Course 1
Pacing Guide and Curriculum Reference
Based on the 2009 Virginia Standards of Learning

2015-2016

Henrico County Public Schools
Introduction

The Mathematics Curriculum Guide serves as a guide for teachers when planning instruction and assessment. It defines the content knowledge, skills, and understandings that are measured by the Standards of Learning assessment. It provides additional guidance to teachers as they develop an instructional program appropriate for their students. It also assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This Guide delineates in greater specificity the content that all teachers should teach and all students should learn.

The format of the Curriculum Guide facilitates teacher planning by identifying the key concepts, knowledge, and skills that should be the focus of instruction for each objective. The Curriculum Guide is divided into sections: Vertical Articulation, Curriculum Information, Essential Knowledge and Skills, Key Vocabulary, Essential Questions and Understandings, and Teacher Notes and Elaborations. The purpose of each section is explained below.

**Vertical Articulation:**
This section includes the foundational objectives and the future objectives correlated to each SOL.

**Curriculum Information:**
This section includes the objective and SOL Reporting Category, focus or topic, pacing guidelines, and links to VDOE’s Enhanced Scope and Sequence lessons.

**Essential Knowledge and Skills:**
Each objective is expanded in this section. What each student should know and be able to do in each objective is outlined. This is not meant to be an exhaustive list nor is a list that limits what taught in the classroom. This section is helpful to teachers when planning classroom assessments as it is a guide to the knowledge and skills that define the objective. (Taken from the Curriculum Framework)

**Key Vocabulary:**
This section includes vocabulary that is key to the objective and many times the first introduction for the student to new concepts and skills.

**Essential Questions and Understandings:**
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the objectives. (Taken from the Curriculum Framework)

**Teacher Notes and Elaborations:**
This section includes background information for the teacher. It contains content that is necessary for teaching this objective and may extend the teachers’ knowledge of the objective beyond the current grade level.

Special thanks to Prince William County Public Schools for allowing information from their curriculum documents to be included in this document.
### Course 1 Pacing and Curriculum Guide

**Course Outline**

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<th>First Marking Period</th>
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<th>Third Marking Period</th>
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<tr>
<td>6.3 - Integers</td>
<td>6.2* - Relationships among Fractions, Decimals, and Percents</td>
<td>6.16 - Probabilities</td>
<td>6.12 - Congruency</td>
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<td>6.11 - Coordinate Plane</td>
<td>6.4 - Multiplication &amp; Division of Fractions</td>
<td>6.14 - Graphical Methods</td>
<td>6.17 - Geometric and Arithmetic Sequences</td>
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<td>6.19 - Properties</td>
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<td>6.10ab - Problem Solving with Circumference</td>
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<td>6.18 - Variable Equations</td>
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<td>6.10cd - Problem Solving with Area, Perimeter, Surface Area &amp; Volume</td>
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<tr>
<td>6.20 - Inequalities</td>
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</table>

Download the HCPS Pacing Spreadsheet for more details

**GRADE 6 SOL TEST BLUEPRINT (45 QUESTIONS)**

*The Grade 6 SOL is a computer adaptive test (CAT)*

<table>
<thead>
<tr>
<th>Category</th>
<th>Questions</th>
<th>Percentage of Test</th>
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<tbody>
<tr>
<td>Number and Number Sense</td>
<td>9</td>
<td>20%</td>
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<tr>
<td>Computation and Estimation</td>
<td>8</td>
<td>18%</td>
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<tr>
<td>Measurement and Geometry</td>
<td>11</td>
<td>24%</td>
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<tr>
<td>Probability, Statistics, Patterns, Functions, and Algebra</td>
<td>17</td>
<td>38%</td>
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</table>

Henrico County Course 1 Website
Grade 6 Mathematics Formula Sheet
VDOE Middle School Math Vocabulary Cards
## Vertical Articulation

