicand.  
✓ 3102.2.4 Operate efficiently with both rational and irrational numbers.  
✓ 3102.2.7 Identify the subsets in the real number system and understand their relationships.  
✓ 3102.2.8 Use multiple strategies to approximate the value of an irrational number including irrational square roots including location on the real number line.  
SPI 3102.2.2 Multiply, divide, and square numbers expressed in scientific notation.  
✓ 3102.2.5 Perform operations with numbers in scientific notation (multiply, divide, powers).  
✓ 3102.2.6 Use appropriate technologies to apply scientific notation to real-world problems. | ▪ Determine the conjugate of a complex number. | properties of complex numbers (including simplification and standard form).  
✓ 3103.2.4 Add and subtract complex numbers.  
✓ 3103.2.5 Multiply complex numbers.  
✓ 3103.2.6 Define and utilize the complex conjugates to write the quotient of two complex numbers in standard form. |
| ▪ Select a reasonable solution for a real-world division problem in which the remainder must be considered.  
▪ Select ratios and proportions to represent real-world problems (e.g., scale drawings, sampling, etc.). | | SPI 3103.2.3 Use the number system, from real to complex, to solve equations and contextual problems.  
✓ 3103.2.8 Solve quadratic equations over the complex number system.  
✓ 3103.2.10 Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers over |

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| Former Standards Algebra I  
Review Material | New Standards Algebra I  
Building blocks for new standards | Former Standards Algebra II  
Curriculum for 2008-2009 | New Standards Algebra II  
new End of Course  2009-2010 |
<table>
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<td></td>
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<td></td>
<td>complex numbers.</td>
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<td></td>
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<td></td>
<td>✓ 3103.2.13 Analyze and evaluate contextual situations involving any type of number from the complex number system.</td>
</tr>
<tr>
<td>Use estimation to determine a reasonable solution for a tedious arithmetic computation.</td>
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<td></td>
<td>✓ 3103.2.11 Understand the capabilities and limitations of technology. Make estimations without a calculator to detect potential errors.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>✓ 3103.2.12 Select and use appropriate methods to make estimations without technology when solving contextual problems.</td>
</tr>
</tbody>
</table>

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**Algebra II – Algebra**

**Former Learning Expectations**

2.1 Analyze mathematical patterns related to algebra and geometry in real-world problem solving.

2.2 Use algebraic thinking to generalize a pattern by expressing the pattern in functional notation.

2.3 Solve linear systems using a variety of techniques, including matrices.

2.4 Communicate the meaning of variables in algebraic expressions, equations, and inequalities.

2.5 Manipulate the algebraic functions with constants and analyze graphs to describe the behavior of functions.

2.6 Apply the concept of rate of change.

2.7 Identify and represent a variety of functions (e.g. linear, quadratic, cubic).

2.8 Identify, describe, and articulate the characteristics and the parameters of a parent function.

2.9 Interpret results of algebraic procedures.

2.10 Apply the concept of variable in simplifying algebraic expressions, solving equations, and solving inequalities.

2.11 Interpret graphs that depict real-world phenomena.

2.12 Model real-world phenomena using functions and graphs.

2.13 Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the real-life situations which the functions represent.

2.14 Use linear programming to solve real-world problems.

**New Course Level Expectations**

CLE 3103.3.1 Understand and apply properties of rational exponents and perform basic operations to simplify algebraic expressions.

CLE 3103.3.2 Understand, analyze, transform and generalize mathematical patterns, relations and functions using properties and various representations.

CLE 3103.3.3 Analyze and apply various methods to solve equations, absolute values, inequalities, and systems of equations over complex numbers.

CLE 3103.3.4 Graph and compare equations and inequalities in two variables. Identify and understand the relationships between the algebraic and geometric properties of the graph.

CLE 3103.3.5 Use mathematical models involving equations and systems of equations to represent, interpret and analyze quantitative relationships, change in various contexts, and other real-world phenomena.

---

### Former Standards Algebra I Review Material

- Multiply two polynomials with each factor having no more than two terms. (formerly in Number & Operations)
- Evaluate a first degree algebraic expression given values for one or more variables.
- Evaluate an algebraic expression given values for one or more variables using grouping symbols and/or exponents less than four.

### New Standards Algebra I Building blocks for new standards

- **SPI 3102.3.2 Operate with polynomials and simplify results.**
  - 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure, reflexive, symmetric, transitive, operation properties of equality).
  - 3102.1.10 Use algebraic properties to develop a valid mathematical argument.
  - 3102.2.1 Recognize and use like terms to simplify expressions.
  - 3102.2.2 Apply the order of operations.

### Former Standards Algebra II Curriculum for 2008-2009

- Determine the domain of polynomial, rational, square root, exponential and logarithmic functions.
- Multiply two polynomials with each factor having no more than two terms. (from Number & Operations)
- Add, subtract, and multiply algebraic expressions. (from Number & Operations)

### New Standards Algebra II new End of Course 2009-2010

- **SPI 3103.3.1 Add, subtract and multiply polynomials; divide a polynomial by a lower degree polynomial.**
  - 3103.3.1 Perform operations on algebraic expressions and justify the procedures.
  - 3103.3.21 Factor polynomials using a variety of methods including the factor theorem, synthetic division, long division, sums and differences of cubes, and grouping.

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| Operations to simplify and evaluate algebraic expressions. |
| --- | --- |
| ✓ 3102.3.3 Justify correct results of algebraic procedures using extension of properties of real numbers to algebraic expressions. |
| ✓ 3102.3.5 Add, subtract, and multiply polynomials including squaring a binomial. |
| ✓ 3102.3.6 Find the quotient of a polynomial and a monomial. |
| ✓ 3102.3.7 Use various models (including area models) to represent products of polynomials. |

**SPI 3102.1.3 Apply properties to evaluate expressions, simplify expressions, and justify solutions to problems.**

| Factor polynomials. |
| --- | --- |
| ✓ 3102.3.8 Find the GCF of the terms in a polynomial. |
| ✓ 3102.3.9 Find two binomial factors of a quadratic expression. |

**SPI 3102.3.10 Find the solution of a quadratic equation and/or zeros of a quadratic function.**

| ✓ 3102.3.30 Solve quadratic equations using multiple methods: factoring, graphing, quadratic formula, or square root principle. |
| ✓ 3102.3.31 Determine the number of real solutions for a quadratic equation including using the discriminant and its graph. |
| ✓ 3102.3.32 Recognize the connection among factors, solutions (roots), zeros of related functions, and x-intercepts in equations that arise from |

**SPI 3103.3.2 Solve quadratic equations and systems, and determine roots of a higher order polynomial.**

| ✓ 3103.3.7 Solve quadratic equations by factoring, graphing, completing the square, extracting square roots and using the quadratic formula. |
| ✓ 3103.3.10 Given a quadratic equation use the discriminant to determine the nature of the roots. |
| ✓ 3103.3.22 Determine the number and possible types of zeros for a polynomial function and find the rational roots. |

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quadratic functions.

| SPI 3102.3.4 Operate with, evaluate, and simplify rational expressions including determining restrictions on the domain of the variables. |
| SPI 3103.3.4 Use the formulas for the general term and summation of finite arithmetic and both finite and infinite geometric series. |

- Simplify expressions with rational and negative exponents. (from Number & Operations)
- SPI 3103.3.3 Add, subtract, multiply, divide and simplify rational expressions including those with rational and negative exponents.
- SPI 3103.3.15 Find the sum of an geometric series whose common ratio, r, is in the interval (-1,1).

- SPI 3102.3.10 Add, subtract, multiply, and divide rational expressions and simplify results.
- SPI 3102.3.16 Determine if a relation is a function from its graph or from a set of ordered pairs.

- Determine the domain and/or range of a function represented by the graph of real-world situation.
- SPI 3102.3.7 Determine domain and range of a relation, determine whether a relation is a function and/or evaluate a function at a specified rational value.
- SPI 3103.3.5 Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the contextual situations which the functions represent.

- SPI 3103.3.4 Use the formulas for the general term and summation of finite arithmetic and both finite and infinite geometric series.
- SPI 3103.3.6 Combine functions (such as polynomial, rational, radical and absolute value expressions) by addition, subtraction, multiplication, division, or by composition and
| Evaluate at specified values of their variables. | Identify the exponential form of a logarithmic expression and vice versa. (from Number & Operations) | SPI 3103.3.7 Identify whether a function has an inverse, whether two functions are inverses of each other, and/or explain why their graphs are reflections over the line y = x. ✓ 3103.3 Determine and graph the inverse of a function with and without technology. |
| Identify the inverse of a logarithmic function given its graph. | Determine the inverse of a logarithmic function given its graph. |
| SPI 3103.3.8 Solve systems of three linear equations in three variables. | SPI 3103.3.8 Solve a three by three system of linear equations algebraically and by using inverse matrices and determinants with and without technology. |
| SPI 3103.3.9 Graph the solution set of two or three linear or quadratic inequalities. | SPI 3103.3.9 Graph the solution set of two or three linear or quadratic inequalities. ✓ 3103.3.18 Solve compound inequalities involving disjunction and conjunction and linear inequalities containing absolute values. ✓ 3103.3.19 Solve linear programming problems. |
| Select the system of equations that could be used to solve a given real-world problem. | SPI 3102.3.9 Solve systems of linear equation/inequalities in two variables. ✓ 3102.3.27 Determine the number of solutions for a system of linear equations (0, 1, or infinitely many solutions). ✓ 3102.3.28 Solve systems of linear equations graphically, algebraically, and with technology. ✓ 3102.3.29 Solve contextual problems involving systems of linear equations or inequalities and interpret solutions in context. |
| Solve a system of linear equations with 2 variables (e.g. substitution, elimination, Cramer’s Rule, and graphing). | SPI 3102.3.10 Identify and/or graph a variety of functions and their transformations. ✓ 3103.3.4 Analyze the effect of changing various parameters on functions and their graphs. ✓ 3103.3.5 Graph piece-wise and |
| Select the graph that represents a given linear function expressed in slope-intercept form. | SPI 3102.1.5 Recognize and express the effect of changing constants and/or coefficients in problem solving. 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients. |
| SPI 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients. | Predict the graphical transformation that occurs when coefficients and/or constants of given function are changed (no trigonometric or logarithmic functions). Describe the transformation that |
| SPI 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients. | SPI 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients. | SPI 3102.1.14 Apply graphical transformations that occur when changes are made to coefficients. |
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- Select the linear graph that models the given real-world situation described in a tabular set of data.
- Determine the slope from the graph of a linear equation (no labeled points).
- Apply the concept of rate of change to solve real-world problems.
- Recognize the graphical transformation that occurs when coefficients and/or constants of the corresponding linear equations are changed.
- Apply the concept of slope to represent rate of change in a real-world situation. *(formerly in Number & Operations)*

| SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems. |
|SPI 3102.1.6 Determine and interpret slope in multiple contexts including rate of change in real-world problems. |
| 3102.1.16 Understand and express the meaning of the slope and y-intercept of linear functions in real-world contexts. |

- SPI 3102.3.8 Determine the equation of a line and/or graph a linear equation. |
  - 3102.3.18 Analyze the characteristics of graphs of basic linear relations and linear functions including constant function, direct variation, identity function, vertical lines, absolute value of linear functions. Use technology where appropriate. |
  - 3102.3.20 Understand that a linear equation has a constant rate of change called slope and represent slope in various forms. |
  - 3102.3.21 Determine the equation of a line using given information including a point and slope, two points, a point and a line parallel or perpendicular, graph, intercepts. |
  - 3102.3.22 Express the equation of a line in standard form, slope-intercept, and point-slope form. |
  - 3102.3.23 Determine the graph of a linear equation including those that depict contextual situations. |
  - 3102.3.24 Interpret the changes in the slope-intercept form and graph of a linear equation by looking at different parameters, m and b in the slope-intercept form. |

- SPI 3103.3.11 Graph conic step functions. |
  - 3103.3.11 Describe and articulate the characteristics and parameters of a parent function. |

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| SPI 3102.3.11 Analyze nonlinear graphs including quadratic and exponential functions that model a contextual situation. |
| Select the graph that models a given real-world situation (i.e., linear and non-linear). |
| SPI 3103.3.12 Interpret graphs that depict real-world phenomena. |

- 3102.3.17 Recognize “families” of functions.
- 3102.3.19 Explore the characteristics of graphs of various nonlinear relations and functions including inverse variation, quadratic, and square root function. Use technology where appropriate.
- 3102.3.33 Recognize data that can be modeled by an exponential function.
- 3102.3.34 Graph exponential functions in the form $y = a(b^x)$ where $b \neq 0$.
- 3102.3.35 Apply growth/decay and simple/compound interest formulas to solve contextual problems.
- Identify matrices that model given real-world situations.
- Apply properties of logarithms to solve contextual problems using quadratic, rational, radical and exponential functions.

sections (circles, parabolas, ellipses and hyperbolas) and understand the relationship between the standard form and the key characteristics of the graph.

- 3103.3.9 Find an equation for a parabola when given its graph or when given its roots.
- 3103.3.12 Understand the relationship between real zeros of a function and the x-intercepts of its graph.
- 3103.3.20 Understand the relationships between the equations of conic sections and their graphs.

3102.3.35 Apply growth/decay and simple/compound interest formulas to solve contextual problems.

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<table>
<thead>
<tr>
<th>simplify a logarithmic expression.</th>
<th>Solve real world problems given logarithmic and exponential formulas (e.g. pH scale, Richter scale.)</th>
<th>exponential equations, finite geometric series or systems of equations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve real world problems given</td>
<td>- 3103.3.6 Simplify expressions and solve equations containing radicals.</td>
<td>✓ 3103.3.6 Simplify expressions and solve equations containing radicals.</td>
</tr>
<tr>
<td>logarithmic and exponential</td>
<td>- 3103.3.13 Solve problems using exponential functions requiring the use of logarithms for their</td>
<td>✓ 3103.3.13 Solve problems using exponential functions requiring the use of logarithms for their solutions.</td>
</tr>
<tr>
<td>formulas (e.g. pH scale, Richter</td>
<td>solutions.</td>
<td>✓ 3103.3.16 Prove basic properties of logarithms using properties of exponents and apply those properties to solve problems.</td>
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<td>scale.)</td>
<td></td>
<td>✓ 3103.3.17 Know that the logarithm and exponential functions are inverses and use this information to solve real-world problems.</td>
</tr>
<tr>
<td>exponential equations, finite</td>
<td>✓ 3103.3.14 Solve problems involving the binomial theorem and its connection to Pascal's Triangle,</td>
<td><strong>SPI 3103.3.14 Solve problems involving the binomial theorem and its connection to Pascal's Triangle, combinatorics, and probability.</strong></td>
</tr>
<tr>
<td>geometric series or systems of</td>
<td>combinatorics, and probability.</td>
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<tr>
<td>equations.</td>
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<tr>
<td>SPI 3102.1.1 Interpret patterns</td>
<td>▪ Extend a geometric pattern.</td>
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<tr>
<td>found in sequences, tables, and</td>
<td>▪ Extend a numerical pattern.</td>
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<tr>
<td>other forms of quantitative</td>
<td>▪ Select the algebraic notation which generalizes the pattern represented by data in a given</td>
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<tr>
<td>information using variables or</td>
<td>table.</td>
<td></td>
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<tr>
<td>function notation.</td>
<td>✓ 3102.1.4 Write a rule with variables that expresses a pattern.</td>
<td></td>
</tr>
<tr>
<td>SPI 3102.3.1 Express a generalization of a pattern in various representations including algebraic and function notation.</td>
<td>✓ 3102.3.1 Recognize and extend arithmetic and geometric sequences.</td>
<td></td>
</tr>
<tr>
<td>✓ 3102.3.2 Explore patterns</td>
<td>✓ 3102.3.2 Explore patterns including Pascal's Triangle and the Fibonacci sequence.</td>
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<tr>
<td>including Pascal's Triangle and</td>
<td>▪ Select the algebraic equation that generalizes the pattern represented by data in a given table.</td>
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<tr>
<td>the Fibonacci sequence.</td>
<td>▪ Select functional notation to generalize a given numeric pattern.</td>
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<tr>
<td>SPI 3102.1.2 Write an</td>
<td>▪ Translate a verbal expression</td>
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</tr>
<tr>
<td>SPI 3102.1.2 Write an</td>
<td>▪ Translate a verbal sentence into</td>
<td></td>
</tr>
</tbody>
</table>

Prepare through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008
- Translate a verbal sentence into an algebraic equation.
- Solve one- and two-step linear equations using integers (with integral coefficients and constants).
- Solve multi-step linear equations (more than two steps, variables on only one side of the equation).
- Solve multi-step linear equations (more than two steps, with variables on both sides of the equation).
- Identify the graphical representation of the solution to a one-variable inequality on a number line.
- Solve multi-step linear inequalities in real-world situations.
- Select the appropriate graphical representation of a given linear inequality.

**equation symbolically to express a contextual problem.**

- 3102.1.5 Use formulas, equations, and inequalities to solve real-world problems including time/rate/distance, percent increase/decrease, ratio/proportion, and mixture problems.

**SPI 3102.3.5 Write and/or solve linear equations, inequalities, and compound inequalities including those containing absolute value.**

- 3102.3.11 Solve multi-step linear equations with one variable.
- 3102.3.12 Recognize and articulate when an equation has no solution, a single solution, or all real numbers as solutions.
- 3102.3.13 Solve multi-step linear inequalities with one variable and graph the solution on a number line.
- 3102.3.14 Solve absolute value equations and inequalities (including compound inequalities) with one variable and graph their solutions on a number line.
- 3102.3.15 Determine domain and range of a relation and articulate restrictions imposed either by the operations or by the real life situation that the function represents.
- 3102.3.25 Find function values using f(x) notation or graphs.
- 3102.3.26 Graph linear inequalities on the coordinate plane and identify regions of the graph containing ordered pairs in the solution.
<table>
<thead>
<tr>
<th>Task</th>
<th>Relevant Standards</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select the nonlinear graph that models the given real-world situation or vice versa.</td>
<td>SPI 3102.1.4 Translate between representations of functions that depict real-world situations.</td>
<td>✓ Select the graph that represents a given linear function expressed in slope-intercept form.</td>
</tr>
<tr>
<td></td>
<td>SPI 3102.3.6 Interpret various relations in multiple representations.</td>
<td>✓ Identify the graphical representation of the solution to a one-variable inequality on a number line.</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.1.12 Create and work flexibly among representations of relations (including verbal, equations, tables, mappings, graphs).</td>
<td>✓ Select the graph of a two-variable inequality.</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.1.13 Change from one representation of a relation to another representation, for example, change from a verbal description to a graph.</td>
<td></td>
</tr>
<tr>
<td>Calculate the distance between two points given the Pythagorean Theorem and the distance formula.</td>
<td>SPI 3102.4.3 Solve problems involving the distance between points or midpoint of a segment.</td>
<td>✓ Select the graph that represents a given linear function expressed in slope-intercept form.</td>
</tr>
<tr>
<td>Identify ordered pairs in the coordinate plane.</td>
<td>✓ 3102.4.3 Understand horizontal/vertical distance in a coordinate system as absolute value of the difference between coordinates. develop the distance formula for a coordinate plane using the Pythagorean Theorem.</td>
<td>✓ Identify the graphical representation of the solution to a one-variable inequality on a number line.</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.4.4 Develop the midpoint formula for segments on a number line or in the coordinate plane.</td>
<td>✓ Select the graph of a two-variable inequality.</td>
</tr>
</tbody>
</table>
### Former Learning Expectations

3.1 Apply geometric properties, formulas, and relationships to solve real-world problems.
3.2 Justify conclusions using deductive reasoning.
3.3 Use inductive reasoning to make conjectures.
3.4 Communicate position using spatial sense with two- and three-dimensional coordinate systems.
3.5 Perform a given transformation and predict the results of the transformation.
4.1 Apply measurement concepts and relationships in algebraic and geometric problem-solving situations.
4.2 Apply appropriate techniques, tools, and formulas to determine measurements.

### New Course Level Expectations

CLE 3103.4.1 Understand the trigonometric functions and their relationship to the unit circle.
CLE 3103.4.2 Know and use the basic identities of sine, cosine, and tangent as well as their reciprocals.
CLE 3103.4.3 Graph all six trigonometric functions and identify their key characteristics.
CLE 3103.4.4 Know and use the law of sines to find missing sides and angles of a triangle, including the ambiguous case.
CLE 3103.4.5 Use trigonometric concepts, properties and graphs to solve problems.

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<tbody>
<tr>
<td></td>
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<td></td>
<td>SPI 3103.4.1 Exhibit knowledge of unit circle trigonometry.</td>
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<tr>
<td></td>
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<td></td>
<td>✓ 3103.4.1 Convert between radians and degrees and vice versa.</td>
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<tr>
<td></td>
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<td></td>
<td>✓ 3103.4.3 Extend the trigonometric functions to periodic functions on the real line by defining them as functions on the unit circle.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>SPI 3103.4.2 Match graphs of basic trigonometric functions with their equations.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>✓ 3103.4.2 Determine the period and the amplitude of a periodic function.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>✓ 3103.4.5 Determine the domain and range of the six trigonometric functions given a graph.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>SPI 3103.4.3 Describe and articulate the characteristics and parameters of parent trigonometric functions to solve contextual problems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ 3103.4.4 Understand the</td>
</tr>
</tbody>
</table>

**Predict the graphical transformation that occurs when coefficients and/or constants of given function are changed (no trigonometric or logarithmic functions).**
|------------------------------------------|-----------------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| Describe the transformation that has changed a “parent function” to the given related function (e.g., right shift of 3 units, reflection in the x-axis). | SPI 3102.4.1 Develop and apply strategies to estimate the area of any shape on a plane grid.  
✓3102.4.1 Using algebraic expressions solve for measures in geometric figures as well as for perimeter, area, and volume. | SPI 3102.4.2 Solve contextual problems using the Pythagorean Theorem.  
✓3102.4.2 Use the Pythagorean Theorem to find the missing measure in a right triangle including those from real-world situations. | relationship between the radius, the central angle, and radian measure.  
✓3103.4.6 Know and be able to use the fundamental trigonometric identities, including the Pythagorean identities, reciprocal identities, sum of sine and cosine, and odd and even identities. |
| SPI 3102.4.4 Convert rates and measurements.  
✓3102.4.5 Use dimensional analysis to convert rates and measurements both within a system and between systems and check the appropriateness of the solution. | SPI 3102.4.6 Select the area representation for a given product of two one-variable binomials.  
SPI 3102.4.7 Apply the given Pythagorean Theorem to a real life problem illustrated by a diagram (no radicals in answer). | SPI 3102.4.8 Apply proportion and the concepts of similar triangles to find the length of a missing side  
SPI 3102.4.9 Apply proportion and the concepts of similar triangles to solve real world problems. | |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>of a triangle.</td>
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</tbody>
</table>

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## Former Learning Expectations

5.1 Understand concept of randomness in sampling.
5.2 Apply appropriate technology in data collection and analysis.
5.3 Apply counting principles of permutations and combinations using appropriate technology.
5.4 Apply theoretical and experimental probability to analyze the likelihood of an event.
5.5 Collect, represent, and describe linear and nonlinear data sets developed from real world.
5.6 Make predictions from a data set using curve fitting with appropriate technology.
5.7 Make inferences about a data set using appropriate measures of central tendency and dispersion.
5.8 Describe and apply the normal distribution and its properties.
5.9 Identify mutually exclusive and non-mutually exclusive events.
5.10 Analyze the probability of dependent events and of independent events.