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<tr>
<th>Grade 4</th>
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<th>Grade 7</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6.1 describe/compare data using ratios</td>
<td>7.4 single and multistep practical problems</td>
<td>8.3 a) solve practical problems involving</td>
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<td></td>
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<td></td>
<td>with proportional reasoning</td>
<td>rational numbers, percent, ratios, and prop</td>
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<tr>
<td>Ratios/Proportions</td>
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<td>6.2 frac/dec/% - a) describe as ratios; b)</td>
<td>7.6 determine similarity of plane figures</td>
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<td>ID from representation; c) equiv relationships;</td>
<td>and write proportions to express</td>
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<td>relationships between similar quads and</td>
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<td>triangles</td>
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<td>4.2 a) compare and order fractions/mixed</td>
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<td>numbers; b) represent equivalent fractions;</td>
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<td>c) ID division statement that represents a</td>
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<td>fraction</td>
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<td>5.2 a) recognize/name fractions in their</td>
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<td>equivalent decimal form and vice versa; b)</td>
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<td>compare/order fracs and decimals</td>
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<td>6.2 a) frac/dec/% - a) describe as ratios;</td>
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<td>b) ID from representation; c) equiv</td>
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<td>relationships; d) compare/order</td>
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<td>7.1 b) determine scientific notation for</td>
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<td>numbers &gt; zero; c) compare/order fract/dec/%</td>
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<td>and scientific notation e) ID/describe</td>
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<td>absolute value for rational numbers</td>
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<td>Modeling/Comparing/Ordering</td>
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<td>7.1 b) determine similarity of plane figures and write proportions to express relationships between similar quads and triangles</td>
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<td>4.3 a) read/write/represent/ID decimals</td>
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<td>through thousandths; b) round to whole,</td>
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<td>tenth, hundredth; c) compare/order; d) write</td>
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<td>decimal and fraction equiv from a model</td>
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<td>5.18 c) model one-step linear equations</td>
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<td>using add/sub</td>
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<td>6.3 a) ID/represent integers; b) order/compare/compare; c) ID/describe absolute value of integers</td>
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<td>7.3 a) model operations</td>
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<td>(add/sub/mult/div) w/ integers</td>
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<td>4.5 a) determine common multiples/factors</td>
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<td>5.3 a) ID/describe characteristics of prime/</td>
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<td>composite numbers; b) ID/describe characteristics of even/odd numbers</td>
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<td>6.4 Represent mult and div of fract</td>
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<td>8.2 describe orally/in writing relationships between subsets of the real number system</td>
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<td>Exponents/Squares/Square Roots</td>
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<td>6.5 investigate/describe positive exponents, perfect squares</td>
<td>7.1 a) investigate/describe negative exponents; d) determine square roots</td>
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<td>7.1 a) investigate/describe negative</td>
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<td>exponents; d) determine square roots</td>
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<td>8.5 a) determine if a number is a perfect</td>
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<td>square; b) find two consecutive whole numbers between which a square root lies</td>
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<td>Operations/Recall</td>
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<td>4.5 b) add/sub fractions w/ like and unlike denominators; c) add/sub decimals</td>
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<td>5.5 a) find sum/diff/product/quotient of two decimals through thousandths</td>
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<td>6.6 a) mult/div fractions</td>
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<td>7.3 b) add/sub/mult/div integers</td>
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<td>Solve Practical Problems</td>
<td>Expressions/Operations</td>
<td>Measurement Apps - Geom Figures</td>
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<td>4.5 d) solve single-/multistep practical problems involving add/sub fractions and decimals</td>
<td>5.5 b) create/solve single-/multistep practical problems involving add/sub/mult/div decimals</td>
<td>6.6 b) solve practical problems involving add/sub/mult/div fractions</td>
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<td>4.4 d) solve single-step and multistep add/sub/mult problems with whole numbers</td>
<td>5.4 create/solve single-/multistep practical problems involving add/sub/mult/div of whole numbers</td>
<td>6.7 solve practical problems involving add/sub/mult/div decimals</td>
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<td>5.6 solve single-/multistep practical problems involving add/sub w/ fractions and mixed numbers</td>
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<td>5.7 evaluate whole number numerical expressions using order of operations</td>
<td>6.8 evaluate whole number expressions using order of operations</td>
<td>7.13 a) write verbal expressions as algebraic expressions and sentences as equations and vice versa; b) evaluate algebraic expressions</td>
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<td>8.1 a) simplify numerical expressions involving positive exponents, using rational numbers, order of operations, properties</td>
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<td>8.4 evaluate algebraic expressions using order of operations</td>
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<td>8.6 a) estimate/measure weight/mass, describe results in U.S. Cust/metric units; b) ID equiv measurements between units within U.S. Cust system and between units within metric system</td>
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<td>5.8 a) find perimeter/area/volume; b) differentiate among perimeter/area/ volume, ID which measure is appropriate; c) ID equiv measurements within metric system; d) estimate/measure U.S. Cust/metric; e) choose appropriate unit of measure w/ U.S. Cust/ metric</td>
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<td>6.9 make ballpark comparisons between U.S. Cust/metric system</td>
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<td>7.5 a) describe volume/surface area of cylinders; b) solve practical problems involving volume/surface area of rect. prims and cylinders; c) describe how changes in measured attribute affects volume/surface area</td>
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<td>8.7 a) investigate/solve practical problems involving volume/surface area of prisms, cylinders, cones, pyramids; b) describe how changes in measured attribute affects volume/surface area</td>
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<td>8.11 solve practical area/perimeter problems involving composite plane figures</td>
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<td>8.11 solve practical area/perimeter problems involving composite plane figures</td>
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<tr>
<td>Plane and Solid Figures</td>
<td>4.10 a) ID/describe representations of points/lines/line segments/rays/angles; b) ID representations of lines illustrating parallelism/perpendicularity</td>
<td>5.11 measure right/acute/obtuse/straight angles</td>
<td>6.11 a) ID coordinates of a point in a coordinate plane; b) graph ordered pairs in coordinate plane</td>
<td>7.8 represent transformations of polygons in the coordinate plane by graphing</td>
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<td>4.11 a) investigate congruence of plane figures after transformations; b) recognize images of figures from transformations</td>
<td>5.13 a) using plane figures will develop definitions of plane figures; b) investigate/describe results of combining/subdividing plane figures</td>
<td>6.12 determine congruence of segments/angles/polygons</td>
<td>7.6 determine similarity of plane figures and write proportions to express relationships between similar quads and triangles</td>
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<td>4.12 a) define polygon; b) ID polygons with 10 or fewer sides</td>
<td>5.12 a) classify angles as right/acute/obtuse/straight; b) triangles as right/acute/obtuse/equilateral/scalene/isosceles.</td>
<td>6.13 ID/describe properties of quadrilaterals</td>
<td>7.7 compare/contrast quadrilaterals based on properties</td>
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<tr>
<td>Collect/Represent Data</td>
<td>4.14 collect/organize/display/interpret data from variety of graphs</td>
<td>5.15 collect/organize/interpret data, using stem-and-leaf plots/line graphs</td>
<td>6.14 a) construct circle graphs; b) draw conclusions/make predictions, using circle graphs; c) compare/contrast graphs</td>
<td>7.11 a) construct/analyze histograms; b) compare/contrast histograms</td>
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<tr>
<td>Measures of Center</td>
<td>4.13 a) predict the likelihood of simple event; b) represent probability as a number between 0 and 1</td>
<td>5.14 make predictions/determine probability by constructing a sample space</td>
<td>6.16 a) compare/contrast dep/indep events; b) determine probabilities for dep/indep events</td>
<td>7.9 investigate/describe the difference between the experimental/theoretical probability</td>
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<tr>
<td>Probability</td>
<td>4.15 recognize/create/extend numerical/geometric patterns</td>
<td>5.17 describe/express the relationship in a number pattern</td>
<td>6.17 ID/extend geometric/arithmetic sequences</td>
<td>7.2 describe/represent arithmetic/geometric sequences using variable expressions</td>
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<tr>
<td>Alg Patt/Seq</td>
<td>4.16 recognize/create/extend numerical/geometric patterns</td>
<td>5.18 describe/express the relationship in a number pattern</td>
<td>6.18 describe/extend geometric/arithmetic sequences</td>
<td>7.3 describe/represent arithmetic/geometric sequences using variable expressions</td>
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<tr>
<td>Properties</td>
<td>4.16 b) investigate/describe associative property for add/mult</td>
<td>5.19 distributive property of mult over addition</td>
<td>6.19 a) investigate/recognition identity properties for add/mult; b) multiplicative property of zero; c) inverse property for mult</td>
<td>7.16 a) apply properties w/ real numbers: commutative and associative properties for add/mult; b) distributive property; c) additive/multiplicative identity properties; d) additive/multiplicative inverse properties; e) multiplicative property of zero</td>
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<td>4.16 a) recognize/demonstrate meaning of equality in equation</td>
<td>5.18 a) investigate/describe concept of variable; b) write open sentence using variable; c) model one-step linear equations using add/sub; d) create problems based on open sentence</td>
<td>6.18 solve one-step linear equations in one variable</td>
<td>7.14 a) solve one- and two-step linear equations; b) solve practical problems in one variable</td>
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Equations and Inequalities

|                         | 4.16 a) recognize/demonstrate meaning of equality in equation | 5.18 a) investigate/describe concept of variable; b) write open sentence using variable; c) model one-step linear equations using add/sub; d) create problems based on open sentence | 6.20 graph inequalities on number line | 7.15 a) solve one-step inequalities; b) graph solutions on number line | 8.16 graph linear equation in two variables |
|                         |                                                                  |                                                                  | 7.12 represent relationships with tables, graphs, rules, and words |                                                                  | 8.14 make connections between any two representations (tables, graphs, words, rules) |
|                         |                                                                  |                                                                  |                                                                  | 8.17 ID domain, range, indep/dep variable |                                                                  |

Virginia Department of Education - Fall 2010

DRAFT - Vertical Articulation of the 2009 Mathematics Standards of Learning
In the middle grades, the focus of mathematics learning is to
- build on students’ concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students in the middle grades focus on mastering rational numbers. Rational numbers play a critical role in the development of proportional reasoning and advanced mathematical thinking. The study of rational numbers builds on the understanding of whole numbers, fractions, and decimals developed by students in the elementary grades. Proportional reasoning is the key to making connections to most middle school mathematics topics.

- Students develop an understanding of integers and rational numbers by using concrete, pictorial, and abstract representations. They learn how to use equivalent representations of fractions, decimals, and percents and recognize the advantages and disadvantages of each type of representation. Flexible thinking about rational number representations is encouraged when students solve problems.

- Students develop an understanding of the properties of operations on real numbers through experiences with rational numbers and by applying the order of operations.

- Students use a variety of concrete, pictorial, and abstract representations to develop proportional reasoning skills. Ratios and proportions are a major focus of mathematics learning in the middle grades.
### SOL Reporting Category
Number and Number Sense

### Focus
Relationships among Fractions, Decimals, and Percents

#### Virginia SOL 6.1
The student will describe and compare data, using ratios, and will use appropriate notations, such as \( \frac{a}{b} \), \( a:b \), and \( a:b \).

#### HCPS Website
SOL 6.1 - Ratios

#### DOE Lesson Plans
Field Goals, Balls, and Nets (PDF) - Using ratios to compare quantities (Word)

### SOL 6.1
The student will describe and compare data, using ratios, and will use appropriate notations, such as \( \frac{a}{b} \), \( a:b \), and \( a:b \).

### Key Vocabulary
- Ratio
- Part
- Whole
- Fraction
- Rate
- Numerator
- Denominator

### Essential Knowledge and Skills

#### Key Vocabulary
- Description of relationships within a set by comparing part of the set to the entire set.
- Describe a relationship between two sets by comparing part of one set to a corresponding part of the other set.
- Describe a relationship between two sets by comparing all of one set to all of the other set.
- Describe a relationship within a set by comparing one part of the set to another part of the same set.
- Represent a relationship in words that makes a comparison by using the notations \( \frac{a}{b} \), \( a:b \), and \( a:b \).
- Determine a ratio from a pictorial representation.
- Create a relationship in words for a given ratio expressed symbolically.

### Essential Questions and Understandings
- What is a ratio?
  - A ratio is a comparison of any two quantities. A ratio is used to represent relationships within a set and between two sets. A ratio can be written using fraction form \( \frac{2}{3} \), a colon (2:3), or the word to (2 to 3).