## New Course Level Expectations

CLE 3103.5.1 Describe, interpret, and apply quantitative data.
CLE 3103.5.2 Evaluate and critique various ways of collecting data and using information based on data published in the media.
CLE 3103.5.3 Use data and statistical thinking to draw inferences, make predictions, justify conclusions and identify and explain misleading uses of data.
CLE 3103.5.4 Develop an understanding of probability concepts in order to make informed decisions.

## Table: Former Standards vs. New Standards

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>▪ Determine the mean (average) of a given set of real-world data (no more than five two-digit numbers).</td>
<td>SPI 3102.5.2 Identify the effect on mean, median, mode, and range when values in the data set are changed.</td>
<td>▪ Determine the measures of central tendency for a given set of real-world data.</td>
<td>SPI 3103.5.1 Compute, compare and explain summary statistics for distributions of data including measures of center and spread.</td>
</tr>
<tr>
<td>▪ Determine the median for a given set of real-world data (even number of data).</td>
<td>✓ 3102.5.3 When a set of data is changed, identify effects on measures of central tendency, range, and inter-quartile range. ✓ 3102.5.4 Explore quartiles, deciles, and percentiles of a distribution.</td>
<td></td>
<td>✓ 3103.5.5 Calculate measures of central tendency and spread (variance and standard deviation).</td>
</tr>
<tr>
<td>▪ Choose the matching linear graph given a set of ordered pairs. ▪ Make a prediction from the graph of a real-world linear data set.</td>
<td>SPI 3102.5.3 Using a scatter-plot, determine if a linear relationship exists and describe the association between variables. SPI 3102.5.4 Generate the equation of a line that fits linear data and use it to make a prediction. ✓ 3102.5.8 Examine real-world graphical relationship (including scatter-plots) to determine type</td>
<td>▪ Choose the matching linear graph when given a set of ordered pairs representing real-world data.</td>
<td>SPI 3103.5.3 Analyze patterns in a scatter-plot and describe relationships in both linear and non-linear data. ✓ 3103.5.1 Collect, represent and describe both linear and non-linear data developed from contextual situations. ✓ 3103.5.2 Organize and display data using appropriate methods (including spreadsheets and technology tools) to detect</td>
</tr>
</tbody>
</table>

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of relationship (linear or nonlinear) and any association (positive, negative or none) between the variables of the data set.

- 3102.5.9 Determine an equation for a line that fits real-world linear data. Interpret the meaning of the slope and y-intercept in context of the data.
- 3102.5.10 Using technology with a set of contextual linear data to examine the line of best fit. Determine and interpret the correlation coefficient.
- 3102.5.11 Use an equation that fits data to make a prediction.

SPI 3103.5.4 Apply the characteristics of the normal distribution.
- 3103.5.8 Know the Empirical Rule for one, two and three standard deviations for a normal distribution.

SPI 3103.5.5 Determine differences between randomized experiments and observational studies.
- 3103.5.4 Understand the impact of various sampling methods and use them to draw valid conclusions.
- 3103.5.10 Design simple experiments to collect data to answer questions of interest.
- 3103.5.11 Evaluate published data by considering the source, the design of the study and the analysis and representation (or misrepresentation) of the data.
- 3103.5.12 Investigate bias and the phrasing of questions during data acquisition to formulate reasonable conclusions.
<table>
<thead>
<tr>
<th>Topic</th>
<th>SPI 3102.5.1 Interpret displays of data to answer questions about the data set(s) (e.g., identify pattern, trends, and/or outliers in a data set).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ 3102.5.1 Identify patterns or trends in data.</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.5.2 Develop a meaning for and identify outliers in a data set and verify.</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.5.5 Construct and interpret various forms of data representations, (including line graphs, bar graphs, circle graphs, histograms, scatter-plots, box-and-whiskers, stem-and-leaf, and frequency tables).</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.5.6 Draw qualitative graphs of functions and describe a general trend or shape.</td>
</tr>
<tr>
<td></td>
<td>✓ 3102.5.7 Compare two data sets using graphs and descriptive statistics.</td>
</tr>
<tr>
<td></td>
<td>Make a prediction from the graph of a real-world data set.</td>
</tr>
<tr>
<td></td>
<td>Find the equation for the line of best fit given a scatterplot depicting real-world data.</td>
</tr>
<tr>
<td></td>
<td>SPI 3103.5.6 Find the regression curve that best fits both linear and non-linear data (using technology such as a graphing calculator) and use it to make predictions.</td>
</tr>
<tr>
<td></td>
<td>✓ 3103.5.6 Use technology to find the appropriate regression equation for both linear and non-linear data.</td>
</tr>
<tr>
<td></td>
<td>SPI 3103.5.7 Determine and recognize when the correlation coefficient measures goodness of fit.</td>
</tr>
<tr>
<td></td>
<td>✓ 3103.5.7 Recognize when the correlation coefficient measures goodness of fit and does not imply causation.</td>
</tr>
<tr>
<td></td>
<td>SPI 3103.5.8 Apply probability concepts such as conditional probability and independent events to calculate simple probability.</td>
</tr>
<tr>
<td></td>
<td>✓ 3103.5.13 Apply both theoretical and experimental probability to analyze the likelihood of an event.</td>
</tr>
</tbody>
</table>

**Prepared through collaboration of Williamson County Mathematics Curriculum Specialists: Jackie Arthur (K-5) and Pat Tyree (6-12) and Franklin Special School District Curriculum Director Sharon Cooksey Spring 2008**
| 3102.5.13 | Determine the complement of an event and the probability of that complement. |
| 3102.5.15 | Explore joint and conditional probability. |
| 3102.5.14 | Determine if two events are independent or dependent. |
| 3102.5.16 | Identify situations for which the Law of Large Numbers applies. |
| 3102.5.17 | Perform simulations to estimate probabilities. |
| 3102.5.18 | Make informed decisions about practical situations using probability concepts. |
APPENDIX F
VOCABULARY IN FOCUS
Tennessee Academic Vocabulary

This vocabulary section is designed to help systematically enhance the academic vocabulary of students to better prepare them to learn new content in mathematics. The research and theory underlying the recommendations made here have been detailed in the book *Building Background Knowledge for Academic Achievement* (Marzano, 2004). The logic of such an endeavor is that the more general background knowledge a student has about academic content addressed in a given class or course, the easier it is for the student to understand and learn.

The bar on the left side of the graph shows a student at the 50th percentile in terms of ability to comprehend the subject matter taught in school with no direct vocabulary instruction. The bar on the right side shows the comprehension level of the same student after vocabulary terms have been taught in a specific way. The dramatic increase to 83% provides a strong argument for teaching academic vocabulary.

Due to a variety of factors, there is typically great disparity in the academic background knowledge of students. This disparity increases as students progress through the school years. However, if all students were exposed to specific academic terms across the grade levels, a strong common foundation for all students would be formed. To this end, this section lists important academic terms in mathematics. The words listed in this document are not all inclusive, but are suggested as a starting point in building the academic vocabulary for a given grade or course.

To demonstrate the potential power of addressing common terms and phrases, there are approximately 300 terms listed for grades K – 8. If every teacher were to teach these terms, students would enter ninth grade with common, in depth experiences with these key mathematics terms. Certainly this would provide a strong base on which ninth grade mathematics teachers could build.

A five-step process
There is no single best way to teach terms and phrases. However, research and theory on vocabulary development point to a few generalizations that provide strong guidance.

1. **Initially Provide Students with a Description, Explanation, or Example as Opposed to a Formal Definition**
   When introducing a new term or phrase it is useful to avoid a formal definition at the start. Formal definitions are typically not very “learner friendly.” They make sense after there is a general understanding of a term. Provide students with a description, explanation, or example. Ask students what they already know to avoid misconceptions.
2. **Have Students Generate Their Own Descriptions, Explanations, or Examples**

   After students are then exposed to the correct definition, one that is well-written, mathematically accurate and grade appropriate in its sophistication, students should be asked to restate that information in their own words. It is important that students do not copy exactly what the teacher has offered. However, the correct definition forms a foundation on which students build understanding and check the accuracy of their own explanations. Student descriptions, explanations and examples should be their own constructions using their own background knowledge and experiences to forge linkages between the new term or phrase and what they already know.

3. **Have Students Represent Each Term or Phrase Using a Graphic Representation, Picture, or Pictograph**

   Once students have generated their own description, explanation, or example they should be asked to represent the term or phrase in some graphic, picture, or pictographic form. This allows them a different, nonlinguistic way to process the information. It also provides a second processing of the information which should help deepen students’ understanding of the new term or phrase.

4. **Have Students Keep an Academic Vocabulary Notebook**

   Over time students will develop an understanding of a set of terms and phrases that are important to the academic content in mathematics. This implies that the terms and phrases that are taught using this approach represent a related set of knowledge that expands and deepens from year to year.

   To facilitate this cumulative effect it is highly advisable for students to keep an “academic vocabulary” notebook that contains the terms and phrases that have been taught. Enough space should be provided for students to record their initial descriptions, explanations, and examples of the terms and phrases as well as their graphic representations, pictures, and pictographs.

   Students should be engaged in activities that allow them to review the terms in their academic vocabulary notebooks and add to their knowledge base.

5. **Periodically Review the Terms and Phrases and Provide Students with Activities That Add to Their Knowledge Base**

   If students experience a new term or phrase only once, they will be left with their initial, partial understanding of the term or phrase. To develop deep understanding of the terms, students must be engaged in review activities. Offer students activities that add to their knowledge base about the terms in their notebooks. For example, they might make comparisons between selected terms; they might create analogies or metaphors for selected terms; they might simply compare their entries with those of other students. Finally, they might be engaged in games that use the terms from their academic vocabulary notebooks.

   After each of these activities students should be asked to make corrections, additions, and changes to the entries in their notebooks. In this way, students’ knowledge of the academic terms and phrases deepen and become a sound foundation on which to build the academic content presented in class.
<table>
<thead>
<tr>
<th>Kindergarten</th>
</tr>
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<tbody>
<tr>
<td><strong>Above:</strong> A location directly overhead or on top of.</td>
</tr>
<tr>
<td><strong>Below:</strong> Beneath or lower than something else</td>
</tr>
<tr>
<td>The circle is above the square</td>
</tr>
<tr>
<td>The square is below the circle</td>
</tr>
<tr>
<td><strong>Break Apart/Take Away:</strong> To remove, to subtract.</td>
</tr>
<tr>
<td>3 – 1 = 2</td>
</tr>
<tr>
<td><strong>Cardinal Number:</strong> A number used to name how many.</td>
</tr>
<tr>
<td>How many coins are there? There are 5 coins. Five is a cardinal number.</td>
</tr>
<tr>
<td><strong>Calendar:</strong> A chart showing the days, weeks and months of the year.</td>
</tr>
<tr>
<td><strong>Circle:</strong> A set of points, (in a plane), which are all the same distance from the center point. This distance is called the radius of the circle.</td>
</tr>
<tr>
<td><strong>Coin:</strong> A round circular flat piece of metal used as money.</td>
</tr>
<tr>
<td>Coins: Penny, nickel, dime, quarter</td>
</tr>
<tr>
<td><strong>Cone:</strong> A three-dimensional shape that has a circular base, a curved surface and one vertex (called an apex).</td>
</tr>
<tr>
<td><strong>Cube:</strong> A closed, three-dimensional figure whose six surfaces, or faces, are all squares. A cube has eight vertices and twelve edges. Six-sided number cubes are shaped like cubes.</td>
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<tr>
<td><img src="image1" alt="Cube" /> <img src="image2" alt="Cube" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Cylinder:</strong> A three-dimensional shape that has two parallel circular bases that are the same size and are connected by a curved surface. A can is shaped like a cylinder.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Cylinder" /> <img src="image4" alt="Cylinder" /></td>
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<thead>
<tr>
<th><strong>Day/Date:</strong> A phrase or number that denotes a particular day of the month.</th>
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<tr>
<td><img src="image5" alt="Day/Date" /></td>
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<thead>
<tr>
<th><strong>Graph:</strong> A diagram used to display data. A graph can show the relationship between two quantities.</th>
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<tr>
<td><img src="image6" alt="Graph" /></td>
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<thead>
<tr>
<th><strong>Hexagon:</strong> A shape or figure with six sides.</th>
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<tbody>
<tr>
<td><img src="image7" alt="Hexagon" /> <img src="image8" alt="Hexagon" /></td>
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<table>
<thead>
<tr>
<th><strong>Hour:</strong> A day is divided into 24 equal parts; an hour is 60 minutes or 3600 seconds; 12 hours are shown on a clock.</th>
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<tr>
<td><img src="image9" alt="Hour" /></td>
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<thead>
<tr>
<th><strong>Inside:</strong> The interior part of something, the place or part within.</th>
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<tbody>
<tr>
<td><img src="image10" alt="Inside" /></td>
</tr>
<tr>
<td><strong>Left</strong>: The opposite of right; west when facing north.</td>
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<td>---</td>
</tr>
<tr>
<td><strong>Less Than/ More Than/ Same</strong>: Comparative words used to indicate a smaller amount, a larger amount or an equal amount.</td>
</tr>
<tr>
<td>Less than</td>
</tr>
<tr>
<td><strong>Longer/ Shorter; Heavier/ Lighter; Colder/ Warmer</strong>: Comparative words for length, weight and temperature.</td>
</tr>
<tr>
<td>shorter</td>
</tr>
<tr>
<td><strong>Minus</strong>: Made less by the subtraction of a number or removal of members of a set.</td>
</tr>
<tr>
<td><strong>Number</strong>: A quantity, an amount, how many in a set, a quantity that can be expressed by a numeral.</td>
</tr>
<tr>
<td><strong>Numeral</strong>: A symbol used to represent a number.</td>
</tr>
<tr>
<td><strong>Outside</strong>: The exterior part of something, the part beyond the borders.</td>
</tr>
<tr>
<td><strong>Pattern</strong>: A repeated design, a repeated cycle of elements. Recognizing patterns can help in making predictions.</td>
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</tr>
<tr>
<td><strong>Position</strong>: The location of somebody or something in relation to other things.</td>
</tr>
<tr>
<td><strong>Put Together/ Count On</strong>: To add by joining more to a set; putting two or more sets together, continuing to the positive direction (right) when counting on the number line.</td>
</tr>
<tr>
<td><strong>Rectangle</strong>: A shape with four sides and four right angles; a square is a special rectangle with its four sides having the same length.</td>
</tr>
<tr>
<td><strong>Right</strong>: The opposite of left; east when facing north.</td>
</tr>
<tr>
<td><strong>Shape</strong>: A geometric form of an object, a figure or two-dimensional object.</td>
</tr>
<tr>
<td><strong>Sort</strong>: To put into groups with things having shared attributes; for example, sorting by shape, size and color</td>
</tr>
<tr>
<td><strong>Sphere</strong>: Circular 3-dimensional shape. All points on a sphere are the same distance from its center.</td>
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</tr>
<tr>
<td><img src="image" alt="sphere" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Square</strong>: A rectangle with its four sides all having the same length.</th>
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<tbody>
<tr>
<td><img src="image" alt="square" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Tally</strong>: Marks that show how many times an item appears in a set.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="tally" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Temperature</strong>: A measure of how cold or hot something is.</th>
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</thead>
<tbody>
<tr>
<td><img src="image" alt="temperature" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Thermometer</strong>: An instrument for measuring temperature.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="thermometer" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Trapezoid</strong>: A four-sided figure with exactly one pair of parallel sides.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="trapezoid" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Triangle</strong>: A closed plane figure that has 3 sides and 3 angles.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="triangle" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Under</strong>: Beneath or below something, directly below or underneath something</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="under" /></td>
</tr>
</tbody>
</table>

<p>| The books are under the apple. |</p>
<table>
<thead>
<tr>
<th><strong>Value:</strong></th>
<th>How much a coin is worth.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1¢ is the value of the penny.</td>
</tr>
<tr>
<td><strong>Whole Numbers:</strong></td>
<td>The numbers $0, 1, 2, 3, \ldots$ There is no largest whole number.</td>
</tr>
<tr>
<td></td>
<td>The smallest whole number is zero.</td>
</tr>
<tr>
<td><strong>Zero:</strong></td>
<td>A number indicating that there is no amount; it is also used as a place holder</td>
</tr>
<tr>
<td></td>
<td>The zero in 20 means that there are 2 tens and no ones. Four minus four is zero. $(4 - 4 = 0)$</td>
</tr>
</tbody>
</table>
### First Grade

**Addition:** Combining two or more numbers to find a total.

![Addition Diagram](image)

\[ 3 + 1 = 4 \]

**Arithmetic:** The basic math that we do in everyday life involving addition, subtraction, multiplication and/or division. (the arithmetic operations are \(+,-,\times,\div\).)

<table>
<thead>
<tr>
<th>Arithmetic problems:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 + 5 = 9</td>
</tr>
<tr>
<td>15 ÷ 5 = 3</td>
</tr>
<tr>
<td>5 – 2 = 3</td>
</tr>
<tr>
<td>2 \times 3 = 6</td>
</tr>
</tbody>
</table>

**Backward/forward:** Directional words indicating the way one is facing (forward) or the opposite direction which one is facing (backward).

- The children are running [forward](image).
- The woman is bending [backward](image).

**Between:** An intermediate point between two places.

[Between Diagram](image)

- The square is between the two circles.

**Chart (100s):** A chart displaying the numbers from one to one hundred. It can be used to find patterns, skip count, add, subtract etc.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
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<td>20</td>
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<td>36</td>
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<td></td>
<td>41</td>
<td>42</td>
<td>43</td>
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<td>46</td>
<td>47</td>
<td>48</td>
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<td>50</td>
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<tr>
<td></td>
<td>51</td>
<td>52</td>
<td>53</td>
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<td>61</td>
<td>62</td>
<td>63</td>
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<td>66</td>
<td>67</td>
<td>68</td>
<td>69</td>
<td>70</td>
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<tr>
<td></td>
<td>71</td>
<td>72</td>
<td>73</td>
<td>74</td>
<td>75</td>
<td>76</td>
<td>77</td>
<td>78</td>
<td>79</td>
<td>80</td>
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<tr>
<td></td>
<td>81</td>
<td>82</td>
<td>83</td>
<td>84</td>
<td>85</td>
<td>86</td>
<td>87</td>
<td>88</td>
<td>89</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>91</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>95</td>
<td>96</td>
<td>97</td>
<td>98</td>
<td>99</td>
<td>100</td>
</tr>
</tbody>
</table>

Use the hundred’s chart to skip count by fives.
**Commutative law:** The order in which two numbers are added is not important. (However, order matters, it is important for subtraction; so subtraction is not commutative.)

<table>
<thead>
<tr>
<th>2 + 1 = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>red + red + blue = 3</td>
</tr>
<tr>
<td>blue + red + red = 3</td>
</tr>
<tr>
<td>1 + 2 = 3</td>
</tr>
</tbody>
</table>

**Compose/decompose:** Put together/take apart.

- The hexagon is composed of six triangles.
- The trapezoid can be decomposed into a triangle and a rectangle.

**Counting On/Counting Back:** A strategy used in solving an addition or subtraction problem.

To solve $6 + 3$ using the counting on strategy, a student will say “6” and then count on 3 more by saying “7, 8, 9.”

**Cube:** A 3-dimensional figure with six square faces.

**Data:** Information that is gathered by counting, measuring, asking questions or observing.

**Digit:** One of the number symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9.

The numeral 96 has two digits.

**Estimate/guess (measurement):** An answer that is close to an exact answer.

Because Emily’s book was 9 paper clips long, she estimated that it was about 9 inches long.
<table>
<thead>
<tr>
<th><strong>Even/odd</strong></th>
<th>An even number is a number that is evenly divisible by 2; any number that can be shared equally among two groups; an odd number of items cannot be shared equally among two groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2, 10, and 24 are examples of <strong>even</strong> numbers. 5, 9, and 17 are examples of <strong>odd</strong> numbers.</td>
</tr>
<tr>
<td><strong>Face (in relation to 3-d figure)</strong></td>
<td>A flat surface (a side) on a 3-dimensional shape.</td>
</tr>
<tr>
<td></td>
<td>A cube has six <strong>faces</strong>. Each one is a square.</td>
</tr>
<tr>
<td><strong>Facts</strong></td>
<td>The basic addition and subtraction sentences with sums up to 20.</td>
</tr>
<tr>
<td></td>
<td>Fact Family: (3 + 4 = 7, \ 4 + 3 = 7, \ 7 - 3 = 4, \ 7 - 4 = 3)</td>
</tr>
<tr>
<td><strong>Fraction (parts/whole)</strong></td>
<td>A number that names parts of a whole or a group.</td>
</tr>
<tr>
<td></td>
<td>In the fraction (\frac{1}{4}): 1 is the part and 4 is the whole.</td>
</tr>
<tr>
<td><strong>Greater than</strong></td>
<td>Describes the bigger number or quantity</td>
</tr>
<tr>
<td></td>
<td>8 is <strong>greater than</strong> 5, (8 &gt; 5)</td>
</tr>
<tr>
<td><strong>Grouping</strong></td>
<td>Arranging objects or numbers in clusters so that they are easier to count, add, or subtract. Grouping by twos, fives or tens is often useful.</td>
</tr>
</tbody>
</table>
|  | \[\begin{array}{ccc}
1 & 1 & 6 \\
2 & 1 & 7 \\
3 & 1 & 8 \\
4 & 1 & 9 \\
5 & \ & 10 \\
\end{array}\] |
<p>| <strong>Half-hour</strong> | Describes the two equal parts of the hour created when starting at zero minutes and counting thirty minute increments, such as 2:00 and 2:30. |
|  | Eleven-thirty is sometimes called “half past eleven.” |
| <strong>Inch</strong> | A basic unit of length in the US measurement system. |
|  | One inch is about (2\frac{1}{2}) centimeters. |
| <strong>Length</strong> | The distance from end to end. |
|  | The length of this ruler is 6 inches. |</p>
<table>
<thead>
<tr>
<th><strong>Less than:</strong></th>
<th>Describes the smaller number or quantity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 is <strong>less than</strong> 8; 5 &lt; 8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Measure:</strong></th>
<th>To find a number that shows the size or amount of something.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Ruler" /></td>
<td>The ruler is used to measure the blue segment which is about 3 inches long.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Minute:</strong></th>
<th>A period of 60 seconds; there are 60 minutes in one hour.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Clock" /></td>
<td>The minute hand is longer than the hour hand on a clock. This clock shows a time of 5 minutes after 5 o’clock.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Number Line:</strong></th>
<th>A line which shows numbers placed in their correct position; it can be used to show relationships between numbers.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Number Line" /></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Number Sentence:</strong></th>
<th>A numerical statement using mathematical symbols; an arrangement of numbers and symbols to show an addition or subtraction fact.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 + 4 = 10</td>
<td><strong>6 + 4 = 10</strong> is a number sentence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Place value:</strong></th>
<th>The value of a digit according to its position in a number.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Place Value" /></td>
<td>In the numeral <strong>25</strong>, the place value of the “2” is 2 tens or twenty and the place value of the “5” is 5 ones.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Pound:</strong></th>
<th>A unit used to measure weight in the US system.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Pound" /></td>
<td>This man is standing on the scale to see how many pounds he weighs. He weighs about 200 pounds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Quarter-hour:</strong></th>
<th>Describes the four equal parts of the hour created when starting at zero minutes and counting fifteen minute increments, such as 2:00, 2:15, 2:30 and 2:45.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Quarter-hour" /></td>
<td><strong>10:15</strong> The clock shows it is a quarter after ten o’clock.</td>
</tr>
</tbody>
</table>
**Rule**: A description or formula which results in the continuation of a picture or number pattern.

<table>
<thead>
<tr>
<th>Rule</th>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

**Sequence**: Numbers or objects arranged in a particular order.

2, 4, 6, 8, 10, 12 is a sequence of (even) numbers.

**Solve**: To find the answer to a question or puzzle.

Solve the equation: \(2 + \square = 5\)

**Standard/ Non-Standard unit**: Standard units are widely accepted units of measurement such as the US system or Metric system. Non-standard units are measurements made using common objects such as paper clips, hand span etc.

Using a tape measure to find the length of a shelf in inches is an example of using a **standard** unit of measure.

**Subtraction**: Taking one number away from another. A mathematical operation that finds the difference between two numbers or quantities.

\[5 - 2 = 3\]

**Sum**: The total resulting when two or more numbers are added; the answer in an addition problem.

\[7 + 3 = 10\] 10 is the sum of 7 and 3

**Symbol**: A picture or image used to represent something.

\[\text{+ means to add}\]

**Temperature**: How hot or cold an object is.

The **temperature** outside is about 30 degrees.
<table>
<thead>
<tr>
<th><strong>Attribute</strong></th>
<th>A distinctive characteristic of something such as its color, shape or size.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base-Ten</strong></td>
<td>A numbering system which uses the ten digits 0-9 and place values of ones, tens, hundreds, thousands etc. to represent numbers.</td>
</tr>
<tr>
<td><strong>Centimeter</strong></td>
<td>A metric unit of measure, equal to one hundredth of a meter. (abbreviation: cm)</td>
</tr>
<tr>
<td><strong>Commutative/ Associative property</strong></td>
<td>The commutative property states that changing the order of the numbers being added or multiplied does not change the answer. The associative property states that the grouping of the numbers being added or multiplied does not change the answer.</td>
</tr>
<tr>
<td><strong>Diagonal</strong></td>
<td>A segment joining two non-consecutive vertices (vertices is the plural of vertex, the point where two sides meet) of a shape.</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>The answer in a subtraction problem.</td>
</tr>
<tr>
<td><strong>Elapsed time</strong></td>
<td>The amount of time that has passed from one starting time to an ending time.</td>
</tr>
<tr>
<td><strong>Fahrenheit/ Celsius</strong></td>
<td>Measurement scales for temperature.</td>
</tr>
</tbody>
</table>

One of the attributes of the two figures is that they have four sides.

Numerals used in base ten:

\[(0,1,2,3,4,5,6,7,8,9)\]

In base ten: \[345 = 3(100) + 4(10) + 5\]

One inch is about \(2 \frac{1}{2}\) cm.

A triangle has no diagonals. A square has two diagonals.

5 is the difference between 8 and 3.

From 12:30 AM to 2:30 AM

2 hours have elapsed

Fahrenheit: water freezes at 32°F and boils at 212°F.

Celsius: water freezes at 0°F and boils at 100°F.
Foot (measurement): A unit of length equal to 12 inches. There are three feet in a yard. A ruler is usually 12 inches long which is one foot. This ruler is 6 inches long or one half foot.

![Ruler Image]

It is measuring a segment that is 3 inches long.

<table>
<thead>
<tr>
<th>Fraction: A number that names part of a whole or a group. A fraction expresses the ratio between two numbers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ruler is usually 12 inches long which is one foot. This ruler is 6 inches long or one half foot.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Geometric Shapes/Figures: Objects made from points, segments and curves such as triangles, squares and circles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>These are geometric shapes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Halves/ thirds/ fourths: Halves is the name given to the equal pieces created when cutting a whole into two parts; thirds is the name given to the equal pieces created when cutting a whole into three parts; fourths is the name given to the equal pieces when cutting a whole into four parts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A hexagon divided into halves  A hexagon divided into thirds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length: the distance between two points. (how far apart from end to end).</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you measure the lengths of the diagonals of a rectangle you will find out that they have the same lengths.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Likely/ Unlikely Likely describes an event that will probably happen; unlikely describes an event that probably will not happen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events that are likely have a probability closer to one. Events that are unlikely have a probability closer to zero.</td>
</tr>
</tbody>
</table>

If you roll a six sided number cube (1-6), it is likely that you will roll a number greater than one. It is unlikely that you will roll a seven.
<table>
<thead>
<tr>
<th><strong>Meter/ yard</strong></th>
<th>a meter is a metric unit for measuring length and a yard is a customary unit for measuring length.</th>
<th>3 feet = 1 yard : a meter is a little more than a yard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>A picture or diagram used to illustrate a mathematical concept.</td>
<td><img src="image" alt="Model Example" /></td>
</tr>
<tr>
<td><strong>This model shows that</strong></td>
<td><img src="image" alt="Fraction Comparison" /></td>
<td>$\frac{1}{5} &lt; \frac{1}{4}$</td>
</tr>
<tr>
<td><strong>Multiplication</strong></td>
<td>Repeated addition on the same number to find a total.</td>
<td><img src="image" alt="Multiplication Example" /></td>
</tr>
<tr>
<td><strong>Numeric pattern</strong></td>
<td>A sequence of numbers that follow a rule.</td>
<td>2, 4, 6, 8,.....</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>One of the possible results in a probability experiment; the set of all possible outcomes is the sample space.</td>
<td>The four possible outcomes from flipping two coins are: HH, HT, TH, TT. The possible outcomes from rolling a 6-sided number cube are 1, 2, 3, 4, 5 or 6.</td>
</tr>
<tr>
<td><strong>Polygon (composition, decomposition)</strong></td>
<td>A polygon is a 2-dimensional closed figure made up of line segments called sides. <strong>Composition</strong>: adding polygons together to make a new figure; its parts are smaller polygons <strong>Decomposition</strong>: Breaking a polygon into its parts (the figures that combine to make it).</td>
<td><img src="image" alt="Polygon Composition" /> The trapezoid can be decomposed into a triangle and a rectangle.</td>
</tr>
<tr>
<td><strong>Pound/ Kilogram</strong></td>
<td>The pound is the basic unit of weight in the US system of measurement, equal to about .45 kilograms, the kilogram is the basic unit of weight in the metric (SI) system.</td>
<td>1 kg = 2.205 pounds (approximately) 1 lb = 0.45 kg (approximately)</td>
</tr>
<tr>
<td><strong>Predict</strong></td>
<td>To make a guess based on data collected or past experience.</td>
<td>After measuring the opposite sides of a number of rectangles, students predict that the opposite sides of any rectangle are congruent.</td>
</tr>
<tr>
<td><strong>Quantitative Change</strong></td>
<td>changing the amount or number (quantity) of something.</td>
<td>The student grew two inches during the school year. This is a quantitative change.</td>
</tr>
</tbody>
</table>
**Regroup/ Rename**: to say or write a number in a different way.

| 24 is 2 tens and 4 ones  | 24 is 1 ten and 14 ones |

**Set**: A collection of objects or numbers.

| The set of whole numbers is {0, 1, 2, 3, …}, |

**Skip Counting**: Counting by a number other than one; a method for finding multiples and counting items more quickly.

| Skip count by fives: 5, 10, 15, 20 … |

**Symmetry**: Having two matching halves after being folded along a line of symmetry.


**Table**: An arrangement of information or data into columns and rows.

| Examples of tables: |

<table>
<thead>
<tr>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>0</td>
</tr>
<tr>
<td>70</td>
<td>21</td>
</tr>
<tr>
<td>77</td>
<td>28</td>
</tr>
<tr>
<td>93</td>
<td>44</td>
</tr>
</tbody>
</table>

**Time Interval**: A period of time between events.

| The time from 2:00 to 3:00 in 20 minute intervals would be: 2:00, 2:20, 2:40, and 3:00 |

**Transform** (reflect, rotate, translate): Something done to a geometric figure across a line of symmetry that produces a new geometric figure. Reflections, translations, and rotations are commonly described as flips, slides, and turns.

| A rotation of 180 degrees about point P (a turn) |
| A translation (a slide) |
| A reflection over the vertical line (a flip) |

**Unknown/ Missing Term**: The “hidden” (or missing) number that will make a number sentence true.

| 3 + ? = 11 ; the missing term is 8 |
| □ + 2 = 5 ; the missing term is 3 |

**Value**: How much a number is worth according to its place (position) in a number.

| 20 = 2 tens |
| The 5 in the number 52 has a value of 5 tens or 50. |
### Third Grade

<table>
<thead>
<tr>
<th><strong>Area:</strong>  The number of non-overlapping units that cover a closed boundary (measured in square units).</th>
<th>The area of this square is 9 square units.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Array:</strong>  An arrangement of objects in a regular pattern, usually rows and columns. Arrays are commonly used to model multiplication.</td>
<td>This array has 2 rows and 5 columns. So, $2 \times 5 = 10$.</td>
</tr>
<tr>
<td><strong>Benchmark Fraction:</strong>  A fraction which is easily recognizable and can be used to estimate the size of other fractions or to compare other fractions. (ie, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$)</td>
<td>$\frac{2}{7}$ is close in size to $\frac{1}{4}$.</td>
</tr>
<tr>
<td><strong>Capacity:</strong>  The amount of liquid or dry matter that a container can hold.</td>
<td>The gas container has a capacity of 5 gallons.</td>
</tr>
<tr>
<td><strong>Common Equivalencies:</strong>  Units within measurement systems that are equal and can be substituted for each other. (For example, 4 quarts equal 1 gallon, 100 centimeters equal 1 meter, 16 ounces equal 1 pound)</td>
<td></td>
</tr>
</tbody>
</table>
| **Commutative Property:**  A property of addition and multiplication (but not of subtraction and division) that says that changing the order of the numbers being added or multiplied does not change the answer. | $3 + 6 = 6 + 3$  
$8 \times 2 = 2 \times 8$  
$3 - 6 \neq 6 - 3$  
$8 \div 2 \neq 2 \div 8$ |
<p>| <strong>Conclusion:</strong>  A sensible decision reached after looking at many facts. | After looking at the pattern 3, 8, 13, 18, 23,…. , the conclusion was made that the next number is 28 based on the observation that 5 was being added each time. |</p>
<table>
<thead>
<tr>
<th><strong>Congruent Figures</strong>: Figures that have exactly the same shape and size.</th>
<th><strong>Congruent Pentagons</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>These pentagons are the same size and the same shape. One will fit exactly over the other.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Conjecture</strong>: A guess about an outcome before all the facts are known.</th>
<th>After looking at many examples, students made the conjecture that order doesn’t matter when adding, but is important when subtracting.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Data</strong>: Information that is gathered by counting, measuring, asking questions, or observing. A collection of facts from which conclusions may be drawn.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Decimal</strong>: A number that uses place value and a decimal point to show tenths and hundredths.</th>
<th>The decimal 0.3 is read as three-tenths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Denominator</strong>: The number below the bar in a fraction that tells the number of equal parts in the whole.</th>
<th>In the fraction ( \frac{3}{4} ), the numerator is 3, the denominator is 4. This fraction tells you that you have 3 out of four parts.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Numerator</strong>: The number above the bar in a fraction which represents the number of equal parts being considered.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Distributive property</strong>: A property that relates multiplication and addition or subtraction. This property gets its name because it “distributes” a factor over terms inside parentheses.</th>
<th>( 3 \times (4 + 2) = (3 \times 4) + (3 \times 2) )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Division</strong>: The process of determining how many equal groups can be made from a quantity. Division is the inverse of multiplication.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Elapsed time</strong>: The amount of time taken to go from a start time to a finish time.</th>
<th>The soccer game started at 5:30 P.M. The game was over at 6:15 P.M. The elapsed time was 45 minutes. It took a total of 45 minutes to play the game.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Equation</strong>: A number sentence that contains an equal sign.</th>
<th>( 7 + x = 10 ) and ( 25 = 29 - \square ) are both equations.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Equivalent Fractions:** Fractions that have different denominators but name the same amount.

\[
\frac{2}{4} = \frac{1}{2}
\]

**Estimation:** An answer that should be close to an exact answer.

53 + 38 can be estimated as 50 + 40 = 90

**Expanded Form:** A numeral showing the sum of values of each digit.

**Standard Form** A numeral shown as the sum of its place value addends is standard form.

\[
50,000 + 3,000 + 200 + 5 = 53,205
\]

(expanded form) (standard form)

**Factor:** Any of the numbers that are multiplied to find a product.

\[5 \times 3 = 15\]

5 and 3 are factors and 15 is the product.

**Frequency Table:** Data which shows the amount of times that a number occurs.

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>TALLY</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 1 1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>1 1 1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>1 1 1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1 1 1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1 1 1</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>1 1 1</td>
<td>3</td>
</tr>
</tbody>
</table>

**Graph (using different types):** A picture representation of data such as bar graphs, line plots, pictographs and frequency tables.

Find the next number in the pattern and justify the answer: 98, 87, 76, 65, …

The next number is 54 because you subtract 11 each time to get the next number.

**Justify:** To demonstrate that a statement is correct or valid. To give a reason to support an answer.

**Line of Symmetry:** A line drawn through a figure that divides the figure into two parts that are mirror images of each other. When you fold a figure along its line of symmetry, both parts match.
**Line Plot:** A sketch of data in which check marks, Xs, or other marks above a labeled line show the frequency of each value.

<table>
<thead>
<tr>
<th>Number</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Pets</th>
</tr>
</thead>
</table>

**Measurement:** A number used to describe the quantity, dimension, weight, or capacity of an object.

The measurements of the room were 10 ft by 12 ft, so the area was 120 square feet.

**Metric system:** A measurement system based on the base-ten numeration system.

- 10 millimeters = 1 centimeter
- 100 centimeters = 1 meter
- 1000 milliliters = 1 liter

**Multiple:** A number is a multiple of a given number if it is evenly divisible by that number. If you skip count by fours from 0, you name multiples of 4.

- 0, 3, 6, 9, and 12 are multiples of 3.
- 0, 25, 50, 75, and 100 are multiples of 25.

**Number Sentence:** A complete numerical statement using mathematical symbols demonstrating an equality or an inequality.

- 12 = 9 + 3 and 15 + 30 + 50 < 100 are number sentences.

**Ounce/ Gram:** Units used to measure weight.

Small weights are measured in ounces or milligrams and heavier weights are measured in pounds or grams.

**Parallel/ Perpendicular/ Intersecting Lines:** Parallel lines are always the same distance apart, and never meet or cross. Perpendicular lines meet at right angles. Intersecting lines meet or cross one another.

**Perimeter:** The distance around a closed 2-dimensional shape.

The perimeter of the triangle is 12 units.
**Pictograph:** A graph that uses pictures or symbols to represent numbers.

<table>
<thead>
<tr>
<th>Dogs at the Park</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Dog</strong></td>
</tr>
<tr>
<td>Beagle</td>
</tr>
<tr>
<td>Collie</td>
</tr>
<tr>
<td>Poodle</td>
</tr>
<tr>
<td>Dalmatian</td>
</tr>
</tbody>
</table>

**Key**
- represents 1 dog

**Place value:** A system for writing numbers in which the value of a digit depends on its place in the number.

The 5 in the number 25,692 has a place value of 5 thousand.

**Plane/ Solid Figures:** Plane figures are two-dimensional shapes such as rectangles, squares and circles. Solids are three-dimensional shapes such as prisms, pyramids and spheres.

<table>
<thead>
<tr>
<th>Plane figures</th>
<th>Solid shapes</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Plane Fig 1]</td>
<td>![Solid Fig 1]</td>
</tr>
<tr>
<td>![Plane Fig 2]</td>
<td>![Solid Fig 2]</td>
</tr>
</tbody>
</table>

**Probability (conceptual):** The possibility that an event will happen.

Terms used to describe probability are likely, unlikely, certain, possible or impossible.

**Properties:** Basic characteristics.

Three properties of squares are that they have four sides, are equilateral and have four right angles.

**Survey:** A gathering of a sample of data. A method of gathering information by questioning people in a poll.

Chris took a survey to find the favorite lunch of students in the cafeteria.

<table>
<thead>
<tr>
<th>3rd Grade Students’ Favorite Lunch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburger</td>
</tr>
<tr>
<td>Taco</td>
</tr>
<tr>
<td>Hot dog</td>
</tr>
<tr>
<td>Pizza</td>
</tr>
</tbody>
</table>

**Three-Dimensional:** Solid objects that have length, width, and height and take up space. They have surface area and volume.

**Two-Dimensional figures:** Flat shapes that have only two dimensions, length and width (plane figures). They have area, but do not have volume.

**Unit Fraction:** A fraction that has a numerator of one.

\[
\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9}, \frac{1}{10}
\]

are unit fractions
**Fourth Grade**

<table>
<thead>
<tr>
<th><strong>Acute angle:</strong> An angle whose measure is greater than zero degrees but less than 90 degrees.</th>
<th>$\angle$ CAB, $\angle$ BAD and $\angle$ CAD are all acute angles.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Algorithm:</strong> A set of step-by-step instructions for carrying out a computation or solving a problem.</td>
<td>Partial sums and column addition are both algorithms used to solve addition problems.</td>
</tr>
<tr>
<td><strong>Angle:</strong> A figure formed by two rays with a common endpoint called its vertex.</td>
<td></td>
</tr>
</tbody>
</table>
| **Associative Property:** A property of addition and multiplication (but not of subtraction or division) that states that the sum or product of three numbers does not depend on the way the numbers are grouped. | Associative Property of Addition $(5 + 9) + 11 = 5 + (9 + 11)$  
Associative Property of Multiplication $2 \times (5 \times 8) = (2 \times 5) \times 8$ |
| **Attributes:** Characteristics of an object. | The square and rectangle share the attributes of color and number of sides. |
| **Capacity:** The amount a container can hold or the heaviest weight a scale can measure. | The gas container has a capacity of 5 gallons. |
| **Convert:** To change into another form. | 12 inches = 1 foot, $\frac{6}{8} = \frac{3}{4}$ |
| **Coordinate system:** A plane formed by two perpendicular axes (the horizontal $x$-axis and the vertical $y$-axis) which intersect at a point called the origin. An ordered pair is uniquely determined by its horizontal and vertical distance from the origin. | |
**Degree:** A unit of measure for angles based on dividing a circle in 360 equal parts.

<table>
<thead>
<tr>
<th>0 degrees</th>
<th>45 degrees</th>
<th>90 degrees</th>
</tr>
</thead>
</table>

**Equivalent:** Equal in amount. Equivalent forms are different representations for the same number.

\[
\frac{1}{4} = \frac{1 \times 25}{4 \times 25} = \frac{25}{100}
\]

**Event:** An occurrence, something that happens.

Tossing a coin or rolling a die are common events in a probability activity.

**Function table:** A way of showing the relationship of numbers before and after a rule is applied.

<table>
<thead>
<tr>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>0</td>
</tr>
<tr>
<td>70</td>
<td>21</td>
</tr>
<tr>
<td>77</td>
<td>28</td>
</tr>
<tr>
<td>93</td>
<td>53</td>
</tr>
</tbody>
</table>

The rule for this function table is to subtract 49. The missing number is 44.

**Generalization (patterns):** Taking knowledge from one idea and extending to another.

To find the next number in the sequence 2, 3, 5, 7, 11, … make the generalization that the numbers are all prime and the next number would be 13.

**Hundredths:** The place value position two places after the decimal point. Its value is \( \frac{1}{100} \).

The number twenty-five hundredths is written as 0.25.

**Improper Fraction:** A fraction whose numerator is greater than or equal to its denominator. An improper fraction’s value is greater than or equal to one.

\( \frac{22}{8} \) is an improper fraction. It can also be written as \( 2 \frac{3}{4} \).

**Line:** A straight path that extends infinitely in opposite directions. It contains an infinite number of points.

**Median:** The middle value in a set of data when the data are listed in order from smallest to largest. If there is an even number of data points, the median is the mean of the two middle values.