### Teacher Notes and Elaborations
- Describe the different forms of comparisons
  - **Part-whole**
    - There is a class of 12 boys and 14 girls. What is the ratio of boys to the class?
  - **Part-part of the same set**
    - There is a class of 12 boys and 14 girls. What is the ratio of boys to girls in the class?
  - **Part-part of different sets**
    - There is a math class with 10 boys and 13 girls and an English class with 16 boys and 12 girls. What is the ratio of boys in math to girls in English?
  - **Whole-whole**
    - There is a math class with 10 boys and 13 girls and an English class with 16 boys and 12 girls. What is the ratio of students in the English class to students in the math class?
- Order of the quantities in a ratio is directly related to the order of the quantities expressed in the relationship
  - **EX:** ratio of boys in a class to the girls in the class, the ratio must be expressed as the number of boys to the number of girls
- All fractions are ratios and all ratios are fractions
- Ratios may or may not be written in simplest form
- Rates can be expressed as ratios \( \frac{\text{miles}}{\text{min}} \)
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<th>SOL Reporting Category</th>
<th>Essential Questions and Understandings</th>
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<tbody>
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**Focus**
Relationships among Fractions, Decimals, and Percents

**Virginia SOL 6.1**
The student will describe and compare data, using ratios, and will use appropriate notations, such as \( \frac{a}{b} \), \( a \) to \( b \), and \( a:b \).

### Examples of practice problems:

1. In the PE closet there are 6 kick balls, 10 tennis balls, 9 softballs, and 4 footballs.
   - What is the ratio of soft balls to kick balls (simplest form)?
   - What is the ratio of all the balls in the closet to the footballs (simplest form)?
   - What is the ratio of tennis balls to softballs (simplest form)?
   - What is the ratio of softballs to tennis balls? How does this differ from tennis balls to softballs or is it the same ratio?

2. What is the ratio of circle to squares?

   ![Diagram of circles and squares]

3. What is the ratio of gray and white circles to black circles?

   ![Diagram of gray, white, and black circles]
6.1 The student will describe and compare data, using ratios, and will use appropriate notations, such as $\frac{a}{b}$, $a$ to $b$, and $a:b$.

### UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)
- A ratio is a comparison of any two quantities. A ratio is used to represent relationships within and between sets.
- A ratio can compare part of a set to the entire set (part-whole comparison).
- A ratio can compare part of a set to another part of the same set (part-part comparison).
- A ratio can compare part of a set to a corresponding part of another set (part-part comparison).
- A ratio can compare all of a set to all of another set (whole-whole comparison).
- The order of the quantities in a ratio is directly related to the order of the quantities expressed in the relationship. For example, if asked for the ratio of the number of cats to dogs in a park, the ratio must be expressed as the number of cats to the number of dogs, in that order.
- A ratio is a multiplicative comparison of two numbers, measures, or quantities.
- All fractions are ratios and vice versa.
- Ratios may or may not be written in simplest form.
- Ratios can compare two parts of a whole.
- Rates can be expressed as ratios.

### ESSENTIAL UNDERSTANDINGS
- What is a ratio?
  A ratio is a comparison of any two quantities. A ratio is used to represent relationships within a set and between two sets. A ratio can be written using fraction form ($\frac{2}{3}$), a colon (2:3), or the word to (2 to 3).

### ESSENTIAL KNOWLEDGE AND SKILLS
The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
- Describe a relationship within a set by comparing part of the set to the entire set.
- Describe a relationship between two sets by comparing part of one set to a corresponding part of the other set.
- Describe a relationship between two sets by comparing all of one set to all of the other set.
- Describe a relationship within a set by comparing one part of the set to another part of the same set.
- Represent a relationship in words that makes a comparison by using the notations $\frac{a}{b}$, $a:b$, and $a$ to $b$.
- Create a relationship in words for a given ratio expressed symbolically.
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<td><strong>Focus</strong></td>
<td><em>What is the relationship among fractions, decimals and percents?</em> The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:</td>
<td><strong>Teacher Notes and Elaborations</strong></td>
</tr>
</tbody>
</table>
| Relationships among Fractions, Decimals, and Percents | - Identify the decimal and percent equivalents for numbers written in fraction form including repeating decimals. | □ **Percent** means “per 100” or “out of 100” (Percent is another name for hundredths- 35% = thirty five hundredths)  
-o Percent is a ratio in which the first term is compared to 100  
-o A number followed by a percent symbol (%) is equivalent to that number with a denominator of 100  
  ▪ $20\% = \frac{20}{100} = \frac{2}{10} = \frac{1}{5}$  
  ▪ $75\% = \frac{75}{100} = \frac{3}{4}$  
-o To change a percent to a fraction: use the percent as the numerator and use 100 as the denominator.  
  ▪ $20\% = \frac{20}{100} = \frac{2}{10} = \frac{1}{5}$  
-o To change a percent to a decimal: divide the percent by 100  
  ▪ $39.2\% = \frac{39.2}{100} = 0.392$  
-o Percents are used in real life  
  ▪ Taxes  
  ▪ Sales (discount)  
  ▪ Data description  
  ▪ Data comparison  |
| Virginia SOL 6.2 | - Represent fractions, decimals, and percents on a number line.  
-o Represent in fraction, decimal, and percent form a given shaded region of a grid.  
-o Compare two fractions with denominators of 12 or less using manipulatives, pictorial representations, number lines, and symbols ($<, \leq, \geq, >, =$).  
-o Compare two decimals, through thousandths, using manipulatives, pictorial representations, number lines, and symbols ($<, \leq, \geq, >, =$).  
-o Compare two percents using pictorial representations and symbols ($<, \leq, \geq, >, =$).  
-o Order no more than 3 fractions, decimals, and percents (decimals through thousandths, fractions with denominators of 12 or less), in ascending or descending order. | |
| SOL 6.2ab – Representations of Fractions  
SOL 6.2cd – Compare & Order |

**Key Vocabulary**

- Essential Questions and Understandings
- Teacher Notes and Elaborations

Return to Course Outline
### SOL Reporting Category
Number and Number Sense

### Focus
Relationships among Fractions, Decimals, and Percents

### Virginia SOL 6.2
The student will:
- **a.** investigate and describe fractions, decimals and percents as ratios;
- **b.** identify a given fraction, decimal or percent from a representation;
- **c.** demonstrate equivalent relationships among fractions, decimals, and percents;* and
- **d.** compare and order fractions, decimals, and percents.*

*SOL test items measuring Objective 6.2c-d will be completed without the use of a calculator.

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### Key Vocabulary
- Ascending
- Benchmark
- Composite number
- Decimal
- Denominator
- Descending
- Ellipses
- Equivalent
- Factor
- Fraction
- Greatest common factor
- Inequality
- Least common multiple
- Mark up
- Multiple
- Numerator
- Percent
- Prime number
- Prime factorization
- Repeating decimal
- Tax
- Terminating decimal

### Teacher Notes and Elaborations
- The decimal point is a symbol that separates the whole number part from the fractional part of a number; it separates the whole number amount from the part of a number that is less than one.
- Some fractions can be rewritten as equivalent fractions with denominators of powers of 10, and can be represented as decimals or percents.
  - \( \frac{4}{5} = \frac{8}{10} = \frac{0.80}{100} = 0.80 = 80\% \)
- Benchmark fractions \( 0, \frac{1}{2}, 1 \) should be used to compare fractions.
  - When comparing two fractions, use \( \frac{1}{2} \) as a benchmark.
    - Which is greater, \( \frac{4}{7} \) or \( \frac{2}{5} \)? \( \frac{4}{7} \) is greater than \( \frac{1}{2} \) because 4, the numerator, represents more than half of 7, the denominator.
    - \( \frac{2}{5} \) is less than \( \frac{1}{2} \) because 2, the numerator, is less than half of 5, the denominator.
    - Therefore, \( \frac{4}{7} > \frac{2}{5} \).
  - When comparing two fractions close to 1, use the distance to 1 as a benchmark.
    - Which is greater, \( \frac{7}{8} \) or \( \frac{10}{11} \)? \( \frac{7}{8} \) is \( \frac{1}{8} \) away from 1 whole. \( \frac{10}{11} \) is \( \frac{1}{11} \) away from 1 whole.
    - Since \( \frac{1}{8} > \frac{1}{11} \), then \( \frac{7}{8} \) is a greater distance from 1 whole than \( \frac{10}{11} \).
    - So \( \frac{7}{8} > \frac{10}{11} \).