<table>
<thead>
<tr>
<th>75</th>
<th>82</th>
<th>90</th>
</tr>
</thead>
</table>

To find the median of this set of data, first put the data in order: 75, 82, 90, 90. Since there is no middle number, find the mean of the two middle numbers 75 and 82 which is 78.5.
**Mixed number:** A number that is written using both a whole number and a fraction.  
\[
\frac{9}{10}
\]  
is a mixed number equivalent to \[
\frac{59}{10}
\].

**Mode:** The value or values that occur most often in a set of data.

<table>
<thead>
<tr>
<th>90</th>
<th>75</th>
<th>82</th>
<th>90</th>
<th>98</th>
</tr>
</thead>
</table>

The mode of the number set is 90 because 90 occurs the most often.

**Obtuse:** An angle whose measure is greater than 90 degrees but less than 180 degrees.

This 158° angle is obtuse.

**Outcome:** The result of an event.

When flipping a coin, one outcome of the event is “heads” and the other is “tails”.

**Over-estimate/ Under-Estimate:** A calculation that results in an estimate that is too high is an over-estimate. A calculation that results in an estimate that is too low is an under-estimate.

Lisa wants to buy a shirt that costs $9.95 and a sweater that costs $18.25. She has $13.20 that she has saved and $25.40 from baby-sitting. Does she have enough money?

You would underestimate the amount of money she has: $13 + $25 = $38

You would overestimate the cost of the items: $10 + $20 = $30

So, she has enough money.

**Overlap/ Gap:** Overlap is when one shape is positioned so that it covers part of another shape. Gap is when there is visible space between two shapes so that they are not touching.

**Parallel/ Perpendicular/ Intersecting Lines:** Parallel lines are always the same distance apart, and never meet or cross. Perpendicular lines meet at right angles. Intersecting lines meet or cross one another.

**Path:** A route between two points.

Moving along grid lines (up and left), there are three paths from Gina’s to the baseball field.
**Pie chart** : A graph in which a circle and its interior are divided into parts to show the parts of a set of data.  

![Pie chart of favorite subjects in school](image)

**Point** : An exact location in space.  

![Point A is located at (4,2)](image)

**Probability** : A number from 0 to 1 that tells the chance that an event will happen. The closer a probability is to 1, the more likely the event is to happen.  

The probability that a coin will land on “heads” after one flip is $\frac{1}{2}$.

**Quadrant** : One of four sections on the coordinate plane formed by the $x$- and $y$-axis. Points in quadrant I have both positive $x$-values and positive $y$-values.  

This coordinate system has 4 quadrants with location (2, 3) being in quadrant I. The quadrants are numbered starting with the upper right in a counterclockwise direction.

**Range** : The difference between the greatest number and the least number in a set of data.  

<table>
<thead>
<tr>
<th>90</th>
<th>75</th>
<th>82</th>
<th>90</th>
<th>98</th>
</tr>
</thead>
</table>
The range of this data is from 75 (lowest) to 98 (highest), so the range is $98 - 75 = 23$.

**Ray** : A straight path that extends infinitely from a point called the vertex.  

![Ray AB](image)
**Reasonable:** An answer or estimate that is sensible.  
Joe knows that he must have entered the wrong numbers in his calculator because the answer of 170 mph for the speed of the car was not reasonable.

**Remainder:** An amount left over when one number is divided by another number.  
\[
\begin{array}{c}
3 \text{ R1} \\
7 \overline{)22}
\end{array}
\]  
There are 3 groups of 7 in 22 with one left over.

**Scale:** The numbers along a side of a bar graph.  
![Scale Diagram]

The scale on the x-axis (horizontal) is dollars, and on the y-axis (vertical) tens of bushels.

**Stem-and-Leaf Plot:** A way to show data by using two columns separated by a vertical line so that the left column shows the stem and the right column shows the leaves.  
Example: The scores on a test were: 83, 79, 84, 86, 84, 99, 98, 87, 98, 78, 96, 92, 90, 100, 84, and 85.  
The stem-and-leaf plot would look like:

\[
\begin{array}{c|cc|cc|cc|cc}
10 & 0 \\
9 & 0 & 2 & 6 & 8 & 8 & 9 \\
8 & 3 & 4 & 4 & 5 & 6 & 7 \\
7 & 8 & 9 \\
\end{array}
\]

The stems represent tens, the leaves represent units.

**Symmetry: Line/ Rotational:** A line of symmetry is drawn through a figure so that the figure is divided into two equal parts that look exactly alike but are facing in opposite directions.  
A figure has rotation symmetry if it can be rotated less than a full turn around a point or an axis so that the resulting figure exactly matches the original figure.
<table>
<thead>
<tr>
<th><strong>Tilings/ Tessellations</strong></th>
<th>a collection of plane figures that fill the plane with no overlap and no gaps. M.C. Escher is a famous artist that incorporated tessellations into his art.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Undefined</strong></td>
<td>A term used to describe the result of dividing a number by zero.</td>
</tr>
<tr>
<td></td>
<td>30 ÷ 0 = undefined (How many groups of zero are in 30?????????)</td>
</tr>
<tr>
<td><strong>Vertices</strong></td>
<td>The points where the rays of an angle, the sides of a polygon, or the edges of a polyhedron meet.</td>
</tr>
<tr>
<td></td>
<td>The rectangle has four vertices.</td>
</tr>
<tr>
<td><strong>Zero Property</strong></td>
<td>A number cannot be divided by zero.</td>
</tr>
<tr>
<td></td>
<td>15 ÷ 3 = 5 means 5 × 3 = 15</td>
</tr>
<tr>
<td></td>
<td>15 ÷ 0 = n would have to mean that n × 0 = 15 Since this cannot happen, division by zero is undefined.</td>
</tr>
</tbody>
</table>
### Fifth Grade

<table>
<thead>
<tr>
<th><strong>Categorical Data</strong></th>
<th>Data with no established arrangement or numerical order. Data that can be put into categories.</th>
<th>Example: For M&amp;Ms, each M&amp;M is either red, green, blue, yellow, orange or brown. Thus, we can classify each M&amp;M by putting it in one of each of these categories.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compose/Decompose</strong></td>
<td>To put shapes together (compose) or to take shapes apart (decompose).</td>
<td>The hexagon is composed of six triangles. The trapezoid can be decomposed into a triangle and a rectangle, making it easier to find its area.</td>
</tr>
<tr>
<td><strong>Convex Polygon</strong></td>
<td>A polygon in which all vertices are “pushed outward.” If you connect two non-consecutive vertices, the segment would lie entirely inside the polygon.</td>
<td>Convex</td>
</tr>
<tr>
<td></td>
<td>*All even numbers are evenly divisible by two. *If the sum of the digits of a number is divisible by 3, the number is divisible by 3. *Numbers ending in 5 or 0 are divisible by 5.</td>
<td></td>
</tr>
<tr>
<td><strong>Edges/Faces</strong></td>
<td>A line segment where two faces of a polyhedron meet is an edge. A flat surface on a 3-dimensional shape is a face.</td>
<td>edge</td>
</tr>
</tbody>
</table>
**Equation (Modeling):** A mathematical sentence that shows that two quantities are equal.

To solve an equation, find a value for the variable that makes the sentence true.

\[
x + 3 = 7
\]

\[
x = 4
\]

**Exponential Notation:** A way to show repeated multiplication by the same factor. A number written with a base and an exponent.

\[
2 \times 2 \times 2 \times 2 = 2^4 = 16
\]

**Greatest Common Factor/Least Common Multiple:** The largest number that can be divided evenly into each number in a set is called the greatest common factor.

The smallest number that each number in a set divides into evenly (the smallest multiple of every number in a set) is called the least common multiple.

Use a Venn Diagram to find the LCM and GCF:

\[
12 = 2 \cdot 2 \cdot 3
\]

\[
18 = 2 \cdot 3 \cdot 3
\]

Their intersection: \(2 \cdot 3 = 6\) is the GCF

Their union: \(2 \cdot 2 \cdot 3 \cdot 3 = 36\) is the LCM

**Inverse Operation:** An “operation” that reverses another operation. It undoes the effect of another operation such as addition, subtraction, multiplication or division.

Addition and subtraction are inverse operations (undo adding 3 by subtracting 3)

Multiplication and division are inverse operations (undo multiplying by 2 by dividing by 2)

**Linear Equations/Inequalities (Solve):** An equation or inequality containing variables of degree one or constants; (no squares, cubes, etc.) such as \(x + 8 = 12\). To solve an equation, find a value for the variable that makes the sentence true.

\[
x + 8 < 12\]

\[
x < 4
\]

**Mean:** The average value of a set of data. The sum of a set of numbers divided by the number of numbers in the set. It is one of the measures of central tendency.

In the data set 95, 85, 92, 84, the mean is 89.

\[
\frac{95 + 85 + 92 + 84}{4} = 89
\]
**Millions/Millionths**: The seventh place value position is the **millions**. The sixth place value position after the decimal point is the **millionths**.

One million is written 1,000,000.

One millionth is written 0.000001

One million pennies

**Mixed number**: A number that is written using both a whole number and a fraction.

\[\frac{25}{9} \text{ is a mixed number. } \frac{25}{9} = 25 + \frac{9}{10}\]

**Net**: Two-dimensional representation for constructing 3-dimensional shapes.

A net for a cylinder. The length of the side of the rectangle is equal to the circumference of the circle.

**Order of Operations**: Rules that tell in what order to perform operations in arithmetic and algebra: Parentheses, exponents, multiplication and/or division from left to right, addition and/or subtraction from left to right.

**PEMDAS**: Parentheses, Exponents, Multiply or Divide from left to right, Add or Subtract from left to right. (The mnemonic to remember this is “Please excuse my dear Aunt Sally”).

**Orthogonal/Projective View**: Orthogonal views of an object are from the top, front and sides. Projective views are picture views.

Orthogonal views of a rectangular prism:

<table>
<thead>
<tr>
<th>Top</th>
<th>Side</th>
<th>Front</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Top View" /></td>
<td><img src="image2" alt="Side View" /></td>
<td><img src="image3" alt="Front View" /></td>
</tr>
</tbody>
</table>

Projective view:

| ![Projective View](image4) |
**Outliers**: A number which is far removed from the other numbers in a data set. Technically, they are values that lie more than one and a half times the length of the box in a box-and-whiskers plot from either end of the box.

**Upper quartile = 93, lower quartile = 64.**

The length of the box or interquartile range (IQR) is $93 - 64 = 28$

So, an outlier is any point that is more than $(1.5)(28) = 42$ away from the upper or lower quartiles.

This means any point greater than $93 + 42 = 135$ or less than $64 - 42 = 22$.

Since there is a data point at 10, (a number less than 22), it is an outlier.

**Polygon (Regular/Irregular)**: A closed 2-dimensional figure that is made up of line segments joined end to end. A **regular** polygon is one whose sides are all the same length and whose angles are all equal.

**Regular polygons**
- pentagon
- octagon

**Not regular polygons**

**Polyhedral (Regular/Platonic) Solids**: A geometric solid with polygons as faces. The faces intersect at edges and the edges come together at the vertices.

The five special solids having faces which are all congruent regular polygons and the same number of polygons at each vertex are called Platonic solids.

**The five Platonic Solids**
- Tetrahedron: 4 faces
- Cube: 6 faces
- Octahedron: 8 faces
- Dodecahedron: 12 faces
- Icosahedron: 20 faces
<table>
<thead>
<tr>
<th><strong>Precision of Measurement</strong>: The level of detail of a measurement, determined by the unit of measure. Precision depends on the smallest unit of measurement being used. The number of significant digits in a measurement is an indication of the precision with which the measurement was taken.</th>
<th>A ruler with ( \frac{1}{16} ) markings would have greater precision than a ruler with only ( \frac{1}{4} ) markings.</th>
</tr>
</thead>
</table>
| **Prism**: A solid with two congruent, parallel faces; its other faces are all parallelograms formed by joining the vertices of the two bases. | Triangular Prism
Rectangular Prism |
| **Proper/Improper Fraction**: A fraction whose numerator is less than the denominator is **proper**. A fraction whose numerator is greater than or equal to its denominator is **improper**. | \( \frac{7}{9} \) **proper** \( \frac{9}{7} \) **improper** |
| **Significant Digits**: Digits that express a quantity to a specified degree of accuracy. Non-zero digits are always significant. Zeros at the end of a decimal and zeros between two non-zero digits are significant. Zeros at the end of a whole number and zeros immediately following a decimal point in front non-zero digits are not significant. | 7.957 has 4 significant digits.
0.07957 has 4 significant digits.
0.79570 has 5 significant digits.
7.957 has 4 significant digits.
79.570 has 4 significant digits.
79,057 has 5 significant digits.
70,905,007 has 8 significant digits. |
| **Substitution Property**: A mathematical rule that states that if two quantities are equal one of the quantities can be substituted for the other in any expression. | If \( x = 51 \), what is the value of the expression: \( x + 99 \)?
\( x + 99 = 51 + 99 = 150 \) |
| **Surface Area**: The sums of the areas of the faces of a solid figure. | The surface area of this solid (rectangular prism) is the sum of the areas of the six faces:
SA = 2(10) + 2(15) + 2(6) = 62 cubic cm |
| **Terminating/Repeating Decimals**: A decimal number that contains a finite number of digits is called **terminating**. A decimal number in which one or more of its digits repeat infinitely is called **repeating**. | 0.25 is a terminating decimal

Repeating decimals:
\( \frac{1}{9} = 0.1111111... = 0.\overline{1} \)
\( \frac{2}{9} = 0.\overline{2} \)
\( \frac{3}{9} = 0.\overline{3} \)
\( \frac{4}{9} = 0.\overline{4} \)
\( \frac{5}{9} = 0.\overline{5} \) |
| **Variable**: A letter or other symbol that is used to represent a number. Numbers are called constants since their values do not change. | In the equation \( x + 15 = 60 \), \( x \) is the variable. 15 and 60 are constants. |
**Sixth Grade**

**Algebraic Expression**: A combination of at least one variable and numbers with at least one operation.

Examples of algebraic expressions:
- $3x$
- $x - 4y$
- $2a + 5$
- $x^2 + x - 6$
- $\frac{1}{2} \div \frac{3}{x}$

(x by itself would be an algebraic expression since it is $1 \cdot x$)

An algebraic expression for the sum of six and a number is: $6 + x$

**Area of a Circle**: The area of a circle is the number of square units needed to cover its surface. The formula for the area of a circle is $A = \pi r^2$.

The area of the given circle is $A = \pi r^2 = \pi (9) = (3.14)(9) = 28.3$

If you could count the squares covering the circle, you would count about 28.3 of them.

**Associative Law (algebraic)**: The sum (or product) of three or more numbers/variables does not depend on their grouping.

Algebraically: $(a + b) + c = a + (b + c)$ or $(ab)c = a(bc)$

$x + (x + 3) = (x + x) + 3$

$(2x)(x) = 2(x \cdot x)$

**Biased Sample**: A sample that is not representative of the entire population.

Example of a biased sample:
To find out the types of movies preferred by students in your school, you stand outside of a horror movie and ask the student moviegoers what type of movie they prefer. (This would be biased toward those who like horror movies.)

**Cartesian Coordinate System**: Also called the coordinate plane: a plane formed by two perpendicular axes (the horizontal x-axis and the vertical y-axis) which intersect at a point called the origin. A point in the plane (x,y) is uniquely determined by its horizontal and vertical distance from the origin.
Circumference of a Circle: The distance around the circle; it is similar to the perimeter of a polygon.

The ratio of the circumference of a circle to its diameter is $\pi$.

If you take any circle, measure its circumference, measure its diameter, then divide the circumference by the diameter, you will get (depending on the accuracy of your measurements!) a close approximation to $\pi$.

Commutative Law (algebraic): The sum or (product) of two or more numbers/variables does not depend on their order.

Algebraically: $a + b = b + a$ or $ab = ba$

The commutative law tells you that $x + 3 = 3 + x$ and $x \cdot 3 = 3x$

Cone: (surface area/volume): A cone is a 3-dimensional figure with a circular base and one vertex; it has no edges.

Its surface area is $SA = \pi rl + 2\pi r$ where $r$ is the radius of the circular base and $l$ is the slant height.

Its volume is $V = \frac{1}{3} \pi r^2 h$ where $r$ is the radius of the circular base and $h$ is the height (from the vertex to the center of the circular base).

The Surface area of this cone is: $SA = \pi (3)(5) + 2\pi (3) = 21\pi \approx 66$ square units

The volume is: $V = \frac{1}{3} \pi (9)^2 (4) = 12\pi \approx 37.7$ cubic units

Its volume is $\frac{1}{3}$ the volume of a cylinder with the same radius and same height.

Conjecture (with data): To guess or make a prediction about future outcomes based on patterns, logic or survey results.

Add consecutive odd numbers starting with 1:

$1 + 3 = 4, \quad 1 + 3 + 5 = 9, \quad 1 + 3 + 5 + 7 = 16$,

A good conjecture would be that the sums of consecutive odd numbers starting with 1 are always perfect squares.

Complimentary Events: Events having no outcomes in common. Together they contain all possible outcomes of the experiment. The sum of the probability of an event and its complement is one.

The complement of spinning a prime number (2,3,5,7) is spinning a composite number (4,6,8,9,10,15).

The probability of spinning a prime is $\frac{4}{10} = \frac{2}{5}$.

The probability of spinning its complement (a composite) is $1 - \frac{2}{5} = \frac{3}{5}$.
**Cylinder (surface area/volume):** A cylinder is a 3-dimensional figure with two parallel congruent circular bases and a curved lateral surface connecting the bases; it has no edges. Its surface area is \( SA = 2\pi r^2 + 2\pi rh \) where \( r \) is the radius of the circular base and \( h \) is the height. Its volume is \( V = \pi r^2 h \) where \( r \) is the radius of the circular base and \( h \) is the height.

The surface area of this cylinder is:
\[
SA = 2\pi(3^2) + 2\pi(3)(4) = 42\pi \approx 131.9 \text{ square units}
\]

The volume is:
\[
V = \pi(3^2)(4) = 36\pi \approx 113 \text{ cubic units}
\]

Its volume is 3 times that of a cone with the same radius and the same height.

**Dilation:** A transformation that enlarges or reduces a figure by some scale factor, but does not change its shape.

Dilation:

Each side of the large triangle is \( \frac{1}{2} \) that of the smaller triangle. The dilation left the triangles the same shape, but different sizes with their sides in proportion.

**Distributive Law (algebraic):** The distributive law allows you to simplify a product when one of the factors is a sum or difference.

Algebraically:
\[
x(y + z) = xy + xz
\]

And
\[
x(y - z) = xy - xz
\]

Examples:
\[
2(a + 3) = 2a + 6
\]
\[
x(x + 4) = x^2 + 4x
\]
\[
5(c - 6) = 5c - 30
\]

**Equation (solving):** An equation is a mathematical sentence that shows that two quantities are equal. To solve an equation, find a value for the variable that makes the sentence true.

Examples:
\[
x + 8 = 22 \quad 3c = 21 \quad \frac{55}{a} = 11
\]
\[
x = 14 \quad c = 7 \quad a = 5
\]

**Formula:** A rule showing the relationship between certain quantities.

The formula for the volume of a rectangular prism is
\[
V = l \cdot w \cdot h
\]

**Independent Events:** Two events are independent if the outcome of one does not affect the outcome of the other.

If you roll a number cube and flip a coin, the probability of rolling an even number on the number cube is independent of getting either heads or tails on the coin.
| **Integers:** The set of whole numbers and their opposites. The numbers in the set \{… -3, -2, -1, 0, 1, 2, 3, …\} | The set of integers is an infinite set. Zero is an integer that is neither positive nor negative. |
| --- |
| **Odds of an Event:** Odds in favor: A ratio that compares favorable outcomes to unfavorable outcomes. Odds against: A ratio that compares unfavorable outcomes to favorable outcomes. (It is not the same as probability.) | Example  
If you roll a six-sided number cube (1 - 6):  
The odds in favor of getting a 3 are 1 to 5  
(There is one 3, there are five numbers that are not 3)  
This is different than the probability of getting a 3, which is one out of six or \(\frac{1}{6}\). |
| **Percent:** Per 100 or out of 100; a ratio that compares a number to 100. | Examples:  
\[
24\% = \frac{24}{100} = 0.24 \\
1\% = \frac{1}{100} = .01 \\
0.5\% = \frac{.5}{100} = \frac{5}{1000} = .005 \\
150\% = \frac{150}{100} = 1.5
\] |
| **Probability:** A ratio that compares the number of ways a certain event can occur to the total number of possible outcomes. | Examples:  
If you roll a six-sided number cube (1-6):  
The probability of getting a 3 is \(\frac{1}{6}\)  
(there is one way to get a 3 out of six possible outcomes).  
The probability of getting an even number is 3/6 or 1/2  
(there are three outcomes that are even: 2, 4, 6 out of six possible outcomes). |
| **Properties of Polygons:** Characteristics or features that can be used to help recognize and identify polygons. | Properties of a parallelogram:  
Quadrilateral with opposite sides congruent, opposite sides parallel, and opposite angles congruent. |
**Proportion:** An equation stating that two ratios are equal or equivalent. If the cross products of two ratios are equal then the pair forms a proportion.

\[
\frac{4}{5} = \frac{8}{10}
\]

4 \cdot 10 = 5 \cdot 8

**Pyramid (surface area/volume):** The surface area of a pyramid is the sum of the areas of all of its faces. The volume of a pyramid is one-third of the area of the base multiplied by the height.

\[SA = B + \frac{1}{2}sp\]

where \(B\) is the area of the base, \(s\) is the slant height and \(p\) is the perimeter of the base.

\[V = \frac{1}{3}Bh\]

**Qualitative Graph:** A graph that focuses on the important general features of a situation.

This qualitative graph could describe the following situation:
A boy is walking to his piano lesson, he stops and talks to his friend, then realizes he is going to be late, runs the rest of the way to his lesson.

**Random:** Occurring without any pattern or order. A chance pick from items which have an equal likelihood of being chosen.

Example:
There are six different colored marbles in a hat: If you choose one at random, there is an equal chance that you pick any one of them.

**Ratio:** A comparison of two numbers or quantities by division. The most common way to express a ratio is by a fraction. Ratios can also be written as \(x:y\).

Examples:
If a class has 14 boys and 12 girls then

The ratio of boys to girls is \(14:12 = 7:6\)

\[
\frac{14}{12} = \frac{7}{6}
\]

The ratio of girls to boys is \(12:14 = 6:7\)

\[
\frac{12}{14} = \frac{6}{7}
\]

The ratio of boys to total number of students is

\[
14:26 = 7:13
\]

**Sample Space:** A part of a set, group or population that is used to represent the entire population.

Example:
Instead of surveying the entire sixth grade class about their favorite food, you only survey two sixth grade classrooms.
Simplify: To write a fraction, expression or equation in its simplest form.

Simplify: \[ \frac{3}{9} = \frac{3 \div 3}{9 \div 3} = \frac{1}{3} \]

Simplify: \[ x + 50 = 60 + 7 \]
\[ x + 50 = 67 \]
\[ x = 17 \]

Simplify: \[ 3(2x + 5) = 6x + 15 \]

Simulation: A model of an experiment. The model is usually used because the experiment would be too difficult or time consuming to do.

Example:

Students participate in a stock market simulation game, buying stocks with play money and keeping track of mock portfolios to make predictions and follow trends in the real stock market.

Stem-and-Leaf Plot: A graph that uses the digits of each number to show the shape of the data.

Examples:
The scores on a test were: 83, 79, 84, 86, 84, 99, 87, 98, 78, 96, 92, 90, 100, 84, and 85. The stem-and-leaf plot would look like:

<table>
<thead>
<tr>
<th>10</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>0 2 6 8 8 9</td>
</tr>
<tr>
<td>8</td>
<td>3 4 4 5 6 7</td>
</tr>
<tr>
<td>7</td>
<td>8 9</td>
</tr>
</tbody>
</table>

(The stems represent tens, the leaves represent units)

Transformation (reflection, rotation, & translation)
Reflection: A “flip” of an image over a line of reflection. Each point of the reflected image and the original image is the same distance from the line of reflection.

Rotation: A “turn” of an image about a given point a certain number of degrees.

Translation: A “slide” of an image which moves each point a certain distance in a given direction.

Triangle Inequality Theorem: The sum of the measures of any two sides of a triangle is always greater than the measure of its third side.

The triangle inequality states that:
\[ x + 14 > 20, \ x + 20 > 14 \]
and \[ 14 + 20 > x \]
which means that \[ 6 < x < 34 \]
**Types of Triangles (isosceles, equilateral, scalene)**

*Isosceles:* A triangle with at least two congruent sides. The two congruent sides are called legs, the third side is the base. The angle formed by the legs is the vertex angle.

*Equilateral:* A triangle with three congruent sides. (Equilateral triangles also have three congruent angles.)

*Scalene:* A triangle with no congruent sides. Its sides are different in length.

<table>
<thead>
<tr>
<th>Isosceles</th>
<th>equilateral</th>
<th>scalene</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Isosceles Diagram" /></td>
<td><img src="image2.png" alt="Equilateral Diagram" /></td>
<td><img src="image3.png" alt="Scalene Diagram" /></td>
</tr>
</tbody>
</table>

**Volume:** The number of cubic units needed to fill a three-dimensional shape or solid.

The volume of the cube that is 5 units on each side is $5 \times 5 \times 5 = 125$ cubic units.
### Seventh Grade

**Absolute Value:** A number’s distance from zero on the number line. A number’s absolute value is either positive or zero.

![Absolute Value Diagram](image)

\[ |-4| = |4| = 4 \]

**Box-and-Whisker Plot:** A graph that show how far apart and how evenly data are distributed.

![Box-and-Whisker Plot](image)

The lower quartile is the median of the data to the left of the median. The upper quartile is the median of the data to the right of the median.

**Cubes/Cube Roots:** The cube of a number is written as \( x^3 \) and is equal to \( x \cdot x \cdot x \).

If \( m \) is the cube root of a number \( n \), then \( m^3 = n \).

Cube and cube root are inverses,

\[
\begin{align*}
3^3 &= 27 \iff 3\sqrt[3]{27} = 3 \\
2^3 &= 8 \iff 3\sqrt[3]{8} = 2 \\
4^3 &= 64 \iff 3\sqrt[3]{64} = 4 \\
5^3 &= 125 \iff 3\sqrt[3]{125} = 5
\end{align*}
\]

**Degree of Accuracy:** The degree of accuracy tells how “correct” the measurement is or the closeness to its true value. It depends on the units and tools used in the measurement.

If a ruler has centimeter markings, and you measure a segment to be 3.4 cm when its length is 3.2 cm, the relative error is

\[
\frac{3.4 - 3.2}{3.2} = \frac{0.2}{3.2} = 6.25\%
\]

The smaller the relative error, the more accurate the measurement.

**Derived Quantities:** A quantity whose measurement is determined by calculating with or combining one or more measurements.

Length, mass, and time are called base quantities and are assumed to be mutually independent.

Some derived quantities that are defined in terms of the base quantities are: miles/kilometers per hour, area, and volume.

**Descriptive Statistics:** Statistics that summarize and describe data such as the measures of central tendency (e.g. mean, median, mode).

Consider the following scores:

45, 68, 75, 85, 85, 88, 90, 92, 97, 99.

What do different measures of central tendency tell about a score of 85?

Looking at the median (86.5), the score is "below average," but, compared to the mean (82.4), it is "above average."
**Directly Proportional:** A relationship between two quantities where as one increases, the other increases or decreases at a constant rate. Two quantities that are directly proportional have the same or a constant ratio. They are related by the equation $y = kx$.

The graph of two quantities that are directly proportional will pass through the origin and will be linear.

<table>
<thead>
<tr>
<th>Function</th>
<th>A relation or rule that assigns one and only one output for each input. Given an input, you get exactly one output.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Different ways to represent a function:</td>
</tr>
<tr>
<td></td>
<td>Equation: $y = 2x$, $x \in {0,1,2,3}$</td>
</tr>
<tr>
<td></td>
<td>Mapping diagram:</td>
</tr>
<tr>
<td></td>
<td>Set of ordered pairs: ${(0,0), (1,2), (2,4), (3,6)}$</td>
</tr>
<tr>
<td></td>
<td>Graph:</td>
</tr>
</tbody>
</table>

**Function Notation:** Function notation uses the symbol $f(x)$ in place of $y$. “$f(x)$” is read “f of x” and means that the value of the function ($f(x)$ or $y$) depends on the input value of $x$. $f(x)$ is the output of the function with input $x$.

Find the value of $y$ if $y = x + 5$ and $x = -2$ can be written in function notation as $f(-2)$ if $f(x) = x + 5$.

If $f(x) = -x^2$ then $f(0) = 0$, $f(3) = -9$, $f(-3) = -9$

**Indirect Measurement:** A measurement that is not obtained by direct measurement with a measuring tool. The measurement is often calculated by using a proportion.

The height of the building can be found using indirect measurement. If a 32 ft flagpole casts a 16 ft shadow, find the height of a building casting 50 ft shadow. $\frac{32}{16} = \frac{x}{50}$, $x = 100$ ft.

**Inequalities (number line):** The graph of a mathematical sentence showing the relationship between quantities that are not equal using $<$, $\leq$, $>$, $\geq$, or $\neq$.
<table>
<thead>
<tr>
<th><strong>Inequality Symbols:</strong> Symbols showing relationships between quantities that are not equal using $&lt;, \leq, &gt;, \geq, or \neq$ (less than, less than or equal to, greater than, greater than or equal to, not equal to)</th>
<th>If $x &lt; 4$ then the following inequalities are true: $x \leq 4$, $4 &gt; x$, $4 \geq x$, $x \neq 4$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inversely Proportional:</strong> A relationship between two quantities where a number increases as another decreases or it decreases as the other increases. The product of two inversely proportional numbers is a constant and they are related by the equation $y = \frac{k}{x}$.</td>
<td>For a given distance, rate is inversely proportional to time, $t = \frac{d}{r} \Rightarrow rt = d$. If it takes you 30 minutes to get to a store traveling at 35 mph, how long would it take you to get there driving 50 mph? Since $rt = d$, $(35)(30) = (50)(t)$ or $t = 21$ minutes. So, as speed increases, time decreases. Here is the graph of an inverse variation: As $x$ increases, $y$ decreases.</td>
</tr>
<tr>
<td><strong>Negative Exponents:</strong> A negative exponent is used to denote the reciprocal of a number to a power. If $x \neq 0$, then $x^{-b} = \left(\frac{1}{x}\right)^{b}$. Negative exponents are used in scientific notation to denote numbers smaller than one.</td>
<td>Examples: $6.23 \times 10^{-2} = 0.0623$ $3.45 \times 10^{-1} = 0.345$ $2^3 = 8$, $3^3 = 27$, $2^2 = 4$, $3^2 = 9$, $2^1 = 2$, $3^1 = 3$, $2^0 = 1$, $3^0 = 1$, $2^{-1} = \frac{1}{2}$, $3^{-1} = \frac{1}{3}$, $2^{-2} = \frac{1}{4}$, $3^{-2} = \frac{1}{9}$, $2^{-3} = \frac{1}{8}$, $3^{-3} = \frac{1}{27}$</td>
</tr>
</tbody>
</table>
**Nonlinear**: Nonlinear equations have graphs which are not straight lines. Two common nonlinear functions are quadratic and inverse variation.

![Graph of nonlinear function: \( y = x^2 \)]

**Opposite**: Two numbers represented by points on the number line that are the same distance from zero and on opposite sides of zero. The opposite of 3 is -3, the opposite of -½ is ½.

![The absolute values of numbers that are opposites are the same.](image)

**Percents (above 100, below 1)**: A percent is a ratio that compares a number to 100.

A percent greater than 100% means you have more than a whole.

A percent less that 1% means that you have less than \( \frac{1}{100} \)th of the quantity.

\[
100\% = 1.00 = 1, \quad 125\% = 1.25, \quad 350\% = 3.50 = 3.5
\]

A half of a percent: \( .5\% = \frac{0.5}{100} = \frac{5}{1000} = 0.005 \)

**Rate of Change**: A number that compares one quantity to the unit value of another quantity.

A number that represents a change in one measure with respect to another. The slope of a line represents the rate of change of two quantities.

![Rate of change graph](image)

There is a direct relation between slope and the rate of change of a function.

A balloon is falling at a constant rate. It starts at 2500 ft above the ground and after 35 seconds is at 2115 ft. How fast is the balloon falling (what is its rate of change)?

The slope of the line is \( \frac{2500 - 2115}{0 - 35} = \frac{385}{-35} = \frac{-11 \text{ ft}}{1 \text{ sec}} \)

The balloon is falling 11 feet every second.
Rational Numbers: A real number that can be expressed as the ratio of two integers $p$ and $q$ where $q$ cannot be zero. Decimals representing rational numbers either terminate or repeat.

Integers, whole numbers and rational numbers are all subsets of the real numbers.

Rules of Rounding: Identify the number in the position to which you are rounding. Then look at the number to the right of that number. Follow these rules:
- If the number to the right is $\geq 5$, increase the number in the rounding position by 1 (round up).
- If the number to the right is $< 5$, leave the number in the rounding position alone (round down).

4,828 rounded to the nearest ten is 4,830
4,828 rounded to the nearest hundred is 4,800
4,828 rounded to the nearest thousand is 5,000

7.8198 rounded to the nearest tenth is 7.8
7.8198 rounded to the nearest hundredth is 7.82
7.8198 rounded to the nearest thousandth is 7.820
7.8198 rounded to the nearest whole number is 8

Scale Factor: The common ratio for pairs of corresponding sides of similar figures. The ratio used to enlarge and reduce objects proportionally.

The scale factor is 2: \[
\frac{6}{3} = \frac{8}{4} = \frac{10}{5} = 2
\]

7.957 has 4 significant digits.
0.07957 has 4 significant digits.
0.79570 has 5 significant digits.
7,957 has 4 significant digits.
79,570 has 4 significant digits.
79,057 has 5 significant digits.
70,905,007 has 8 significant digits.
709,050,070 has 8 significant digits.
70,905,007.0 has 9 significant digits.
Single/Two-Variable Data:

Single Variable Data:
- involves a single variable
- does not deal with causes or relationships between data
- the major purpose is to describe
- use measures of central tendency – such as mean, mode, median
- describe using: range, quartiles,
- display using bar graph, histogram, pie chart, line graph, box-and-whisker plot

Two Variable Data:
- involves two variables
- deals with causes or relationships between variables
- the major purpose is to explain
- look at correlations between the data (comparisons, relationships, causes)
- display using tables or graphs where one variable is contingent on the values of the other variable.

An example of using single variable data would be to record the height of each student in the class. Another example would be to record the arm spans of students in the class. Here is a sample graph of each student’s height and arm span. You could calculate the mean height and arm span for the class.

An example of using two variable data would be to plot for each student, their height vs their arm span.

You could ask if there is a correlation between a student’s arm span and their height.

Slope: The ratio of the vertical change to the horizontal change of a line on a graph. Given two points on a line slope is the ratio of the change in y to the change in x.

\[ m = \frac{\text{vertical change}}{\text{horizontal change}} = \frac{y_2 - y_1}{x_2 - x_1} \]

Positive slope \( m = 1 \)

Negative slope \( m = -1 \)

Zero slope

Undefined or no slope
**Squares/Square Roots:** The square of a number is written as $x^2$ and is equal to $x \cdot x$. If $m$ is the square root of a number $n$, then $m^2 = n$.

<table>
<thead>
<tr>
<th>$m$</th>
<th>$n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

$3^2 = 9 \iff \sqrt{9} = 3$. Square and square root are inverses.

**SSS/SAS/AA (similar triangles):**
Three ways to prove triangles are similar:
1. If two sets of corresponding sides are in proportion and the angle between them is congruent. (SAS)
2. If all three sides are of one triangle are in proportion with three sides of another triangle. (SSS)
3. If two pairs of angles are congruent. (AA)

![Similar Triangles Diagram](Image)

$$\Delta ABC \sim \Delta DEF \text{ by SAS.}$$
$$\frac{AC}{BC} = \frac{2}{3} \text{ and the included angles are congruent.}$$

**Theoretical Probability:** The ratio of the number of *equally likely outcomes* in an event to the total number of *possible outcomes*. A number used to describe the chance of an event occurring.

$$P(E) = \frac{n(E)}{n(S)} = \frac{\text{number of ways to get what you want}}{\text{the total number of possibilities}}$$

A six-sided number cube is tossed. What is the probability that a number greater than 3 is tossed? On a six-sided cube the numbers greater than 3 are {4, 5, 6}. The possibilities are {1, 2, 3, 4, 5, 6}.

$$P(\text{number} > 3) = \frac{3}{6} = \frac{1}{2}$$

**Unit Rate:** A rate in which a quantity is compared to one unit. A slope is a unit rate.

Some common unit rates are miles (or kilometers) per hour, cost per item, earnings per week, dollars per pound etc. In each case the first quantity is related to 1 unit of the second quantity.

**Upper Quartile, Lower Quartile, Inter-quartile Range:** The upper quartile (Q3) is median of the upper half of the data. The lower quartile (Q1) is the median of the lower half of the data. The inter-quartile range is the range of the middle 50% of the data. Because it uses the middle 50%, it is not affected by outliers or extreme values. The IQR is equal to the length of the box in a box-and-whiskers plot.

To find the upper and lower quartiles and inter-quartile range: find the median of the data set, then find the median of the upper and lower halves of the data set. For the data set: \{1, 4, 9, 16, 25, 36, 49, 64, 81\} first find the median value, which is 25.

To find the quartile values, find the medians of: \{1, 4, 9, 16\} and \{36, 49, 64, 81\}

The lower quartile value is 6.5 and the upper quartile value is 56.5

The inter-quartile range is the range of the data from 6.5 to 56.5, so the IQR is 56.5 – 6.5 = 50.

**Vertical Line Test:** A way of testing the graph of a relation to determine if it is a function. If a vertical line passes through *more than one* point on the graph, then the relation is not a function.

```
<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
```

Every vertical line passes through only one point, so, $y = x^2$ is a function.
### Eighth Grade

<table>
<thead>
<tr>
<th><strong>Accuracy</strong></th>
<th>The closeness of a given measurement or value to the true measurement or value. How closely a measured value agrees with the correct value.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adjacent Angles</strong></td>
<td>Angles that have a common vertex and a common side.</td>
</tr>
<tr>
<td><strong>Alternate Exterior Angle</strong></td>
<td>A pair of angles on the outer sides if two lines cut by a transversal, but on opposite sides of the transversal. If the lines are parallel: $\angle 1$ and $\angle 8$ are alternate exterior angles and are congruent. $\angle 2$ and $\angle 7$ are also alternate exterior angles and are congruent.</td>
</tr>
<tr>
<td><strong>Alternate Interior Angle</strong></td>
<td>A pair of angles on the inner sides of two lines cut by a transversal, but on the opposite sides of the transversal. If the lines are parallel $\angle 3$ and $\angle 6$ are alternate interior angles and are congruent. $\angle 4$ and $\angle 5$ are also alternate interior angles and are congruent.</td>
</tr>
<tr>
<td><strong>Complementary Angle</strong></td>
<td>Two angles that add up to 90 degrees. (Their sum is 90.)</td>
</tr>
</tbody>
</table>

The accuracy of a measured value expresses the deviation of the measurement from the true value of the quantity. Since accuracy is based on the true value, relative error, in this case, would indicate how far the measurement is from the true value.

If you are measuring a piece of string and do not stretch it out straight, you could have good precision, but poor accuracy.

(Adjacency refers to how closely individual measurements agree with each other. So, the smaller the unit of measurement, the better the precision.)
**Compound Event**: An event whose probability depends on the occurrence of two or more events such as two socks being drawn from a drawer.

To find the probability of two independent events both occurring, multiply the probability of the first event by the probability of the second event:
\[ P(A \text{ and } B) = P(A) \cdot P(B) \]

To find the probability of two dependent events both occurring, multiply the probability of A and the probability of B after A occurs:
\[ P(A \text{ and } B) = P(A) \cdot P(B \text{ following } A) \]

To find the probability of one or the other of two mutually exclusive events, add the probability of the first event to the probability of the second event:
\[ P(A \text{ or } B) = P(A) + P(B) \]

**Dependent events (and)**: 
A drawer contains 4 blue, 6 black, and 2 brown socks. What is the probability that you choose two blue socks in a row?
\[ p(\text{blue and blue}) = \frac{4}{12} \cdot \frac{3}{11} = \frac{12}{132} = \frac{1}{11} \]

**Independent events (and)**: 
If you roll two six-sided number cubes, what is the probability that you roll two even numbers?
\[ p(\text{even and even}) = \frac{3}{6} \cdot \frac{3}{6} = \frac{9}{36} = \frac{1}{4} \]

**Mutually exclusive events (or)**: 
If you roll a six-sided number cube, what is the probability that you roll a 1 or a 6?
\[ p(1 \text{ or 6}) = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3} \]

**Corresponding Angle**: Angles that are on the same side of the transversal and are both above or both below the lines cut by the transversal.

- \( \angle 1 \) and \( \angle 5 \) are corresponding and congruent.
- \( \angle 3 \) and \( \angle 7 \) are corresponding and congruent.

**Cost Per Unit**: A unit rate used to compare costs per single item; a rate in which the second quantity is one.

\[
\begin{align*}
\text{Unit Cost} &= \frac{\$3.90}{10 \text{ markers}} = \frac{\$0.39}{1 \text{ marker}} \\
\text{Unit Cost} &= \$0.39
\end{align*}
\]

**Distance Formula**: 
From the Pythagorean Theorem, the distance \( d \) between any two points \((x_1, y_1)\) and \((x_2, y_2)\) is
\[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}. \]

If you let the horizontal distance \( x_2 - x_1 = a \)
And the vertical distance \( y_2 - y_1 = b \)
Then the equation becomes
\[ d = \sqrt{a^2 + b^2} \text{ or } d^2 = a^2 + b^2 \]

The distance \( d = \sqrt{9 + 16} = \sqrt{25} = 5 \)
### Exterior Angles
The angles on the outer sides of two lines cut by a transversal

\[ \angle 1, \angle 2, \angle 7, \text{ and } \angle 8 \text{ are exterior angles.} \]

### Hypotenuse
The longest side of a right triangle, or the side directly across from the right angle

### Intercept
The point where a graph crosses either the x- or the y-axis. The y-intercept of the line \( y = mx + b \) is \( b \).

The y-intercept can be found algebraically by letting \( x = 0 \) and solving for \( y \).

The x-intercept can be found algebraically by letting \( y = 0 \) and solving for \( x \).

\[ y = \frac{2}{3}x + 2 \]

The y-intercept is 2. The x-intercept is -3.

### Interior Angles
Angles on the inner sides of two lines cut by a transversal

Angles 3, 4, 5 and 6 are interior angles.

### Irrational Numbers
A number that cannot be written as a ratio of two integers. Irrational numbers in decimal form are non-terminating and non-repeating.

These numbers are irrational:

\[ \sqrt{2} = 1.414213562... \]

0.010110110111...\]

\[ \pi \approx 3.14159265358979323... \]
### Laws of Exponents:
If you multiply two expressions with the same base, the base stays the same and you add the exponents: \( b^x \cdot b^y = b^{x+y} \)

If you divide two expressions with the same base, the base stays the same and you subtract the exponents:

\[
\frac{b^x}{b^y} = b^{x-y} \quad \text{if} \quad b \neq 0
\]

If you raise an expression with an exponent to a power, the base stays the same and you multiply the exponents:

\[
(b^y)^x = b^{xy}
\]

Additionally, \((ab)^n = a^n b^n\)

but, \((a + b)^n \neq a^n + b^n\) for \(a, b, n \in \mathbb{R}\)

### Examples:
\[(2^3)(2^2) = (2 \cdot 2 \cdot 2)(2 \cdot 2) = 2^5 = 32\]
\[
\frac{3^5}{3^2} = \frac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3} = 3^3 = 27
\]
\[(4^2)^3 = (4^2) \cdot (4^2) \cdot (4^2) = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 = 4^6 = 4096
\]
If \(x \neq 0\), \(x^0 = 1\) (\(0^0\) is undefined)

\[
\frac{3^2}{3^2} = 3^0 = 1
\]

\[(3 + 4)^2 \neq 9 + 16\]

### Legs of a Triangle:
In a right triangle, the two sides that are not the hypotenuse (the longest side) or the two sides that form the right angle.

### Line of Best Fit (conceptual):
A straight line that best fits the data on a scatter plot. It can be used to predict a trend in the data.