(continued)
### SOL Reporting Category
Number and Number Sense

### Focus
Relationships among Fractions, Decimals, and Percents

### Virginia SOL 6.2
The student will
a. investigate and describe fractions, decimals and percents as ratios;
b. identify a given fraction, decimal or percent from a representation;
c. demonstrate equivalent relationships among fractions, decimals, and percents;* and  
d. compare and order fractions, decimals, and percents.*

*SOL test items measuring Objective 6.2c-d will be completed without the use of a calculator.

| Terminating decimals and repeating decimals need to be represented in lessons.  
| Fractions such as $\frac{1}{8}$ can be represented by terminating decimals, decimals that end. $\frac{1}{8} = 0.125$  
| Fractions such as $\frac{2}{9}$ can be represented by repeating decimals, decimals that do not end but continue to repeat. $\frac{2}{9} = 0.222...$  
| The repeating decimal can be written with ellipses (three dots) as in 0.222... OR denoted with a bar above the digits that repeat as in $0.\overline{2}$

| Decimals, fractions, and percents can be represented using concrete materials  
| Represent fractions, decimals, and percents on a number line  
| Represent fractions, decimals, and percents using Base-10 blocks  
| Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100  
| Represent fractions, decimals, and percents using decimal squares  
| Represent, by shading a grid, a fraction, decimal, and percent  
| Represent in fraction, decimal, and percent form a given shaded region of a grid

| Compare two decimals through thousandths using manipulatives, pictorial representations, number lines, and symbols ($<,\leq,>,\geq,=)$

| Compare two fractions with denominators of 12 or less using manipulatives, pictorial representations, number lines, and symbols ($<,\leq,>,\geq,=)$

| Compare two percents using pictorial representations and symbols ($<,\leq,>,\geq,=)$

| Order no more than 3 fractions, decimals, and percents (decimals through thousandths, fractions with denominators of 12 or less), in ascending or descending order.

| Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100.

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TERMINATING DECIMALS AND REPEATING DECIMALS

- Fractions such as $\frac{1}{8}$ can be represented by terminating decimals, decimals that end. $\frac{1}{8} = 0.125$
- Fractions such as $\frac{2}{9}$ can be represented by repeating decimals, decimals that do not end but continue to repeat. $\frac{2}{9} = 0.222...$
  - The repeating decimal can be written with ellipses (three dots) as in 0.222... OR denoted with a bar above the digits that repeat as in $0.\overline{2}$

- Decimals, fractions, and percents can be represented using concrete materials:
  - Represent fractions, decimals, and percents on a number line.
  - Represent fractions, decimals, and percents using Base-10 blocks.
  - Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100.
  - Represent fractions, decimals, and percents using decimal squares.
  - Represent, by shading a grid, a fraction, decimal, and percent.
  - Represent in fraction, decimal, and percent form a given shaded region of a grid.

- Compare two decimals through thousandths using manipulatives, pictorial representations, number lines, and symbols ($<,\leq,>,\geq,=)$.
- Compare two fractions with denominators of 12 or less using manipulatives, pictorial representations, number lines, and symbols ($<,\leq,>,\geq,=)$.
- Compare two percents using pictorial representations and symbols ($<,\leq,>,\geq,=)$.
- Order no more than 3 fractions, decimals, and percents (decimals through thousandths, fractions with denominators of 12 or less), in ascending or descending order.
- Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100.

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<tr>
<td><strong>Focus</strong></td>
<td>Examples of practice problems:</td>
</tr>
<tr>
<td>Relationships among Fractions, Decimals, and Percents</td>
<td>1. What percent of this grid is shaded?</td>
</tr>
<tr>
<td><strong>Virginia SOL 6.2</strong></td>
<td>2. Of the students in Mrs. Bendit’s class, 35% are girls. Give the decimal and fraction that represents the girls in Mrs. Bendit’s class.</td>
</tr>
<tr>
<td>The student will</td>
<td>3. Put the following numbers in ascending order.</td>
</tr>
<tr>
<td>a. investigate and describe fractions, decimals and percents as ratios;</td>
<td></td>
</tr>
<tr>
<td>b. identify a given fraction, decimal or percent from a representation;</td>
<td></td>
</tr>
<tr>
<td>c. demonstrate equivalent relationships among fractions, decimals, and percents;*</td>
<td></td>
</tr>
<tr>
<td>d. compare and order fractions, decimals, and percents.*</td>
<td></td>
</tr>
<tr>
<td>*SOL test items measuring Objective 6.2c-d will be completed without the use of a calculator.</td>
<td></td>
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Examples of practice problems:
1. What percent of this grid is shaded?

2. Of the students in Mrs. Bendit’s class, 35% are girls. Give the decimal and fraction that represents the girls in Mrs. Bendit’s class.

3. Put the following numbers in ascending order.
6.2 The student will
a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

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<tr>
<td><strong>(Background Information for Instructor Use Only)</strong></td>
<td><strong>What is the relationship among fractions, decimals and percents?</strong> Fractions, decimals, and percents are three different ways to express the same number. A ratio can be written using fraction form ( \frac{2}{3} ), a colon (2:3), or the word <em>to</em> (2 to 3). Any number that can be written as a fraction can be expressed as a terminating or repeating decimal or a percent.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• <em>Percent</em> means “per 100” or how many “out of 100”; <em>percent</em> is another name for <em>hundredths</em>.</td>
<td></td>
<td>• Identify the decimal and percent equivalents for numbers written in fraction form including repeating decimals.</td>
</tr>
<tr>
<td>• A number followed by a percent symbol (%) is equivalent to that number with a denominator of 100 (e.g., 30% = ( \frac{30}{100} = \frac{3}{10} = 0.3 )).</td>
<td></td>
<td>• Represent fractions, decimals, and percents on a number line.</td>
</tr>
<tr>
<td>• Percents can be expressed as fractions with a denominator of 100 (e.g., 75% = ( \frac{75}{100} = \frac{3}{4} )).</td>
<td></td>
<td>• Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100.</td>
</tr>
<tr>
<td>• Percents can be expressed as decimal (e.g., 38% = ( \frac{38}{100} = 0.38 )).</td>
<td></td>
<td>• Represent, by shading a grid, a fraction, decimal, and percent.</td>
</tr>
<tr>
<td>• Some fractions can be rewritten as equivalent fractions with denominators of powers of 10, and can be represented as decimals or percents (e.g., ( \frac{3}{5} = \frac{6}{10} = \frac{60}{100} = 0.60 = 60% )).</td>
<td></td>
<td>• Represent in fraction, decimal, and percent form a given shaded region of a grid.</td>
</tr>
<tr>
<td>• Decimals, fractions, and percents can be represented using concrete materials (e.g., Base-10 blocks, number lines, decimal squares, or grid paper).</td>
<td></td>
<td>• Compare two decimals through thousandths using manipulatives, pictorial representations, number lines, and symbols (&lt;, ( \leq ), ( \geq ), &gt;, =).</td>
</tr>
<tr>
<td>• Percents can be represented by drawing shaded regions on grids or by finding a location on number lines.</td>
<td></td>
<td>• Compare two fractions with denominators of 12 or</td>
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</table>
6.2 The student will
a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

### UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- Fractions, decimals and percents are equivalent forms representing a given number.
- The decimal point is a symbol that separates the whole number part from the fractional part of a number.
- The decimal point separates the whole number amount from the part of a number that is less than one.
- The symbol `*` can be used in Grade 6 in place of “x” to indicate multiplication.
- Strategies using 0, 1/2 and 1 as benchmarks can be used to compare fractions.
- When comparing two fractions, use 1/2 as a benchmark. Example: Which is greater, 4/7 or 3/9?

\[
\frac{4}{7} \text{ is greater than } \frac{1}{2} \text{ because 4, the numerator, represents more than half of 7, the denominator. The denominator tells the number of parts that make the whole.} \\
\frac{3}{9} \text{ is less than } \frac{1}{2} \text{ because 3, the numerator, is less than half of 9, the denominator, which tells the number of parts that make the whole. Therefore,}
\]