### Multi-step Equations:
Equations that contain more than one operation and thus take more than one step (using inverse operations) to solve.

\[
\begin{align*}
3(x + 1) &= 15 \\
3x + 3 &= 15 \\
3x &= 12 \\
x &= 4
\end{align*}
\]

\[
\begin{align*}
2x - 3 &= 17 \\
2x &= 20 \\
x &= 10
\end{align*}
\]

### Pythagorean Theorem:
In a right triangle, the sum of the squares of the length of the legs is equal to the square of the length of the hypotenuse \(a^2 + b^2 = c^2\)

\[
\begin{align*}
15^2 + 17^2 &= 17^2 \quad \text{and} \quad 8^2 + 15^2 = 289
\end{align*}
\]
Precision: The level of detail of a measurement, determined by the unit of measure. Precision depends on the smallest unit of measurement being used.

A meter stick that has centimeter markings has a precision of 1 cm and a possible error of plus or minus 0.5 cm. Significant digits can indicate the precision of a measurement. A measurement of 45.32 cm contains 4 significant digits. (The 2 is the estimated digit).

A ruler with $\frac{1}{16}$" markings would have greater precision than a ruler with only $\frac{1}{4}$" markings.

Real Number: A number that is either rational or irrational. Real numbers can be represented by the infinite set of points on a number line.

Real numbers include all of the following numbers: rational, irrational, and thus integers, whole numbers, natural numbers, zero.

The properties of real numbers include the commutative, associative, distributive, additive and multiplicative identity, and additive and multiplicative inverse properties.

Relative Frequency: The observed number of successful events for a given number of trials: the ratio of the total number of times a given event occurs to the total number of events. The observed relative frequency is an approximation to the true probability of an event.

If we were able to perform a trial more and more times, the relative frequency would eventually approach the actual probability.

For example:
If you were to flip a coin 20 times, heads might come up 12 times. The relative frequency would be $\frac{12}{20} = 0.6$.
Toss the coin 100 times, if there are 54 heads, the relative frequency would be $\frac{54}{100} = 0.54$.
As you continued to increase the number of coin tosses, the relative frequency should approach the theoretical probability of 0.5.

Scatter Plot: A graph on a coordinate system used to display a set of data points
**Supplementary Angle:** Angles whose sums add up to 180 degrees

Angles 1 and 2 are supplementary.

\[ \angle 1 + \angle 2 = 180^\circ \]

**System of Equations:** Two equations in two variables. The number of solutions of the system can be infinite (if they represent the same line), one point \((x,y)\) (if the two lines intersect) or no solution (if the lines are parallel).

\[
\begin{align*}
  x - y &= -3 \\
  x + 2y &= 8 \\
  x - y &= 2 \\
  x - y &= 2 \\
  2x - 2y &= 4
\end{align*}
\]

No solution: \((x,y)\) Parallel lines
One solution: \((4,2)\) Infinite number of solutions: same line

**Transversal:** A line that intersects two other lines (usually parallel).

Line \(t\) is a transversal which intersects parallel lines \(l\) and \(m\).

**Venn Diagram:** A diagram showing the relationships among sets of objects using overlapping circles.

This Venn diagram shows that the intersection of the factors of 10 and the factors of 15 are those they have in common, 1 and 5.

**Vertical Angles:** A pair of opposite congruent angles formed by intersecting lines

The two 138° angles are vertical

The two 52° angles are vertical
### Algebra I / Technical Algebra

<table>
<thead>
<tr>
<th>Absolute Value: A number’s distance from zero on a number line. A number’s absolute value is nonnegative.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples: Write an algebraic expression for the sum of six and a number: $6 + n$ Evaluate the algebraic expression $-x^2 + 3$ if $x = -4$: $-(-4)^2 + 3 = -(16) + 3 = -13$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Algebraic Expressions: A mathematical phrase that can include numbers, variables, and operation or grouping symbols. A combination of numbers and/or variables with at least one operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples: Write an algebraic expression for the sum of six and a number: $6 + n$ Evaluate the algebraic expression $-x^2 + 3$ if $x = -4$: $-(-4)^2 + 3 = -(16) + 3 = -13$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coefficient: The numerical factor of a variable term. A variable is multiplied by the coefficient in a term.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples: Write an algebraic expression for the sum of six and a number: $6 + n$ Evaluate the algebraic expression $-x^2 + 3$ if $x = -4$: $-(-4)^2 + 3 = -(16) + 3 = -13$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Combinations: An arrangement of the elements of a set without regard to order. The number of combinations is given by</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of ways that 3 letters can be chosen from the letters A,B,C,D,E is ten:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Constants: A term that has no variable factor.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples: Write an algebraic expression for the sum of six and a number: $6 + n$ Evaluate the algebraic expression $-x^2 + 3$ if $x = -4$: $-(-4)^2 + 3 = -(16) + 3 = -13$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coordinate Plane: A plane formed by a horizontal number line (x-axis) and a vertical number line (y-axis). Points on the coordinate plane are defined by their horizontal and vertical distance form the origin (0,0).</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
**Distance Formula**: The distance $d$ between any two points $(x_1, y_1)$ and $(x_2, y_2)$ is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

**Domain & Range**:  

**Domain**: The set of all $x$-coordinates in the ordered pairs $(x, y)$ of a relation.  

**Range**: The set of all the $y$-coordinates in the ordered pairs $(x, y)$ of a relation.  

The domain of a function is the set of all $x$ values for which the function is defined.

**Equations (solving, graphing, slope-intercept, etc.)**: An equation is a mathematical sentence containing an equal sign. To solve an equation, find values for the variable that makes the sentence true. The graph of a linear equation contains all points that make that equation true.

**Factoring**: To write a number (or expression) as a product of two or more numbers (or expressions).

Some common factoring patterns are:

- **Common factor**: $x^2y + 2x^3y = x^2y(1 + 2x)$
- **Difference of squares**: $x^2 - y^2 = (x - y)(x + y)$
- **Grouping**: $x(a + b) - y(a + b) = (a + b)(x - y)$

**Function Notation**: Use the symbol $f(x)$ to mean the function whose input is $x$. “$f(x)$” is read “$f$ of $x$” and means that the value of the function depends on the value of $x$. $f(x)$ is the output (dependent variable) of the function with input (independent variable) $x$.

A function is a mapping from a domain to a range. The graph of a function will pass the vertical line test, that is, any vertical line drawn on the graph will only cross the graph once.

If $f(x) = x + 3$ then $f(0) = 3$, $f(1) = 3$ and $f(-1) = 2$

**Inequality**: The graph of a mathematical sentence showing the relationship between quantities that are not equal, using $<$, $>$, $\le$, $\ge$, or $\neq$.

$$x > 2$$
**Inverse Operations (algebraic):** Operations that undo each other: \( b \) and \(-b\) are additive inverses. \( b \) and \( \frac{1}{b} \) are multiplicative inverses \((b \neq 0)\).

Addition and subtraction are inverse operations (undo adding 3 by subtracting 3)

Multiplication and division are inverse operations (undo multiplying by 2 by dividing by 2)

**Irrational Numbers:** A number that cannot be written as a ratio of two integers. Irrational numbers in decimal form are non-terminating and non-repeating.

These numbers are irrational:
- \( \sqrt{2} = 1.414213562... \quad 0.01011011101111... \)
- \( \pi \approx 3.14159265358979323846264338327950... \)

These are rational:
- \( \sqrt{4} = 2 \)
- \( 0.01010101... = \frac{1}{99} \)

**Line of Best Fit:** A straight line that best fits the data on a scatter plot. (This line may pass through some, none, or all of the points). The line of best fit is a trend line for the data.

The line of best fit for this data suggests a correlation between the x and y values.

**Linear Systems:** A linear system of equations is a set of two equations with the same variables, graphed in the same coordinate plane. If the system has a solution, it is called consistent. If it does not have a solution it is inconsistent.

<table>
<thead>
<tr>
<th>No solution:</th>
<th>One solution:</th>
<th>Infinite number of solutions: same line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel lines</td>
<td>(4,2)</td>
<td></td>
</tr>
<tr>
<td>( x - y = -3 )</td>
<td>( x + 2y = 8 )</td>
<td></td>
</tr>
<tr>
<td>( x - y = 2 )</td>
<td>( x - y = 2 )</td>
<td></td>
</tr>
<tr>
<td>( 2x - 2y = 4 )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Linear systems can be solved graphically, by substitution or by elimination (linear combination).
**Midpoint Formula:** The midpoint, $M$, of a line segment with endpoints $(x_1, y_1)$ and $(x_2, y_2)$ is 
\[ M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \]

The point $M: (-1,1)$ is the midpoint of the segment $AC$ with endpoints $A: (-3,5)$ and $C: (1,-3)$.

**Permutations:** An arrangement of elements of a set in which order is important. The number of permutations is given by 
\[ _nP_r = \frac{n!}{(n-r)!} \]

How many ways can two letters be arranged from the four letters $M, A, T, H$?

There are 12 possible permutations: 
$MA, AM, MT, TM, MH, HM, AT, TA, AH, HA, TH, HT$

\[ _2P_2 = \frac{4!}{(4-2)!} = \frac{4!}{2} = \frac{4!}{2!} = 12 \]

**Polynomial:** A monomial or the sum/difference of two or more monomials. A quotient with a variable in the denominator is not a polynomial.

These are polynomials:
- Monomial: $5x$
- Binomial: $2x + 6$
- Trinomial: $3x^2 + 2x - 1$
- Polynomial: $x^3 - 3x^2 + 2x - 1$

These are not polynomials:
- $3x^{-1} + 2x - 4$
- $\frac{5}{x^2} - x$
- $x + \sqrt{x} + 2$

**Pythagorean Theorem:** The Pythagorean Theorem states that, in a right triangle, the square of the hypotenuse is equal to the sum of the squares of the two legs. There are several proofs that use area models.

Pythagorean Theorem: $a^2 + b^2 = c^2$ where $a$ and $b$ are the lengths of the legs of the right triangle and $c$ is the length of the hypotenuse.

This is an area model to demonstrate the Pythagorean Theorem.
**Quadratic Equation:** A function given by a polynomial equation of degree two. Its graph is a parabola.

A quadratic equation can be expressed in the form $ax^2 + bx + c = 0$. The quadratic term is $ax^2$, the linear term is $bx$, and the constant term is $c$. The real roots (solutions) to the equation are the x-intercepts of its graph. The solutions to $x^2 - x - 6 = 0$ are the x-intercepts of the graph $y = x^2 - x - 6$: $x = -2$ or $x = 3$

**Quadratic Formula (discriminant):** The quadratic formula is used to find the roots/solutions to quadratic equations of the form $ax^2 + bx + c = 0$. Solving the quadratic equation for $x$ by completing the square yields the quadratic formula which states that $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

The discriminant is the part of the quadratic formula that is under the radical. It determines the nature of the roots (what kind and how many).

What is the nature of the roots of the following quadratic equations? What kind of roots are there and how many?

1. $x^2 - 2x - 3 = 0$, $D = b^2 - 4ac = 4 - (-12) = 16$  
   $D$ is a positive perfect square, so two real rational roots.  
   ($x = 3$ or $x = -1$)

2. $x^2 - 3x - 3 = 0$, $D = b^2 - 4ac = 9 - (-12) = 21$  
   $D$ is positive, so two real irrational roots.  
   \[ x = \frac{3 \pm \sqrt{21}}{2} \]

3. $x^2 - 3x + 3 = 0$, $D = b^2 - 4ac = 9 - (12) = -3$  
   $D$ is negative, so two complex conjugate roots.  
   \[ x = \frac{3 \pm \sqrt{3}}{2} i \]

4. $x^2 - 6x + 9 = 0$, $D = b^2 - 4ac = 36 - (36) = 0$  
   $D$ is zero, so one real double root.  
   ($x = 3$)
**Ratio/Proportion (scale factors):** Ratio: A comparison of two numbers by division.  
Proportion: An equation that states that two ratios are equal.

Scale factor: The ratio by which a drawing or figure is enlarged or reduced. The resultant figure is similar to the original.

If the Eiffel Tower is 1000 feet tall and the drawing of it is 10 inches tall, the scale would be:  
10 inches = 1000 feet or 1 inch = 100 feet.

A scale factor of one hundred means that the linear dimensions of the tower are 100 times that of the drawing. However, the area of the tower is \((100)^2\) or 10,000 times that of the figure in the drawing.

**Real number:** A number that is either rational or irrational. Real numbers can be represented by the set of infinite points on a number line.

Real numbers include all of the following numbers: rational, irrational, and thus integers, whole numbers, natural numbers, zero.

The properties of real numbers include the commutative, associative, distributive, additive and multiplicative identity, and additive and multiplicative inverse properties.

<table>
<thead>
<tr>
<th>-22/7</th>
<th>-1 1/2</th>
<th>$\sqrt{2}$</th>
<th>$\pi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>-2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Slope:** For a linear equation, the ratio of the vertical change to the horizontal change between two points on the graph of its line. It measures the steepness of the line.

Positive slope  
Negative slope  
Zero slope  
No or undefined slope
Subsets: A is a subset of B if every member of A is also a member of B. Every set is a subset of itself. The empty set is a subset of every set. The number of subsets of a given set is $2^n$ where n is the number of elements in the set.

Natural numbers is a subset of whole numbers which is a subset of integers which is a subset of rational numbers which is a subset of real numbers.

Irrational numbers is also a subset of real numbers.
### Adjacent angles:
Two angles in the same plane that are next to each other and share a common side and a common vertex.

\[ \angle CAB \text{ and } \angle BAD \]

are adjacent. Ray \( AB \) is their common side and point \( A \) is their common vertex.

### Altitude of a triangle:
The perpendicular segment from a vertex to the line containing the opposite side of a triangle.

In each triangle, the altitude to side \( BC \) is segment \( AF \):

### Angle of Depression:
An angle formed by a horizontal line and the line of sight below it.

\[ \hat{x} \]

Angle \( x \) is the angle of depression. It is congruent to \( \angle ABC \)

### Angle of Elevation:
An angle formed by a horizontal line and the line of sight above it.

\[ \hat{x} \]

Angle \( x \) is the angle of elevation.

### Bisect:
To divide into two equal parts.

An angle bisector is a ray in the interior of an angle that divides the angle into two congruent angles.

A bisector of a segment contains the midpoint of the segment and divides it into two congruent segments. The bisector can be a line, a segment, a ray or a plane.

Segment \( AO \) bisects \( CD \)
Ray \( BD \) bisects \( \angle ABC \)
<table>
<thead>
<tr>
<th><strong>Central Angle of a circle:</strong> An angle in a circle whose vertex is the center of the circle and whose sides intersect the circle.</th>
<th>Angle $BOA$ is a central angle.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chord of a circle:</strong> A segment whose endpoints are points on the circle. The longest chord of a circle is the diameter.</td>
<td>Segments $AB$ and $CD$ are chords of the circle. The diameter $\overline{CD}$ is the longest chord of the circle.</td>
</tr>
<tr>
<td><strong>Complementary Angles:</strong> Two angles whose sum is 90 degrees. $\angle A$ and $\angle B$ are complementary if and only if $\angle A + \angle B = 90^\circ$.</td>
<td>A 58 degree angle and a 32 degree angle are complementary since $58 + 32 = 90$. If complementary angles are adjacent, their exterior sides form a right angle.</td>
</tr>
</tbody>
</table>
| **Congruent figures:** Two figures are congruent if they have exactly the same size and shape. Two polygons are congruent if their corresponding sides and angles are congruent. The symbol for congruence is $\cong$. | $\triangle ABC \cong \triangle DEF$ 
$\overline{AB} \cong \overline{DE}$, $\overline{BC} \cong \overline{EF}$, $\overline{CA} \cong \overline{FD}$  
$\angle A \cong \angle D$, $\angle B \cong \angle E$, $\angle C \cong \angle F$ |
| **Conjecture:** To make an educated guess or a prediction about future outcomes based on patterns, logic or data | After measuring several pairs of vertical angles, a conjecture was made that vertical angles are congruent. This conjecture used inductive reasoning. |
Corresponding Parts of congruent or similar figures: A side (or an angle) of a polygon that is matched with a side (or an angle) of a congruent or a similar polygon. If the polygons are congruent, the corresponding parts are congruent. If the polygons are similar, the corresponding angles are congruent and the corresponding sides are in proportion.

\[ \triangle ABC \cong \triangle DEF \]

The corresponding angles of the two similar triangles are congruent: \( \angle A \cong \angle D, \angle B \cong \angle E, \angle C \cong \angle F \)

The corresponding sides are in proportion:
\[ \frac{AB}{DE} = \frac{BC}{EF} = \frac{CA}{FD} \]

Deductive Reasoning: Using facts, definitions, properties, axioms and theorems to reach a logical conclusion or to show that a conjecture is true. It is reasoning from the general to the specific.

An example of deductive reasoning:
1. Given: Vertical angles are congruent
2. \( \angle A \) and \( \angle B \) are vertical angles
3. Therefore, \( \angle A \) and \( \angle B \) are congruent

Geometric Mean: The geometric mean occurs in a proportion when the two inner terms are the same. If \( \frac{a}{x} = \frac{x}{b} \), then \( x^2 = ab \) and \( x = \sqrt{ab} \); \( x \) is the geometric mean.

\[
\begin{array}{|c|c|c|}
\hline
\text{a - the first term (extreme)} & \frac{a}{x} = \frac{x}{b} & \text{x - the second term (mean)} \\
\hline
\end{array}
\begin{array}{|c|c|c|}
\hline
\text{x - the third term (mean)} & \frac{a}{x} = \frac{x}{b} & \text{b - the fourth term (extreme)} \\
\hline
\end{array}
\]

Inductive Reasoning: A conclusion or a prediction is reached based on patterns or many observations. It is reasoning from the specific to the general.

An example of inductive reasoning:
1. A student measures several pairs of vertical angles
2. Each time, the angles in the pair are congruent
3. The student concludes that vertical angles are congruent.

Inscribed Angle in a circle: An angle whose vertex lies on the circle and whose sides lie on chords of the circle.

\( \angle BPA \) is an inscribed angle.

Median of a Triangle: A segment which connects the vertex of a triangle to the midpoint of its opposite side.

The medians of the triangle are: \( A\overline{Y}, B\overline{X}, C\overline{Z} \)
**Parallel Lines:** Lines that lie in a plane and do not intersect. (Parallel planes are planes which do not intersect)

![Parallel lines](image)

**Perpendicular:** Lines, segments, rays or planes that intersect to form right angles.

![Perpendicular lines](image)

**Pi:** The ratio of the circumference of a circle to the length of its diameter.

Approximations for pi are 3.14 and \(\frac{22}{7}\)

![Pi](image)

**Proof:**
- **Formal:** A logical argument using statements supported by reasons, containing axioms, postulates, definitions and theorems in a chain of deductive reasoning.
- **Paragraph:** A convincing argument that is written in complete sentences which starts with the hypothesis and ends with the conclusion.
- **Flow:** A way to organize ideas in a proof using arrows to display the relationships between the statements in the proof.
- **Coordinate:** A proof using ordered pairs and usually the distance formula, mid-point formula and/or the definition of slope to prove geometric conjectures.

**Properties:**
- **Reflexive:** Any segment or angle is congruent to itself.
- **Symmetric:** If \(a = b\), then \(b = a\).
- **Transitive:** If \(a = b\) and \(b = c\) then \(a = c\).

![Example of Flow Proof](image)

**Reflexive:** \(\angle A \cong \angle A\) or \(AB \cong AB\)

**Symmetric:** \(\angle A \cong \angle B\), therefore \(\angle B \cong \angle A\)

**Transitive:** \(\angle A \cong \angle B\), \(\angle B \cong \angle C\), therefore \(\angle A \cong \angle C\)
**Secant Line**: A line that intersects a circle in exactly two points. A secant will contain a chord of the circle.

![Secant Line Diagram]

**Similar figures**: Two figures are similar if their corresponding angles are congruent and their corresponding sides are in proportion. Similar figures have the same shape but different sizes. The symbol for similar is \( \sim \).

\[ \triangle ABC \sim \triangle DEF \]
\[ \angle A \cong \angle D, \; \angle B \cong \angle E, \; \angle C \cong \angle F \]

And \( \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF} \)

**Supplementary angles**: Two angles whose sum is 180 degrees. \( \angle A \) and \( \angle B \) are supplementary if and only if \( \angle A + \angle B = 180^\circ \)

These two angles are supplementary since \( 139 + 41 = 180 \).

Angles 1 and 2 are supplementary. \( \angle 1 + \angle 2 = 180^\circ \)

If supplementary angles are adjacent, their exterior sides form a straight line.

**Surface Area of Solids**: The surface area of a solid is the sum of the areas of the surfaces of the solid. The lateral area is the area of its lateral faces for a prism or pyramid and its curved lateral surface for a cylinder and a cone.

The surface area of the rectangular solid is \( SA = 2lw + 2lh + 2wh \)

**Tangent Line**: A line which intersects a figure or a solid in only one point.

\( \overline{PT} \) is tangent to circle \( C \) at point \( P \). It is perpendicular to radius \( \overline{PC} \).
**Theorem**: A statement which can be proved to be true.

Example: The Pythagorean Theorem, which states that the sum of the squares of the legs of a right triangle is equal to the square of the hypotenuse, can be proved many different ways.

**Transversal**: In a plane, a line that intersect two or more (usually parallel) lines.

Line $t$ is a transversal which intersects parallel lines $l$ and $m$. 

![Diagram of transversal and lines](image-url)
### Absolute value of a complex number:

(Notation: $|z|$)

$$|a + bi| = \sqrt{a^2 + b^2}$$

and is the number’s distance from the origin in the complex plane.

| The absolute value of $3 + 4i$ is: $|3 + 4i| = \sqrt{3^2 + 4^2} = \sqrt{25} = 5$ |
| --- |

### Amplitude:

The amplitude of a periodic function is the absolute value of one-half of the difference between its maximum value and its minimum value.

$$A = \frac{\text{max} - \text{min}}{2}$$

<table>
<thead>
<tr>
<th>The amplitude of $y = 2 \sin x$ is 2. $A = \frac{2 - (-2)}{2} = 2$</th>
</tr>
</thead>
</table>

### Binomial Theorem:

For any positive integer $n$:

$$(a + b)^n = \binom{n}{0} a^n + \binom{n}{1} a^{n-1}b + \binom{n}{2} a^{n-2}b^2 + \binom{n}{3} a^{n-3}b^3 + \ldots + \binom{n}{n} b^n$$

Where $$\binom{n}{r} = \frac{n!}{(n-r)!r!}$$

The exponents of the first term $(a)$ of the binomial start with $n$ and decrease by one each time. The exponents of the second term $(b)$ of the binomial start with 0 and increase by one each time. The coefficients in the binomial expansion can also be found in Pascal’s triangle.

<table>
<thead>
<tr>
<th>$(x + y)^5 = \binom{5}{0} x^5 y^0 + \binom{5}{1} x^4 y^1 + \binom{5}{2} x^3 y^2 + \binom{5}{3} x^2 y^3 + \binom{5}{4} x^1 y^4 + \binom{5}{5} x^0 y^5$</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Solve by completing the square: $x^2 + 6x - 5 = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $x^2 + 6x = 5$</td>
</tr>
<tr>
<td>2. $(x^2 + 6x + 9) = 5 + 9$</td>
</tr>
<tr>
<td>3. $(x + 3)^2 = 14$</td>
</tr>
<tr>
<td>4. $x + 3 = \pm \sqrt{14}$</td>
</tr>
<tr>
<td>5. $x = -3 \pm \sqrt{14}$</td>
</tr>
</tbody>
</table>

### Completing the Square:

Rewriting a quadratic polynomial (by adding/subtracting constants) so that it contains a perfect square trinomial.

<table>
<thead>
<tr>
<th>Complex Conjugates: A pair of complex numbers of the form $a + bi$ and $a - bi$ whose product will always be a real number.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(a + bi)(a - bi) = a^2 + b^2$</td>
</tr>
<tr>
<td>$(3 - 2i)(3 + 2i) = 9 - 4i^2 = 9 + 4 = 13$</td>
</tr>
</tbody>
</table>

### Complex numbers:

Numbers that can be expressed in the form $a + bi$ where $i = \sqrt{-1}$ and $a$ and $b$ are real numbers.

| Examples: $\sqrt{-4} = 2i$, $6 + 3i$, $-1 = -1 + 0i$ |
**Conic Sections:** The curves formed by the intersections of a plane with an infinite double right circular cone at different angles. The conic sections are the parabola, hyperbola, ellipse and circle.

**Parabola, ellipse, circle, hyperbola**

**Correlation:** The degree to which two or more attributes or measurements on the same group of elements show a tendency to vary together.

Because two variables are highly correlated does not mean that one causes the other.

This graph shows a high correlation between hours studied and grades.

**Cramer's Rule:** A method of solving a system of equations using determinants. Given the system

\[ \begin{align*}
ax + by &= c \\
px + qy &= f 
\end{align*} \]

Cramer’s rule states that the solution is:

\[ x = \frac{D_x}{D} \quad \text{and} \quad y = \frac{D_y}{D} \]

where

\[ D = \begin{vmatrix}
a & b \\
d & e
\end{vmatrix}, \quad D_x = \begin{vmatrix}
c & b \\
f & e
\end{vmatrix}, \quad \text{and} \quad D_y = \begin{vmatrix}
a & c \\
d & f
\end{vmatrix} \]

Solve for \( x \) using Cramer’s rule:

\[ \begin{align*}
3x + 2y &= 7 \\
5x - 2y &= 17
\end{align*} \]

\[ D = \begin{vmatrix}
3 & 2 \\
5 & -2
\end{vmatrix} = -6 - 10 = -16 \quad \text{and} \quad x = \frac{D_x}{D} = \frac{-48}{-16} = 3 \]

\[ D_x = \begin{vmatrix}
7 & 2 \\
17 & -2
\end{vmatrix} = -14 - 34 = -48 \quad y = \frac{D_y}{D} = \frac{-48}{24} = -2 \]

\[ D_y = \begin{vmatrix}
3 & 7 \\
5 & 17
\end{vmatrix} = 51 - 35 = 24 \]

**Delta \( \Delta \):** A Greek letter representing an incremental change.

Slope is defined as the change in \( y \) divided by the change in \( x \):

\[ m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \]

**Dependent/ Independent Events:** Dependent events are such that the occurrence of one event affects the probability of the occurrence of the other. Two events are independent if the outcome of one does not affect the outcome of the other.

Tossing a coin at the same time as rolling a number cube are independent events. The result of tossing the coin has no effect on the outcome of rolling the number cube.

Taking a sock from a drawer containing several socks and not replacing it, and then taking out a second sock are dependent events. Once the first sock is removed, the sample space has changed.
**Discriminant:** The discriminant is the part of the quadratic formula that is under the radical and thus indicates whether the roots of a quadratic equation are real or imaginary.

\[ D = b^2 - 4ac \]

<table>
<thead>
<tr>
<th>What is the nature of the roots of the following quadratic equations?</th>
</tr>
</thead>
</table>
| 1. \[ x^2 - 2x - 3 = 0 \]  
  \[ D = b^2 - 4ac = 4 - (-12) = 16 \]  
  \[ D \text{ is a positive perfect square, so two real rational roots.} \] |
| 2. \[ x^2 - 3x - 3 = 0 \]  
  \[ D = b^2 - 4ac = 9 - (-12) = 21 \]  
  \[ D \text{ is positive, so two real irrational roots.} \] |
| 3. \[ x^2 - 3x + 3 = 0 \]  
  \[ D = b^2 - 4ac = 9 - (12) = -3 \]  
  \[ D \text{ is negative, so two complex conjugate roots.} \] |
| 4. \[ x^2 - 6x + 9 = 0 \]  
  \[ D = b^2 - 4ac = 36 - (36) = 0 \]  
  \[ D \text{ is zero, so one real double root.} \] |

**Factor Theorem:** Given a polynomial \( P(x) \), then \( x - r \) is a factor of \( P(x) \) if and only if \( P(r) = 0 \).

| If \( P(x) = (x - r)q(x) \) then \( P(r) = 0 \) and \( P(r) = 0 \) then \( P(x) = (x - r)q(x) \) \( \) |
| For example: \( x^5 + 1 = (x + 1)(x^4 - x^3 + x^2 - x + 1) \) so \( (x + 1) \) is a factor of \( x^5 + 1 \) and \( P(-1) = (-1)^5 + 1 = 0 \) |

**Factorial:** The product of a given positive integer multiplied by all lesser positive integers: The symbol for factorial is \( ! \).

| Four factorial: \( 4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24 \) |

**Function Domain:** The set of possible \( x \) values (the independent variable) for which the function is defined.

| If \( f(x) = |x| \), the domain is all real numbers, the range is non-negative real numbers. \( \) |
| If \( f(x) = \frac{1}{x-2} \), the domain is all real numbers except 2, and the range is all real numbers except 0. \( \) |

**Functions (polynomial, exponential, logarithmic):** A function is a mapping of each element of the domain to one and only one element in the range. Polynomial function of positive whole number degree \( n \) with rational coefficients:

\[ P(x) = a_nx^n + a_{n-1}x^{n-1} + a_2x^2 + a_1x + a_0 \]

Exponential function: \( P(x) = ab^x \)

Logarithmic function: \( P(x) = \log_b x \)

**Inverse Function:** If \( f \) is a one-to-one function, then the inverse of \( f \) (notation: \( f^{-1} \)) is the set of all ordered pairs of the form \((y, x)\) where \((x, y)\) belongs to \( f \). The domain of \( f \) becomes the range of \( f^{-1} \) and the range of \( f \) becomes the domain of \( f^{-1} \).

| Polynomial function: \( P(x) = x^4 - 3x^2 + 2x - 1 \) \( \) |
| Exponential function: \( P(x) = 3^x \) \( \) |
| Logarithmic function: \( P(x) = \log_3 x \) \( \) |
| (The exponential function and logarithmic function are inverses of each other) \( \) |

\[ f(x) = x^3 + 2 \] and \( g(x) = \sqrt[3]{x-2} \) are inverses. Their graphs are symmetric with respect to the line \( y = x \).
**Inverse Matrix (to solve a system of equations):** The inverse of matrix \( A \) denoted by \( A^{-1} \), is the matrix such that \( AA^{-1} = I \) and \( A^{-1}A = I \) (where \( I \) is the identity matrix).

The system of equations represented by \( AX = B \) has the solution \( X = A^{-1}B \) if \( A \) is the coefficient matrix of a square system (same number of equations as variables) and is invertible (has an inverse).

\[
\begin{align*}
3x + 2y &= 7, \\
5x - 2y &= 17
\end{align*}
\]

Using inverse matrices,

\[
X = \begin{bmatrix}
x \\
y
\end{bmatrix} = \begin{bmatrix}
3 & 2 \\
5 & -2
\end{bmatrix}^{-1} \begin{bmatrix}
7 \\
17
\end{bmatrix} = \begin{bmatrix}
3 \\
-1
\end{bmatrix}
\]

**Law of Sines:** A proportion used to solve an oblique triangle.

The proportion uses the ratios of the sine of an angle to the length of the side opposite the angle:

\[
\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}
\]

Solve for \( a \):

\[
\sin 75^\circ = \frac{\sin 45^\circ}{a}, \quad a = 9.56
\]

**Logarithm:** A logarithm is an exponent; \( \log_b a = c \) if and only if \( b^c = a \).

A logarithm written with no base is a base 10 logarithm.

A logarithm written as \( \ln(x) = c \) (called a natural logarithm) is a base \( e \) logarithm and means \( e^c = x \).

\[
\log_2 8 = 3 \quad \text{because} \quad 2^3 = 8
\]

\[
\log 100 = 2 \quad \text{because} \quad 10^2 = 100
\]

\[
\ln(e^3) = 3 \quad \text{because} \quad e^3 = (e^3)
\]

**Matrices:** A rectangular array of numbers, consisting of horizontal rows and vertical columns.

The coefficient matrix of

\[
\begin{align*}
3x + 2y &= 7, \\
5x - 2y &= 17
\end{align*}
\]

is

\[
\begin{bmatrix}
3 & 2 \\
5 & -2
\end{bmatrix}
\]

**Mutually Exclusive Events:** Two events that cannot both happen at the same time.

If \( A \) and \( B \) are mutually exclusive, then \( P(A \text{ or } B) = P(A) + P(B) \).

Example of mutually exclusive: A pair of dice is rolled. The events of rolling a 5 and of rolling a double have NO outcomes in common.

Example of not mutually exclusive: A pair of dice is rolled. The events of rolling a 4 and of rolling a double have the outcome (2,2) in common.

**Normal Distribution Curve:** The theoretical curve where the data is distributed symmetrically about the mean. The curve is bell shaped. In a normal distribution, the mean, median and mode all coincide.
**Parent Function**: The original function before any transformation is applied.

<table>
<thead>
<tr>
<th>Parent function</th>
<th>Vertical Translation</th>
<th>Horizontal Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 2^x$</td>
<td>$y = 2^x + 2$</td>
<td>$y = 2^{(x+2)}$</td>
</tr>
</tbody>
</table>

**Pascal's Triangle**: A triangular array of numbers where each row is generated by taking the sum of the two entries above it in the previous row. It is useful in expanding binomials and in probability.

Pascal’s Triangle

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

**Period**: A function has positive period $b$, if $f(x) = f(x + b)$ for all $x$. The period of the function is the length of one complete cycle of the function.

The following function repeats every $2\pi$ units, so its period is $2\pi$.

**Piece-wise Functions**: A function defined by two or more equations over a given domain.

The absolute value function can be defined as a piece-wise function:

$$f(x) = |x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$$

**Probability (theoretical, experimental)**:

Theoretical probability is a ratio that compares the number of ways a certain event can occur to the total number of possible outcomes.

Experimental probability of an event is the ratio of the number of times the event actually occurs to the total number of trials.

The theoretical probability of heads when flipping a coin is 1:2 or $\frac{1}{2}$.

The experimental probability is often different in actual trials. But, the higher the number of flips the closer you come to the theoretical probability.

**Pythagorean Identities**:

The Fundamental Trig Identity: $\sin^2 x + \cos^2 x = 1$ and the two trig identities that are derived from it:

$1 + \tan^2 x = \sec^2 x$ and $1 + \cot^2 x = \csc^2 x$.

To prove the two Pythagorean identities from the fundamental trig identity,

1) Divide both sides by $\sin^2 x$ to get $1 + \cot^2 x = \csc^2 x$.

2) Divide both sides by $\cos^2 x$ to get $1 + \tan^2 x = \sec^2 x$. 
### Radian
A unit for measuring angles. On a circle, it is the measure of the central angle that intercepts an arc equal to the radius of the circle. There are exactly $2\pi$ radians in a circle. A radian is equal to about 57.3 degrees.

<table>
<thead>
<tr>
<th>Common radian measures are</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\pi}{6} = 30^\circ$, $\frac{\pi}{4} = 45^\circ$, $\frac{\pi}{3} = 60^\circ$,</td>
</tr>
<tr>
<td>$\frac{\pi}{2} = 90^\circ$, $\pi = 90^\circ$, $\frac{3\pi}{2} = 270^\circ$, $2\pi = 180^\circ$</td>
</tr>
</tbody>
</table>

### Radical Equation
An equation that includes one or more radical expressions containing variables.

To solve a radical equation, isolate the radical and raise both sides to the power which will eliminate the radical. Be careful, because squaring both sides of an equation can introduce extraneous solutions. So, when you raise both sides to an even power, you must check all solutions and reject those that do not solve the equation.

### Reciprocal Trig Identities
The reciprocal of $\sin(x)$ is $\csc(x)$, the reciprocal of $\cos(x)$ is $\sec(x)$, and the reciprocal of $\tan(x)$ is $\cot(x)$.

Example: Find $x$ if $\csc(x) = 2$.

If $\csc(x) = 2$ then $\sin(x) = \frac{1}{2}$.

Therefore $x$ would be $\frac{\pi}{6} = 30^\circ$.

### Regression Equation
An equation that best fits data that appears to model a given curve. The regression equation attempts to find models for sets of data.

Most graphing calculators have built-in regression programs for linear, quadratic, cubic, quartic, logarithmic and exponential models.

### Sampling
The process used to select a representative sample from a larger population.

Example: To try to predict the results of an election, a random sample of voters is taken.

The larger the sample and the more representative the sample is of the entire population, the more accurate the prediction.

### Sigma ($\Sigma$)

$\sum_{k=1}^{n} p(k) = p(1) + p(2) + p(3) + p(4) + \ldots + p(n)$

$$\sum_{k=1}^{3} \left(1 + \frac{1}{k}\right) = \left(1 + \frac{1}{1}\right) + \left(1 + \frac{1}{2}\right) + \left(1 + \frac{1}{3}\right) = 4 \frac{5}{6}$$

### Step Functions
A function whose domain is made up of discrete intervals and whose value is constant over these intervals. The graph resembles a set of steps.

The greatest integer function is a step function:

$$\lfloor x \rfloor = \text{the greatest integer less than or equal to } x$$

![Graph of a step function](image)
**Synthetic Division**: A short-cut alternative algorithm to long divide a polynomial by a binomial.

Use synthetic division to divide $3x^3 + 8x^2 + 5x - 7$ by $(x + 2)$.

<table>
<thead>
<tr>
<th>-2</th>
<th>3</th>
<th>8</th>
<th>5</th>
<th>-7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-6</td>
<td>-4</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-9</td>
<td>2</td>
<td>9</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Answer: $3x^2 + 2x + 1 - \frac{9}{x + 2}$

**Three-dimensional Coordinate**: Instead of an ordered pair, $(x, y)$ as in two-dimensions, there is an ordered triple $(x, y, z)$.

**Transcendental Function**: A function that is not a polynomial function. Functions which cannot be given by any algebraic expression involving only variables and constants.

Examples of transcendental functions are: the trig functions ($\sin(x)$, $\cos(x)$, $\tan(x)$ and their reciprocals), logarithmic functions, and exponential functions ($b^x$).

**Transformation (algebraic)**: The algebraic transformations include: vertical shifts, horizontal shifts, combinations of vertical and horizontal shifts, and reflections about the $x$-axis or the $y$-axis.

Given the graph of $f(x)$:

- $f(x) + c$ shifts $c$ units up if $c > 0$ and down if $c < 0$
- $f(x + c)$ shifts $c$ units left if $c > 0$ and right if $c < 0$
- $f(-x)$ reflects the graph over the $y$-axis
- $-f(x)$ reflects the graph over the $x$-axis

**Trigonometric Functions**: The six functions (sine, cosine, tangent, cotangent, secant and cosecant). They are defined in terms of ratios of sides of a right triangle.

They are also called circular functions when they are defined in terms of ordered pairs on a circle on a coordinate system.

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>$\sin \theta = \frac{\text{opp}}{\text{hyp}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\cos \theta = \frac{\text{adj}}{\text{hyp}}$</td>
</tr>
<tr>
<td></td>
<td>$\tan \theta = \frac{\text{opp}}{\text{adj}}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$(x, y)$</th>
<th>$\sin \theta = \frac{y}{r}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\cos \theta = \frac{x}{r}$</td>
</tr>
<tr>
<td></td>
<td>$\tan \theta = \frac{y}{x}$</td>
</tr>
</tbody>
</table>
**Unit Circle:** A circle used in trigonometry, on the Cartesian plane, with center (0,0) and radius 1. If an angle $\theta$ in standard position passes through the point $(x,y)$ on the unit circle then $\cos \theta = x$ and $\sin \theta = y$. Quadrant I of the unit circle with common angles in radians and their cosine (x) and sine (y) values.
Bloom’s Taxonomy and knowledge taxonomy verbs

Although Benjamin Bloom developed his classification of levels of intellectual behavior important in learning, (the now classic Taxonomy of Instructional Objectives) in 1956, research continues to support the value of objectives that involve the understanding and use of knowledge, those that are usually considered the most important goals of education. In his Taxonomy, Bloom identified three areas in which learning takes place – the cognitive, affective, and psychomotor domains. In the cognitive domain, which deals with the recall or recognition of knowledge and the development of intellectual ability, six major levels are usually identified.

These levels are knowledge, comprehension, application, analysis, synthesis, and evaluation. Each level becomes progressively more complex and builds upon the previous level. So, not only is synthesis a more complex operation than knowledge, but the ability to synthesize depends upon the foundation of knowledge possessed by the learner. By using questions requiring higher-order thinking, teacher questioning moves beyond an assessment tool and becomes a valuable instructional tool as well.

<table>
<thead>
<tr>
<th>Level</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Remember previously learned information, recognize and recall facts and specifics</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Understand the meaning of information, summarize or paraphrase given information</td>
</tr>
<tr>
<td>Application</td>
<td>Utilize knowledge in actual situations, use information in a situation different from the original learning context</td>
</tr>
<tr>
<td>Analysis</td>
<td>Break down objects or ideas into simpler parts, see how the parts relate and are organized, better understand the organization of the whole and the relationships between the parts</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Rearrange component ideas into a new whole, combine elements learned into a new entity</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Make judgments based on internal evidence or external criteria, make decisions, judge, or select based on criteria and rationale</td>
</tr>
</tbody>
</table>

Verb List

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Analysis</th>
<th>Synthesis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrange,</td>
<td>calculate,</td>
<td>relate, apply,</td>
<td>analyze,</td>
<td>arrange,</td>
<td>appraise,</td>
</tr>
<tr>
<td>define,</td>
<td>discuss, select,</td>
<td>change,</td>
<td>calculate,</td>
<td>collect,</td>
<td>argue, assess,</td>
</tr>
<tr>
<td>match,</td>
<td>convert,</td>
<td>choose,</td>
<td>categorize,</td>
<td>compose,</td>
<td>attach, choose</td>
</tr>
<tr>
<td>check,</td>
<td>restate, solve, classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>compute, demonstrate, discover, illustrate, predict, relate, show, sketch, solve</td>
<td>compare, contrast, differentiate, discriminate, distinguish, examine, experiment, question, test</td>
<td>compare, defend estimate, judge, predict, rate, select, support,</td>
<td>compare, defend estimate, judge, predict, rate, select, support,</td>
</tr>
<tr>
<td>order,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>analyze,</td>
<td>calculate,</td>
<td>compose,</td>
<td>attach, choose</td>
</tr>
<tr>
<td>choose,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>change,</td>
<td>choose,</td>
<td>construct,</td>
<td>compare, defend</td>
</tr>
<tr>
<td>find,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>choose,</td>
<td>compute,</td>
<td>create, design,</td>
<td>estimate, judge,</td>
</tr>
<tr>
<td>recall,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>compute,</td>
<td>demonstrate,</td>
<td>develop,</td>
<td>predict, rate,</td>
</tr>
<tr>
<td>group,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>demonstrate,</td>
<td>discover,</td>
<td>formulate,</td>
<td>select, support,</td>
</tr>
<tr>
<td>identify,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>discover,</td>
<td>illustrate,</td>
<td>organize,</td>
<td>evaluate,</td>
</tr>
<tr>
<td>label,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>illustrate,</td>
<td>predict,</td>
<td>plan, prepare,</td>
<td></td>
</tr>
<tr>
<td>list, select</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>predict,</td>
<td>relate, show,</td>
<td>propose, set up</td>
<td></td>
</tr>
<tr>
<td>locate,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>relate, show,</td>
<td>sketch, solve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>name,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td>sketch, solve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recognize,</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>count, draw</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>find</td>
<td>classify, give examples, predict, review, describe, explain, identify, generalize</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Developing Mathematical Thinking with Effective Questions

To help students build confidence and rely on their own understanding, ask…
Why is that true?
How did you reach that conclusion?
Does that make sense?
Can you make a model to show that?

To help students learn to reason mathematically, ask…
Is that true for all cases? Explain.
Can you think of a counterexample?
How would you prove that?
What assumptions are you making?

To check student progress, ask…
Can you explain what you have done so far? What else is there to do?
Why did you decide to use this method?
Can you think of another method that might have worked?
Is there a more efficient strategy?
What do you notice when…?
Why did you decide to organize your results like that?
Do you think this would work with other numbers?
Have you thought of all the possibilities? How can you be sure?

To help students collectively make sense of mathematics, ask…
What do you think about what _____ said?
Do you agree? Why or why not?
Does anyone have the same answer but a different way to explain it?
Do you understand what _____ is saying?
Can you convince the rest of us that your answer makes sense?

To encourage conjecturing, ask…
What would happen if…? What if not?
Do you see a pattern? Can you explain the pattern?
What are some possibilities here?
Can you predict the next one? What about the last one?
What decision do you think he/she should make?