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<td>less using manipulatives, pictorial representations, number lines, and symbols (&lt;, ≤, ≥, &gt;, =).</td>
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<td></td>
<td>Compare two percents using pictorial representations and symbols (&lt;, ≤, ≥, &gt;, =).</td>
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<td></td>
<td>Order no more than 3 fractions, decimals, and percents (decimals through thousandths, fractions with denominators of 12 or less), in ascending or descending order.</td>
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</table>
Standard 6.2

The student will
a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

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<tr>
<td>( \frac{4}{7} &gt; \frac{3}{9} ).</td>
<td></td>
<td></td>
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<tr>
<td>• When comparing two fractions close to 1, use distance from 1 as your benchmark. Example:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which is greater, ( \frac{6}{7} ) or ( \frac{8}{9} )?</td>
<td>6 ( \frac{1}{7} ) is ( \frac{1}{7} ) away from 1 whole.</td>
<td></td>
</tr>
<tr>
<td>then ( \frac{6}{7} ) is a greater distance away from 1 whole than</td>
<td>8 ( \frac{8}{9} ) &gt; ( \frac{6}{7} ).</td>
<td></td>
</tr>
<tr>
<td>• Students should have experience with fractions such as ( \frac{1}{8} ), whose decimal representation is a terminating decimal (e. g., ( \frac{1}{8} = 0.125 )) and with fractions such as ( \frac{2}{9} ), whose decimal representation does not end but continues to repeat (e. g., ( \frac{2}{9} = 0.222\ldots )). The repeating decimal can be written with ellipses (three dots) as in 0.222\ldots or denoted with a bar above the digits that repeat as in 0.\overline{2} .</td>
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### SOL 6.3

**Focus**
Relationships among Fractions, Decimals, and Percents

**Virginia SOL 6.3**
The student will
a. identify and represent integers;
b. order and compare integers; and
c. identify and describe absolute value of integers.

**Key Vocabulary**
- Integer
- Whole number
- Conventional Number Line
- Positive Integer
- Negative Integer
- Absolute Value
- Greater Than
- Less Than
- Equal to
- Equivalent

**Essential Knowledge and Skills**
- The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:
  - Identify an integer represented by a point on a number line.
  - Represent integers on a number line.
  - Order and compare integers using a number line.
  - Compare integers using mathematical symbols (<, >, =, ≠).
  - Identify and describe the absolute value of an integer.

**Essential Questions and Understandings**
- What role do negative integers play in practical situations?
  - Some examples of the use of negative integers are found in temperature (below 0), finance (owing money), and below sea level. There are many other examples.
  - Provide students with word problems involving temperature, banking, sports, swimming below sea level, etc. where negative integers are a common factor.
- How does the absolute value of an integer compare to the absolute value of its opposite?
  - They are the same because an integer and its opposite are the same distance from zero on a number line.

**Teacher Notes and Elaborations**
- Integers are the set of whole numbers, their opposites, and zero.
  - Positive numbers are greater than zero
  - Negative numbers are less than zero
  - Zero is neither positive or negative
- When comparing two negative integers, the negative integer closer to zero is greater.
  - Example: -8 < -2
- On a conventional number line, a smaller number is always located to the left of a larger number.
  - Example: -9 is more left than 2, so 2 is greater than -9.
- The absolute value of a number is the distance a number is from zero on the number line regardless of the direction.
  - Absolute value is represented as | -3 | = 3
  - Absolute value can be represented on a number line
### STANDARD 6.3  
**STRAND: NUMBER AND NUMBER SENSE**  
**GRADE LEVEL 6**

6.3 The student will  
a) identify and represent integers;  
b) order and compare integers; and  
c) identify and describe absolute value of integers.

| UNDERSTANDING THE STANDARD  
(Background Information for Instructor Use Only) | ESSENTIAL UNDERSTANDINGS | ESSENTIAL KNOWLEDGE AND SKILLS |
|-------------------------------------------------|--------------------------|--------------------------------|
| • Integers are the set of whole numbers, their opposites, and zero.  
• Positive integers are greater than zero.  
• Negative integers are less than zero.  
• Zero is an integer that is neither positive nor negative.  
• A negative integer is always less than a positive integer.  
• When comparing two negative integers, the negative integer that is closer to zero is greater.  
• An integer and its opposite are the same distance from zero on a number line. For example, the opposite of 3 is -3.  
• The absolute value of a number is the distance of a number from zero on the number line regardless of direction. Absolute value is represented as $|{-6}| = 6$.  
• On a conventional number line, a smaller number is always located to the left of a larger number (e.g., $-7$ lies to the left of $-3$, thus $-7 < -3$; 5 lies to the left of 8 thus 5 is less than 8). | • What role do negative integers play in practical situations? Some examples of the use of negative integers are found in temperature (below 0), finance (owing money), below sea level. There are many other examples.  
• How does the absolute value of an integer compare to the absolute value of its opposite? They are the same because an integer and its opposite are the same distance from zero on a number line. | The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to  
• Identify an integer represented by a point on a number line.  
• Represent integers on a number line.  
• Order and compare integers using a number line.  
• Compare integers, using mathematical symbols ($<$, $>$, $=$).  
• Identify and describe the absolute value of an integer. |
## SOL Reporting Category
Number and Number Sense

### Focus
Relationships among Fractions, Decimals, and Percents

### SOL Virginia 6.4
The student will demonstrate multiple representations of multiplication and division of fractions.

### HCPS Website
**SOL 6.4 – Representations of Fraction Operations**

### DOE Lesson Plans
- Modeling Multiplication of Fractions (PDF) - Modeling multiplication of fractions (Word)
- Modeling Division of Fractions (PDF) - Modeling division of fractions (Word)

## Essential Knowledge and Skills

### Key Vocabulary
- dividend
- divisor
- improper fraction
- mixed number
- product
- proper fraction
- quotient
- Factor
- Reciprocal
- Numerator
- Denominator
- Fraction
- Whole Number
- Inverse Operation

### Essential Questions and Understandings
- **When multiplying fractions, what is the meaning of the operation?**
  - When multiplying a whole by a fraction such as $3 \cdot \frac{1}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole. When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part.
  - When multiplying a fraction by a whole number such as $\frac{1}{2} \cdot 6$, we are trying to find a part of the whole.
- **What does it mean to divide with fractions?**
  - For measurement division, the divisor is the number of groups and the quotient will be the number of groups in the dividend. Division of fractions can be explained as how many of a given divisor are needed to equal the given dividend. In other words, for $\frac{1}{4} \div \frac{2}{3}$ the question is, “How many $\frac{2}{3}$ make $\frac{1}{4}$?” For partition division the divisor is the size of the group, so the quotient answers the question, “How much is the whole?” or “How much for one?”

### Teacher Notes and Elaborations
- When multiplying fractions, what is the meaning of the operation?
  - $5 \cdot \frac{3}{4}$ means 5 groups of $\frac{3}{4}$ of the whole.
  - $\frac{2}{5} \cdot \frac{1}{2}$ means to find part of a part.

(continued)
### SOL Reporting Category
Number and Number Sense

### Focus
Relationships among Fractions, Decimals, and Percents

### Virginia SOL 6.4
The student will demonstrate multiple representations of multiplication and division of fractions.

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<td>2 ÷ 3</td>
<td>4 means to find part of a whole</td>
</tr>
<tr>
<td>5 8</td>
<td>1 3 means how many 1 3's are in 5 8?</td>
</tr>
<tr>
<td>8 pieces = 1 3</td>
<td>solution = 1 7 8</td>
</tr>
<tr>
<td>3 4 5 6 7</td>
<td></td>
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</tbody>
</table>

- What does it mean to divide with fractions?
  - It means how many of the divisors are needed to equal the dividend?
    - Example: 5 8  ÷ 1 3 means how many 1 3’s are in 5 8?

- The divisor is the size of the original group, so the quotient tells us “What is the value of the whole?” or “How much for one?”

- Use representations to model the multiplication and division of fractions.
  - They can be modeled by using:
    - Arrays
    - Paper folding
    - Fraction strips
    - Pattern blocks
    - Area models
    - Repeated addition or repeated subtraction

---

**Return to Course Outline**
6.4 The student will demonstrate multiple representations of multiplication and division of fractions.