To promote problem solving, ask…
What do you need to find out?
What information do you have?
What strategies are you going to use?
Will you do it mentally? With pencil and paper? Using a number line?
Will a calculator help?
What tools will you need?
What do you think the answer or result will be?
**To help when students get stuck, ask…**
How would you describe the problem in your own words?
What do you know that is not stated in the problem?
What facts do you have?
How did you tackle similar problems?
Could you try it with simpler numbers? Fewer numbers? Using a number line?
What about putting things in order?
Would it help to create a diagram? Make a table? Draw a picture?
Can you guess and check?
Have you compared your work with anyone else? What did other members of your group try?

**To make connections among ideas and applications, ask…**
How does this relate to…?
What ideas that we have learned before were useful in solving this problem?
What uses of mathematics did you find in the newspaper last night?
Can you give me an example of…?

**To encourage reflection, ask…**
How did you get your answer?
Does your answer seem reasonable? Why or why not?
Can you describe your method to us all? Can you explain why it works?
What if you had started with… rather than…?
What if you could only use…?
What have you learned or found out today?
Did you use or learn any new words today? What do they mean? How do you spell them?
What are the key points or big ideas in this lesson?

[www.pbs.org/teacherline](http://www.pbs.org/teacherline)
APPENDIX G
CONTENT IN FOCUS

Standard 4 – Geometry and Measurement

GLE 0506.4.1 Use basic formulas and visualization to find the area of geometric figures.

✓ 0506.4.1 Develop the formula for the area of a triangle as it relates to the area of a parallelogram/rectangle.

Derive the area formula for a parallelogram from the area formula for a rectangle: \( A = lw \).

Start with a parallelogram:

Cut off the triangle formed on the left side by the dashed line segment \( h \) and slide the triangle to the right edge of the figure to form a rectangle.

Final rectangle:

Apply formula for area of a rectangle: \( A = lw \) where length is \( b \) and height is \( h \) to derive area formula for a parallelogram: \( A = bh \).
Now students can use $A = bh$ to derive the **area formula for a triangle**.

Start with a triangle.

![Triangle](image)

Make a copy of it (for example, on patty paper) and use both triangles to construct a parallelogram.

![Parallelogram](image)

Notice that the parallelogram has the same base and height as the original triangle. If we found the area of the parallelogram, we would use $A = bh$, but we want the area of one triangle, so we need $A = \frac{1}{2}bh$ or $A = \frac{bh}{2}$

Notice the relationship between the area of a triangle and the area of a parallelogram that have the same base and height. The area of the triangle is one-half the area of the parallelogram.

In Grade 6, students will use $A = bh$ to derive the **area formula for a trapezoid**.

**GLE 0606.4.3**  Develop and use formulas to determine the circumference and area of circles, and the area of trapezoids, and develop strategies to find the area of composite shapes.

✓ **0606.4.14**  Relate the area of a trapezoid to the area of a parallelogram.
Start with a trapezoid:

![Trapezoid Diagram]

Make a copy of it (for example, on patty paper) and use both trapezoids to construct a parallelogram.

![Parallelogram Diagram]

Notice the parallelogram has the same height as the original trapezoid, but the base has changed. Using the area formula for a parallelogram, we would say: \( A = bh \), where \( b = (b_1 + b_2) \) and \( h = h \). So the area of this parallelogram is \( A = (b_1 + b_2)h \). Notice, however, that the area of the trapezoid is one-half the area of the parallelogram, so the area of the trapezoid is: \( A = \frac{1}{2}(b_1 + b_2)h \) or \( A = \frac{(b_1 + b_2)h}{2} \)

![Trapezoid Area Diagram]

Notice the relationship between the area of a trapezoid and the area of a parallelogram that have the same height and related bases. The area of the trapezoid is one-half the area of the parallelogram.

**0606.4.12** Derive the meaning of Pi using concrete models and/or appropriate technology.

**0606.4.13** Understand the relationships among the radius, diameter, circumference and area of a circle, and that the ratio of the circumference to the diameter is the same as the ratio of the area to the square of the radius, and that this ratio is called Pi.
To derive Pi, students can measure the circumference and diameter of various-sized circles and calculate the ratio of circumference to diameter. Once this is established, the formula for the circumference of a circle can be derived. Students can then focus on the relationships between the radius, diameter, circumference, and area of the circle.

- **0606.4.17** Use manipulatives to discover the volume of a pyramid is one-third the volume of the related prism (the heights and base areas are equal).
- **0606.4.18** Use manipulatives to discover the volume of a cone is one-third the volume of the related cylinder (the heights and base areas are equal).
- SPI 0606.4.5 Determine the surface area and volume of prisms, pyramids and cylinders.
- SPI 0606.4.6 Given the volume of a cone/pyramid, find the volume of the related cylinder/prism or vice versa.

“See-through” geosolids work well for discovering the volume relationships in the above checks. Use rice/sand to pour the contents of one into the other.

For SPI 0606.4.6, students use their knowledge of the relationship to solve problems.

For example, given a cone with volume of 10 cubic centimeters, find the volume of the cylinder with the same base and height. Since the relationship between their volumes is such that the volume of a cone is one-third the volume of the related cylinder, the volume of the cylinder is 3 times the volume of the cone. This implies the volume of the cylinder must be 30 cubic centimeters. Parallel problems can be explored for rectangular pyramids and prisms.

**Triangle Inequality Property**

- **0606.4.5** Model and use the Triangle Inequality Theorem.
- SPI 0606.4.3 Solve problems using the Triangle Inequality Theorem.

The **Triangle Inequality Property** states: The sum of the measures of any two sides of a triangle must be greater than the measure of the third side.

Using this property, students are to determine whether three side lengths could form a triangle. Many teachers use straws, spaghetti, or something similar to connect this activity to measurement. Students measure and cut different lengths and see if they can form a triangle. Students should discover the property through investigation.
Students often do not see connections between the underpinnings of an axiomatic approach and the applications presented to them. That is understandable because most of the information that we receive in life is not initially presented to us in an rule-based format; rather, through experience, we learn what to expect in certain situations, then try to make some rule that explains that phenomenon afterwards.

This has certainly been true for science and even in language arts in the search for grammatical and mechanical rules in communication. But in mathematics, we frequently begin with the axioms and proceed from there, without regard to the fact that these structures often originated in trial-and-error methodologies used to solve real problems. The formal proofs historically succeeded, not preceded, the exploration. Hence, it behooves us, when possible, to at least attempt to introduce our students to the praxis of induction and concrete discovery before we necessarily overlay deduction and abstraction.

And since there are is a lot of material to cover under the new standards, it also behooves us to find ways to compress and collapse what were formerly separate notions, lectures, and lessons into a unity of thought – both for the sake of time, and for the sake of making connections.

Consider a typical unit at the beginning of the year on properties of the real numbers. Let $a$ represent any real number ($a \in \mathbb{R}$): [Note that the symbology is more caught than taught. As the instructor uses mathematical symbols, notation, and language, the student catches on just as he did when learning to speak his native language as a child.]

<table>
<thead>
<tr>
<th>Symbolic</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a \cdot 1 = a$</td>
<td>Any (real) number times one is itself.</td>
</tr>
<tr>
<td>$\frac{a}{a} = 1$ [(a \neq 0)]</td>
<td>Any non-zero number divided by itself is one.</td>
</tr>
</tbody>
</table>

Most algebra students would recognize that $5 \cdot 1 = 5$, and that $\frac{5}{5} = 1$

So go ahead and talk about adding fractions now:

$$\frac{3}{7} \cdot 1 = \frac{3}{7}$$ and since $\frac{5}{5} = 1$, then

$$\frac{3 \cdot 5}{7 \cdot 5} = \frac{15}{35},$$ which is equal to $\frac{3}{7}$

Usually textbooks stop there and review the concept of rational numbers and their operations, which has no doubt been taught for several years to the student, but many still only memorize some algorithm for finding the answer rather than understanding why it works or developing their own algorithms that make sense.
So, instead of stopping there, go ahead and extrapolate the concept to algebraic fractions, i.e., fractions that contain variables:

\[
\frac{x}{7} \cdot 1 = \frac{x}{7} \quad \text{and since} \quad \frac{5}{5} = 1, \quad \text{then}
\]

\[
\frac{x \cdot 5}{7 \cdot 5} = \frac{5x}{35}, \quad \text{which is equal to} \quad \frac{x}{7}
\]

You see that notion that algebraic fractions are somehow different from regular fractions (pardon the lack of formal language here, but we are attempting to use terms that students in the early stages of algebra might use in their classroom discussions) is contrived by the textbook. Students see little difference between the two if the instructor makes the transition smoothly.

Indeed, this concept can be quickly carried forward to include polynomials once the concept of using the distributive law to include polynomials has been introduced (not necessarily mastered):

\[
\frac{(x+2)}{7} \cdot 1 = \frac{(x+2)}{7} \quad \text{and since} \quad \frac{5}{5} = 1, \quad \text{then}
\]

\[
\frac{(x+2) \cdot 5}{7 \cdot 5} = \frac{5(x+2)}{35}, \quad \text{which is equal to} \quad \frac{(x+2)}{7}
\]

The introduction of the concept of polynomials by using algebra tiles can make this a more concrete introduction to an abstract problem, and such an approach is warranted here.

So, the idea that the properties of the real numbers, operations on rational numbers and algebraic fractions (including polynomials) somehow belong to different chapters/units/delineations of time is inefficient, at best, and probably should be considered poor praxis and a recipe for frustration and underachievement, at worst, albeit common.

It is also worthy of note that concepts that are more difficult for students, such as algebraic and polynomial fractions, should be introduced as early in the school year as possible to allow all students time to master the concepts.

The student can, relatively quickly, be guided through one of the more challenging topics in algebra, operations with polynomials, in the first few weeks of the school year, allowing plenty of time for these difficult concepts to soak in.

Note how many Checks for Understanding can be included in one concept by not artificially separating it into concepts using only constants versus concepts using variables.
Checks for Understanding (Formative/Summative Assessment):

- 3102.1.1 Develop meaning for mathematical vocabulary.
- 3102.1.2 Use the terminology of mathematics correctly.
- 3102.1.3 Understand and use mathematical symbols, notation, and common mathematical abbreviations correctly.
- 3102.1.9 Identify and use properties of the real numbers (including commutative, associative, distributive, inverse, identity element, closure, reflexive, symmetric, transitive, operation properties of equality).
- 3102.1.10 Use algebraic properties to develop a valid mathematical argument.
- 3102.1.11 Use manipulatives to model algebraic concepts.
- 3102.1.15 Apply arithmetic concepts in algebraic contexts.

Similarly, rather than tell students about the effect that coefficients have on graphs, allow them to discover the rules for themselves, then direct them to ensure that their solutions are mathematically viable with regard to rigor and sufficiency.

For example, in graphing the polynomial $y = ax^2 + bx + c$, rather than explain how the graph changes when the values of $a$, $b$, and $c$ are changed, have the students use a graphing utility, such as a graphing calculator or computer application, to explore the concept. Combine this exercise with completing the square to form a different method for looking at parabolic graphs: $y = a(x-h)^2 + k$. These are examples of rich tasks, from which several checks for understanding, grade level expectations, and state performance indicators may be extracted.

Often in the mathematics classroom, instructors feel obligated to explain a concept thoroughly, then give word problems or real life examples. Another approach is to give the students a minimal instruction set, get them into a lab or exploration, then have them discover what the teacher was going to lecture on.

Also, this allows students to jump ahead in the book and be introduced to concepts that are not usually encountered until the later chapters as well as help students make connections among concepts instead of viewing them as separate entities. For example, there is no reason that students cannot graph $y = ax^2 + bx + c$ on the first day of class. All they need is a graphing calculator and minimal instructions on adjusting the window.

In data analysis, students enjoy using actual data from their world – surveys of favorite artists among classmates, results from throwing paper wads at a trashcan or dry erase board, etc. There is no need to make an elaborate lecture before doing data analysis. Let the students discover what you wanted to tell them by asking them questions about it and having them write about what they learned.
In order to achieve the content and rigor of the new standards, teachers will need to learn how to compress many topics into a few lessons – called rich tasks – and extract many objectives from those.

Also, the notion that topics must be introduced in the timeline given by a textbook is generally not ideal. Students are capable of, prefer to, and should combine topics that a typical textbook would consider separately.

The typical geometry teacher follows the textbook. Solids are at the end of the book. But is this the most advantageous way in which to teach the objectives?

What if, early in the school year, students are asked to construct geometric solids, like cylinders, cones, prisms, pyramids, etc.? Students could study two and three-dimensional objects simultaneously. And instead of introducing the formulas for volume first, have students fill their constructed 3-dimensional objects with popcorn or sand or birdseed and measure the volume using graduated cylinders from science class. The Pythagorean theorem, trigonometry, measuring angles, and many more objectives could be covered in just a few constructions. Also, do not think that students need to do that same task everyday until it is mastered. Introduce it, then move to another topic, then re-visit the original topic – only this time, take it deeper. Here are a few of the CLEs and Checks for Understanding that could be covered by such an approach.

**CLE 3108.4.1** Develop the structures of geometry, such as lines, angles, planes, and planar figures, and explore their properties and relationships.

**CLE 3108.4.2** Describe the properties of regular polygons, including comparative classification of them and special points and segments.

**CLE 3108.4.4** Develop geometric intuition and visualization through performing geometric constructions with straightedge/compass and with technology.

**CLE 3108.4.5** Extend the study of planar figures to three-dimensions, including the classical solid figures, and develop analysis through cross-sections.

**CLE 3108.4.6** Generate formulas for perimeter, area, and volume, including their use, dimensional analysis, and applications.

- **3108.1.11** Identify and sketch solids formed by revolving two-dimensional figures around lines.
- **3108.1.1** Check solutions after making reasonable estimates in appropriate units of quantities encountered in contextual situations.
- **3108.1.2** Determine position using spatial sense with two and three-dimensional coordinate systems.
✓ 3108.1.5 Use technology, hands-on activities, and manipulatives to develop the language and the concepts of geometry, including specialized vocabulary (e.g. graphing calculators, interactive geometry software such as Geometer’s Sketchpad and Cabri, algebra tiles, pattern blocks, tessellation tiles, MIRAs, mirrors, spinners, geoboards, conic section models, volume demonstration kits, Polydrons, measurement tools, compasses, PentaBlocks, pentominoes, cubes, tangrams).

✓ 3108.1.8 Understand how the similarity of right triangles allows the trigonometric functions sine, cosine, and tangent to be defined as ratio of sides.

✓ 3108.1.9 Expand analysis of units of measure to include area and volume.

✓ 3108.1.10 Use visualization, spatial reasoning, and geometric modeling to solve problems.

In this respect, we can often begin at the end of the textbook and work backward. Most athletes don’t learn the rules by reading the rulebook; they learn the rules by playing the game with a referee. Solids can be taught simultaneously with two-dimensional geometry. And constructions on a Cartesian plane (graph paper) lend themselves well to analytic geometry.

Another rich task that is often overlooked or placed in the category of interesting, but not necessary – especially in a curriculum packed with more material than last year – is that of tessellations. Tessellations can provide a forum to discuss almost all of the properties of lines, segments, and polygons – even three-dimensional objects can be studied through tessellations.

The use of construction and study is vital for the geometry teacher who wishes for his students to master the curriculum and enjoy doing so. Just give students straightedge and compass, and give them a project to construct. For example: construct a circle with radius 3.2 cm, and a 30 degree inscribed angle, and a central angle that contains or intersects that same arc.

And for teachers who do not feel creative, there are many books and ancillary materials on this subject, as well as a wealth of expert teachers who have many ideas they would love to share – all they have to do is ask.
In order to achieve the content and rigor of the new standards, teachers will need to learn how to compress many topics into a few lessons – called rich tasks – and extract many objectives from those.

Also, the notion that topics must be introduced in the timeline given by a textbook is generally not ideal. Students are capable of, prefer to, and should combine topics that a typical textbook would consider separately.

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**CLE 3108.4.2** Describe the properties of regular polygons, including comparative classification of them and special points and segments.

**CLE 3108.4.4** Develop geometric intuition and visualization through performing geometric constructions with straightedge/compass and with technology.

**CLE 3108.4.5** Extend the study of planar figures to three-dimensions, including the classical solid figures, and develop analysis through cross-sections.

**CLE 3108.4.6** Generate formulas for perimeter, area, and volume, including their use, dimensional analysis, and applications.

✓ **3108.1.1** Identify and sketch solids formed by revolving two-dimensional figures around lines.

✓ **3108.1.1** Check solutions after making reasonable estimates in appropriate units of quantities encountered in contextual situations.

✓ **3108.1.2** Determine position using spatial sense with two and three-dimensional coordinate systems.

✓ **3108.1.5** Use technology, hands-on activities, and manipulatives to develop the language and the concepts of geometry, including specialized vocabulary (e.g. graphing calculators, interactive geometry software such as Geometer’s Sketchpad and Cabri, algebra tiles, pattern blocks, tessellation tiles, MIRAs, mirrors, spinners, geoboards, conic section models, volume demonstration kits, Polydrons, measurement tools, compasses, PentaBlocks, pentominoes, cubes, tangrams).
The Algebra II curriculum is full of concepts that are more of an esoteric nature, and as a result, concrete examples are harder to come by for some of these than in Geometry or Algebra I. As in no other math course, Algebra II creates more challenges for students and teachers alike to utilize applications of transcendental and imaginary numbers with which students can relate.

Although real life examples for imaginary and complex numbers certainly exist, they are not in the domain of the common experience for most people. Imaginary/complex numbers crop up in electrical engineering, stock market (the Black-Scholes option pricing model), number theory, fluid mechanics, and other places, but they are not everyday occurrences for the rank-and-file. For this reason, students should be encouraged to find models when they exist and are within the scope of this course, but also to study the topics without always needing to find applications – at least immediately.

Much of the Algebra II course should involve students discovering how various functions and their inverses operate. Students should be encouraged to utilize graphing utilities, such as a graphing calculator or computer graphing application, so that many graphs and their transformations can be graphed in a short period of time to allow the student time to see what effect a particular multiplication or addition or exponential or logarithmic operation has on a function. Reflecting a function through the line $y = x$ allows the student to look at a geometric transformation that generates the graph of an inverse.

Instead of lecturing on trig functions, have students construct the unit circle, graph radii at 15 degree increments ($\frac{\pi}{12}$ radians), measure the rectangular coordinates on graph paper by hand, record the data as $\cos A$ and $\sin A$, respectively, record the values of $\frac{y}{x}$ as $\tan A$, etc., then allow students to graph the angle versus the $\sin A$, $\cos A$, and $\tan A$ on separate graphs, along with their reciprocals, $\csc A$, $\sec A$, and $\cot A$.

CLE 3103.4.1 Understand the trigonometric functions and their relationship to the unit circle.
CLE 3103.4.2 Know and use the basic identities of sine, cosine, and tangent as well as their reciprocals.
✓ 3103.1.7 Use the unit circle to determine the exact value of trigonometric functions for commonly used angles ($0^\circ$, $30^\circ$, $45^\circ$, $60^\circ$...).
This discovery approach works for $e^x$, $\ln(x)$, and other functions that comprise the body of the Algebra II course. Discrete mathematics, with its arithmetic and geometric sequences, are best learned in a lab situation, and with student-led discovery of the various formulas instead of teachers and textbooks presenting them in a lecture or printed format before students have a chance to discover them.

✓ 3103.1.8 Understand and describe the inverse relationship between exponential and logarithmic functions.

✓ 3103.1.9 Translate the syntax of technology to appropriate mathematical notation for non-linear and transcendental functions.

Conic sections can be as concrete as you like. For example, pour flavored gelatin in a pointed ice cream cone, pop it out on a plate, and cut with a fine wire. Students can make their own conic sections before studying them formally. Large parabolic reflectors can be made out of cardboard and aluminum foil and used as solar reflectors to boil water, or as a listening device.

SPI 3103.3.11 Graph conic sections (circles, parabolas, ellipses and hyperbolas) and understand the relationship between the standard form and the key characteristics of the graph.

In other words, allow the students time to explore the concepts before they see them in a textbook or the instructor lectures on the topics. This guided discovery approach is the best and fastest way for students to gain a feel for the nuances of the functions presented in the Algebra II curriculum.
Appendix H
Tennessee Mathematics Standards Acknowledgments

The Tennessee mathematics standards and professional development training were developed by the Tennessee Department of Education with the collaboration of the following professional educators:

Holly Anthony  Tennessee Tech University
Emily Barbee  Memphis City Schools
Micahel Brown  Clarksville Montgomery Schools
Elizabeth Burney  Knox County Schools
Sandy Christen  Oak Ridge Schools
Allison Clark  Shelby County Schools
Cindy Cliché  Rutherford County Schools
Lois Coles  Williamson County Schools
Gene Cowart  Rutherford County Schools
Deborah Currie  Memphis Urban Systemic Program
Kathryn Dillard  Metro Nashville Public Schools
Christy Evans  Hamilton County Schools
Phyllis Gearin  Weakley County Schools
John Graef  University of Tennessee at Chattanooga
Becky Holden  Hamilton County Schools
Melanie Holt  Jackson Madison County Schools
Jason Johnson  Middle Tennessee State University
Daphne Jones  Memphis City Schools
Tammy L. Jones  Wilson County Schools
Eddie Keel  Haywood County Schools
Dovie Kimmins  Middle Tennessee State University (TMSTEC)
Edith Lancaster  Hollow Rock-Bruceton Special School District
Marrie Lasater  Rutherford County Schools
Julie Martin  Metro Nashville Public Schools
Mary Martin  Middle Tennessee State University (TMSTEC)
Deborah McCallister  University of Tennessee at Chattanooga
Karla Mullins  Oak Ridge City Schools
Gary Petko  Knox County Schools
Larry C. Phillips  University of Phoenix, Williamson County Schools
Suzanne Reed  Lenoir City Schools
Carla Richards  Metro Nashville Public Schools
Ernie Roberts  Knox County Schools
Stacey Roddy  Hamilton County Schools
Susan Sanders  Carroll Public Schools
Ernestine Saville-Brock  Metro Nashville Public Schools
Nita Scott  Hardeman County Schools
Jo Ann Simmons  Trenton Special School District
P. Mark Taylor  University of Tennessee at Knoxville
Patricia Tyree  Williamson County Schools
Gail Walker  Henderson County Schools
Diane Webb  Rutherford County Schools  
Jeremy Winters  Middle Tennessee State University  
Mary Lee Witherspoon  Austin Peay State University

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