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<tr>
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</thead>
</table>
| • Using manipulatives to build conceptual understanding and using pictures and sketches to link concrete examples to the symbolic enhance students’ understanding of operations with fractions and help students connect the meaning of whole number computation to fraction computation. 
• Multiplication and division of fractions can be represented with arrays, paper folding, repeated addition, repeated subtraction, fraction strips, pattern blocks and area models. 
• When multiplying a whole by a fraction such as $3 \times \frac{1}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole. 
• When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part. 
• When multiplying a fraction by a whole number such as $\frac{1}{2} \times 6$, we are trying to find a part of the whole. 
• For measurement division, the divisor is the number of groups. You want to know how many are in each of those groups. Division of fractions can be explained as how many of a given divisor are needed to equal the given dividend. In other words, for $\frac{1}{4} \div \frac{2}{3}$, the question is, “How many $\frac{2}{3}$ make $\frac{1}{4}$?” For partition division the divisor is the size of the group, so the quotient answers the question, “How much is the whole?” or “How much for one?” | • When multiplying fractions, what is the meaning of the operation? When multiplying a whole by a fraction such as $3 \times \frac{1}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole. When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part. When multiplying a fraction by a whole number such as $\frac{1}{2} \times 6$, we are trying to find a part of the whole. 
• What does it mean to divide with fractions? For measurement division, the divisor is the number of groups and the quotient will be the number of groups in the dividend. Division of fractions can be explained as how many of a given divisor are needed to equal the given dividend. In other words, for $\frac{1}{4} \div \frac{2}{3}$ the question is, “How many $\frac{2}{3}$ make $\frac{1}{4}$?” | The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to 
• Demonstrate multiplication and division of fractions using multiple representations. 
• Model algorithms for multiplying and dividing with fractions using appropriate representations.
6.4 The student will demonstrate multiple representations of multiplication and division of fractions.

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<tbody>
<tr>
<td>• For partition division the divisor is the size of the group, so the quotient answers the question, “How much is the whole?” or “How much for one?”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Course 1 Curriculum Guide

#### SOL Reporting Category
- **Number and Number Sense**

#### Focus
- **Relationships among Fractions, Decimals, and Percents**

#### Virginia SOL 6.5
The student will investigate and describe concepts of positive exponents and perfect squares.

#### HCPS Website
- **SOL 6.5 – Exponents and Perfect Squares**

#### DOE Lesson Plans
- **Perfecting Squares (PDF)** - Investigating positive exponents and perfect squares (Word)

#### Key Vocabulary
- **Base**
- **Exponent**
- **Factor**
- **Product**
- **Power**
- **Undefined**
- **Perfect Squares**
- **Area**
- **Square**
- **Exponential Form**
- **Natural Number**
- **Powers of Ten**

### Essential Knowledge and Skills
- **The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:**
  - Recognize and describe patterns with exponents that are natural numbers, by using a calculator.
  - Recognize and describe patterns of perfect squares not to exceed 20², by using grid paper, square tiles, tables, and calculators.
  - Recognize powers of ten by examining patterns in a place value chart:
    - $10^4 = 10,000$
    - $10^3 = 1000$
    - $10^2 = 100$
    - $10^1 = 10$
    - $10^0 = 1$

### Essential Questions and Understandings
- **What does exponential form represent?**
  - Exponential form is a short way to write repeated multiplication of a common factor such as $5 \cdot 5 \cdot 5 \cdot 5 = 5^4$ and $4^3 = 4 \cdot 4 \cdot 4$
- **What is the relationship between perfect squares and a geometric square?**
  - A perfect square is the area of a geometric square whose side length is a whole number.

#### Teacher Notes and Elaborations
- **What is the relationship between perfect squares and a geometric sequence?**
  - A perfect square is the area of a geometric square whose side length is a whole number.
- **In exponential notation:**
  - The base is the number multiplied
  - The exponent represents the number of times the base is being multiplied.
    - Example: $4^3 = 4 \cdot 4 \cdot 4$
- **Any real number, expect for the number 0, raised to the power of 0 are equal to 1.**
- **Zero raised to the zero power is undefined.**
- **Perfect squares are the result from multiplying any whole number by itself.**
  - Example: $5 \cdot 5 = 25$
- **Perfect squares can be modeled with:**
  - Grid paper
  - Tiles
  - Geoboards
  - Virtual Manipulatives
STANDARD 6.5

The student will investigate and describe concepts of positive exponents and perfect squares.

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</thead>
<tbody>
<tr>
<td>• In exponential notation, the base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In (8^3), 8 is the base and 3 is the exponent.</td>
<td>• What does exponential form represent? Exponential form is a short way to write repeated multiplication of a common factor such as (5 \times 5 \times 5 = 5^4).</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• A power of a number represents repeated multiplication of the number by itself (e.g., (8^3 = 8 \times 8 \times 8) and is read “8 to the third power”).</td>
<td>• What is the relationship between perfect squares and a geometric square? A perfect square is the area of a geometric square whose side length is a whole number.</td>
<td>• Recognize and describe patterns with exponents that are natural numbers, by using a calculator.</td>
</tr>
<tr>
<td>• Any real number other than zero raised to the zero power is 1. Zero to the zero power (0) is undefined.</td>
<td></td>
<td>• Recognize and describe patterns of perfect squares not to exceed (20^2), by using grid paper, square tiles, tables, and calculators.</td>
</tr>
<tr>
<td>• Perfect squares are the numbers that result from multiplying any whole number by itself (e.g., (36 = 6 \times 6 = 6^2)).</td>
<td></td>
<td>• Recognize powers of ten by examining patterns in a place value chart: (10^4 = 10,000), (10^3 = 1,000), (10^2 = 100), (10^1 = 10), (10^0 = 1).</td>
</tr>
<tr>
<td>• Perfect squares can be represented geometrically as the areas of squares the length of whose sides are whole numbers (e.g., (1 \times 1), (2 \times 2), or (3 \times 3)). This can be modeled with grid paper, tiles, geoboards and virtual manipulatives.</td>
<td></td>
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</tbody>
</table>
In the middle grades, the focus of mathematics learning is to
• build on students’ concrete reasoning experiences developed in the elementary grades;
• construct a more advanced understanding of mathematics through active learning experiences;
• develop deep mathematical understandings required for success in abstract learning experiences; and
• apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

• Students develop conceptual and algorithmic understanding of operations with integers and rational numbers through concrete activities and discussions that bring meaning to why procedures work and make sense.
• Students develop and refine estimation strategies and develop an understanding of when to use algorithms and when to use calculators. Students learn when exact answers are appropriate and when, as in many life experiences, estimates are equally appropriate.
• Students learn to make sense of the mathematical tools they use by making valid judgments of the reasonableness of answers.
• Students reinforce skills with operations with whole numbers, fractions, and decimals through problem solving and application activities.
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<tr>
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<th>Curriculum Information</th>
<th>Essential Knowledge and Skills</th>
<th>Essential Questions and Understandings</th>
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</thead>
<tbody>
<tr>
<td>SOL 6.6</td>
<td>Course 1 Curriculum Guide</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:</td>
<td>Essential Questions and Understandings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Multiply and divide with fractions and mixed numbers. Answers are expressed in simplest form.</td>
<td>• How are multiplication and division of fractions and multiplication and division of whole numbers alike?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Estimate solutions and solve single-step and multi-step practical problems that involve addition and subtraction with fractions and mixed numbers, with and without regrouping, that include like and unlike denominators of 12 or less. Answers are expressed in simplest form. Compare actual answers with estimates to check for reasonableness of results.</td>
<td>Fraction computation can be approached in the same way as whole number computation, applying those concepts to fractional parts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Estimate solutions and solve single-step and multi-step practical problems that involve multiplication and division with fractions and mixed numbers that include denominators of 12 or less. Answers are expressed in simplest form. Compare actual answers with estimates to check for reasonableness of results.</td>
<td>• What is the role of estimation in solving problems? Estimation helps determine the reasonableness of answers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Key Vocabulary</td>
<td>Teacher Notes and Elaborations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>benchmark</td>
<td>□ What is the importance of estimation in problem solving?</td>
</tr>
<tr>
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<td></td>
<td>compatible numbers</td>
<td>o It helps determine the reasonableness of an answer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>denominator</td>
<td>□ Simplify means to make something as simple as possible.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>difference</td>
<td>o The term “reduce” should not be used because it causes confusion for some students. When a fraction is renamed in simplest form, it does not become smaller as the word “reduce” implies. Simplifying fractions to simplest form assists with uniformity of answers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>estimation fraction</td>
<td>□ Addition and subtraction are inverse operations as are multiplication and division.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>greatest Common Factor</td>
<td>□ It is helpful to use estimation to develop computational strategies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>improper fraction</td>
<td>o For example: $\frac{5}{7} \cdot \frac{2}{3}$ means $\frac{2}{3}$ of 5, so the answer is between 5 and 6.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sum</td>
<td>$\frac{12}{3} \div \frac{4}{4}$, think $12 \div 4 = 3$.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>whole Number</td>
<td></td>
</tr>
</tbody>
</table>

### Key Vocabulary
- benchmark
- compatible numbers
- denominator
- difference
- estimation fraction
- greatest Common Factor
- improper fraction
- inverse Operation
- mixed number
- numerator
- part
- product
- proper fraction
- quotient
- reciprocal
- simplest form
- simplify
- sum
- whole
- whole Number

### SOL Reporting Category
- Computation and Estimation

### Focus
- Applications of Operations with Rational Numbers

### Virginia SOL 6.6
The student will:
- multiply and divide fractions and mixed numbers; and*
- estimate solutions and then solve single-step and multi-step practical problems involving addition, subtraction, multiplication, and division of fractions.

*SOL test items measuring Objective 6.6a will be completed without the use of a calculator.

### HCPS Website
- SOL 6.6a – Computation of Fractions
- SOL 6.6b – Practical Problems with Rational Numbers

### DOE Lesson Plans
- Modeling Multiplication of Fractions (PDF) - Modeling multiplication of fractions (Word)
- Modeling Division of Fractions (PDF) - Modeling division of fractions (Word)

Return to Course Outline
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<tr>
<td>Computation and Estimation</td>
<td>It is helpful to use estimation to develop computational strategies</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td>o Using 0, $\frac{1}{2}$, and 1 as benchmarks can be used to compare fractions. When comparing two fractions, use $\frac{1}{2}$ as a benchmark.</td>
</tr>
<tr>
<td>Applications of Operations with Rational Numbers</td>
<td>o Example: Which is greater, $\frac{4}{7}$ or $\frac{3}{9}$? $\frac{4}{7}$ is greater than $\frac{1}{2}$ because 4, the numerator, represents more than half of 7, the denominator. The denominator tells the number of parts that make the whole. $\frac{3}{9}$ is less than $\frac{1}{2}$ because 3, the numerator, is less than half of 9, the denominator, which tells the number of parts that make the whole. Therefore, $\frac{4}{7} &gt; \frac{3}{9}$.</td>
</tr>
<tr>
<td>Virginia SOL 6.6</td>
<td>o When multiplying a whole number by a fraction, the meaning is the same as with multiplication of whole numbers.</td>
</tr>
<tr>
<td>The student will</td>
<td>o Example: $4 \cdot \frac{1}{3}$ means 4 groups the size of $\frac{1}{3}$ of the whole.</td>
</tr>
<tr>
<td>a. multiply and divide fractions and mixed numbers; and*</td>
<td>o When multiplying a fraction by a whole number, we are asking to find part of a whole.</td>
</tr>
<tr>
<td>b. estimate solutions and then solve single-step and multi-step practical problems involving addition, subtraction, multiplication, and division of fractions.</td>
<td>o When multiplying a fraction by a fraction, we are asking to find a part of a part.</td>
</tr>
</tbody>
</table>

*SOL test items measuring Objective 6.6a will be completed without the use of a calculator.

Return to Course Outline
6.6 The student will
a) multiply and divide fractions and mixed numbers; and
b) estimate solutions and then solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of fractions.

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<td>• Simplifying fractions to simplest form assists with uniformity of answers.</td>
<td>• How are multiplication and division of fractions and multiplication and division of whole numbers alike? Fraction computation can be approached in the same way as whole number computation, applying those concepts to fractional parts.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
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<tr>
<td>• Addition and subtraction are inverse operations as are multiplication and division.</td>
<td>• What is the role of estimation in solving problems? Estimation helps determine the reasonableness of answers.</td>
<td></td>
</tr>
<tr>
<td>• It is helpful to use estimation to develop computational strategies. For example, $\frac{7}{8} \cdot \frac{3}{4}$ is about $\frac{3}{4}$ of 3, so the answer is between 2 and 3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• When multiplying a whole by a fraction such as $\frac{3}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole.</td>
<td>• Multiply and divide with fractions and mixed numbers. Answers are expressed in simplest form.</td>
<td></td>
</tr>
<tr>
<td>• When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part.</td>
<td>• Solve single-step and multistep practical problems that involve addition and subtraction with fractions and mixed numbers, with and without regrouping, that include like and unlike denominators of 12 or less. Answers are expressed in simplest form.</td>
<td></td>
</tr>
<tr>
<td>• When multiplying a fraction by a whole number such as $\frac{1}{2} \cdot 6$, we are trying to find a part of the whole.</td>
<td>• Solve single-step and multistep practical problems that involve multiplication and division with fractions and mixed numbers that include denominators of 12 or less. Answers are expressed in simplest form.</td>
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</table>
**Course 1 Curriculum Guide**

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<tr>
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<th>Essential Questions and Understandings</th>
<th>Teacher Notes and Elaborations</th>
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</thead>
<tbody>
<tr>
<td>Computation and Estimation</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:</td>
<td>Essential Questions and Understandings</td>
<td>□ Different strategies can be used to estimate the result of computations and judge the reasonableness of the result.</td>
</tr>
<tr>
<td>Focus</td>
<td>• Solve single-step and multi-step practical problems involving addition, subtraction, multiplication and division with decimals expressed to thousandths with no more than two operations.</td>
<td>□ Understanding the placement of the decimal point is very important when finding quotients of decimals.</td>
<td></td>
</tr>
<tr>
<td>Virginia SOL 6.7</td>
<td>Key Vocabulary</td>
<td>Teacher Notes and Elaborations</td>
<td>□ Example: What is the approximate answer of 3.15 ÷ 0.9? The answer could be around 3 ÷ 1 = 3.</td>
</tr>
<tr>
<td>The student will solve single-step and multi-step practical problems involving addition, subtraction, multiplication, and division of decimals.</td>
<td>compatible numbers estimation front-end estimation rounding Decimals Quotient Dividend Divisor Tenths Hundredths Thousandths Sum Difference Product Quotient</td>
<td>□ Examining patterns with successive decimals provides meaning, such as dividing the dividend by 8, by 0.8, by 0.08, and by 0.008.</td>
<td></td>
</tr>
<tr>
<td>HCPS Website</td>
<td>SOL 6.7 – Operations with Decimals</td>
<td>Examples of real-life situations include:</td>
<td></td>
</tr>
<tr>
<td>SOL 6.7 – Operations with Decimals</td>
<td>DOE Lesson Plans</td>
<td>□ Shopping for groceries □ Buying school supplies □ Budgeting an allowance □ Deciding what time to leave for school or the movies □ Sharing a pizza □ Sharing prize money</td>
<td></td>
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</tbody>
</table>
6.7 The student will solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of decimals.

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<tbody>
<tr>
<td>• Different strategies can be used to estimate the result of computations and judge the reasonableness of the result. For example: What is an approximate answer for (2.19 \div 0.8)? The answer is around 2 because (2 \div 1 = 2).</td>
<td>• What is the role of estimation in solving problems? Estimation gives a reasonable solution to a problem when an exact answer is not required. If an exact answer is required, estimation allows you to know if the calculated answer is reasonable.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• Understanding the placement of the decimal point is very important when finding quotients of decimals. Examining patterns with successive decimals provides meaning, such as dividing the dividend by 6, by 0.6, by 0.06, and by 0.006.</td>
<td>• Solve single-step and multistep practical problems involving addition, subtraction, multiplication and division with decimals expressed to thousandths with no more than two operations.</td>
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<tr>
<td>• Solving multistep problems in the context of real-life situations enhances interconnectedness and proficiency with estimation strategies.</td>
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<tr>
<td>• Examples of practical situations solved by using estimation strategies include shopping for groceries, buying school supplies, budgeting an allowance, deciding what time to leave for school or the movies, and sharing a pizza or the prize money from a contest.</td>
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</tr>
</tbody>
</table>
### SOL Reporting Category

Computation and Estimation

### Focus

Applications of Operations with Rational Numbers

### Virginia SOL 6.8

The student will evaluate whole number numerical expressions, using the order of operations.*

*SOL test items measuring Objective 6.8 will be completed without the use of a calculator.

### HCPS Website

**SOL 6.8 – Order of Operations**

### DOE Lesson Plans

**Order Up! (PDF)** - Exploring the order of operations and using it to evaluate numerical expressions (Word)

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<th>Key Vocabulary</th>
<th>Essential Questions and Understandings</th>
<th>Teacher Notes and Elaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computation and Estimation</td>
<td><strong>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:</strong></td>
<td><strong>Order of Operations</strong></td>
<td><strong>What is the significance of the order of operations?</strong>&lt;br&gt;<strong>The order of operations prescribes the order to use to simplify expressions containing more than one operation. It ensures that there is only one correct answer.</strong></td>
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<tr>
<td></td>
<td></td>
<td><strong>Expression</strong></td>
<td></td>
<td><strong>The order of operations is a convention that defines the computation order to follow in simplifying an expression.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Grouping Symbols</strong></td>
<td></td>
<td><strong>An expression is like a phrase.</strong>&lt;br&gt;<strong>An expression has no equal sign and cannot be solved.</strong>&lt;br&gt;<strong>Expressions are simplified by using the order of operations.</strong></td>
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<tr>
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<td></td>
<td><strong>Product</strong>&lt;br&gt;<strong>Factor</strong>&lt;br&gt;<strong>Dividend</strong>&lt;br&gt;<strong>Quotient</strong>&lt;br&gt;<strong>Sum</strong>&lt;br&gt;<strong>Addend</strong>&lt;br&gt;<strong>Difference</strong>&lt;br&gt;<strong>Base</strong>&lt;br&gt;<strong>Exponent</strong>&lt;br&gt;<strong>Simplify</strong></td>
<td></td>
<td><strong>The order of operations is as follows:</strong>&lt;br&gt;<strong>First, complete all operations within grouping symbols</strong>&lt;br&gt;<strong>If there are grouping symbols within other grouping symbols, do the innermost operation first.</strong>&lt;br&gt;<strong>Second, evaluate all exponential expressions.</strong>&lt;br&gt;<strong>Third, multiply and/or divide in order from left to right.</strong>&lt;br&gt;<strong>Fourth, add and/or subtract in order from left to right.</strong>&lt;br&gt;<strong>Parentheses ( ), brackets [ ], braces { }, and the division bar – as in $$\frac{3+4}{5+6}$$ should be treated as grouping symbols.</strong>&lt;br&gt;<strong>The power of a number represents repeated multiplication of the number.</strong>&lt;br&gt;<strong>Example: 5³ = 5 · 5 · 5</strong>&lt;br&gt;<strong>The base is the number that is multiplied.</strong>&lt;br&gt;<strong>The exponent represents the number of times the base is used as a factor</strong>&lt;br&gt;<strong>Any number, except 0, raised to the zero power is 1.</strong>&lt;br&gt;<strong>Zero to the zero power is undefined.</strong></td>
</tr>
</tbody>
</table>

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**Return to Course Outline**
6.8 The student will evaluate whole number numerical expressions, using the order of operations.

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<tbody>
<tr>
<td>• The order of operations is a convention that defines the computation order to follow in simplifying an expression.</td>
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</tr>
<tr>
<td>• The order of operations is as follows:</td>
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<tr>
<td>– First, complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols, do the innermost operation first.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Second, evaluate all exponential expressions.</td>
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<tr>
<td>– Third, multiply and/or divide in order from left to right.</td>
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<td></td>
</tr>
<tr>
<td>– Fourth, add and/or subtract in order from left to right.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Parentheses ( ), brackets [ ], braces { }, and the division bar ( \frac{3+4}{5+6} ) should be treated as grouping symbols.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The power of a number represents repeated multiplication of the number (e.g., ( 8^3 = 8 \cdot 8 \cdot 8 )). The base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In the example, 8 is the base, and 3 is the exponent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Any number, except 0, raised to the zero power is 1. Zero to the zero power is undefined.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• What is the significance of the order of operations? The order of operations prescribes the order to use to simplify expressions containing more than one operation. It ensures that there is only one correct answer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Simplify expressions by using the order of operations in a demonstrated step-by-step approach. The expressions should be limited to positive values and not include braces { } or absolute value</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>• Find the value of numerical expressions, using order of operations, mental mathematics, and appropriate tools. Exponents are limited to positive values.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the middle grades, the focus of mathematics learning is to
- build on students’ concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop the measurement skills that provide a natural context and connection among many mathematics concepts. Estimation skills are developed in determining length, weight/mass, liquid volume/capacity, and angle measure. Measurement is an essential part of mathematical explorations throughout the school year.
- Students continue to focus on experiences in which they measure objects physically and develop a deep understanding of the concepts and processes of measurement. Physical experiences in measuring various objects and quantities promote the long-term retention and understanding of measurement. Actual measurement activities are used to determine length, weight/mass, and liquid volume/capacity.
- Students examine perimeter, area, and volume, using concrete materials and practical situations. Students focus their study of surface area and volume on rectangular prisms, cylinders, pyramids, and cones.
<table>
<thead>
<tr>
<th>SOL Reporting Category</th>
<th>Essential Knowledge and Skills</th>
<th>Essential Questions and Understandings</th>
</tr>
</thead>
</table>
| Measurement and Geometry | The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to: | **What is the difference between weight and mass?**
- Estimate the conversion of units of length, weight/mass, volume, and temperature between the U.S. Customary system and the metric system by using ballpark comparisons. Ex: 1L ≈ 1qt. Ex: 4L ≈ 4qt.
- Estimate measurements by comparing the object to be measured against a benchmark. | • Weight and mass are different. Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. |

### Virginia SOL 6.9
The student will make ballpark comparisons between measurements in the U.S. Customary System of measurement and measurements in the metric system.

### Key Vocabulary
- capacity
- Celsius
- centimeter
- Cubic units
- cup
- custom system
- estimate
- Fahrenheit
- foot
- gallon
- gram
- gravity
- inch
- kilogram
- kilometer
- linear units
- liter
- mass
- matter
- meter
- mile
- metric system
- millimeter
- milliliter
- ounce
- pint
- pound
- quart
- square units
- ton
- U.S. Customary System
- System
- yard
- weight

### Essential Questions and Understandings
- **How do you determine which units to use at different times?**
  - Units of measure are determined by the attributes of the object being measured. Measures of length are expressed in linear units, measures of area are expressed in square units, and measures of volume are expressed in cubic units.

- **Why are there two different measurement systems?**
  - Measurement systems are conventions invented by different cultures to meet their needs. The U.S. Customary System is the preferred method in the United States. The metric system is the preferred system worldwide.

### Teacher Notes and Elaborations
- **Making reasonable estimations of measurements means you know the relation to other units of measure.**
  - 1 inch is about 2.5 centimeters.
  - 1 foot is about 30 centimeters.
  - 1 meter is a little longer than a yard, or about 40 inches.
  - 1 mile is slightly farther than 1.5 kilometers.
  - 1 kilometer is slightly farther than half a mile.
  - 1 ounce is about 28 grams.
  - 1 nickel has the mass of about 5 grams.
  - 1 kilogram is a little more than 2 pounds.
  - 1 quart is a little less than 1 liter.
  - 1 liter is a little more than 1 quart.
  - Water freezes at 0°C and 32°F.
  - Water boils at 100°C and 212°F.
  - Normal body temperature is about 37°C and 98°F.
  - Room temperature is about 20°C and 70°F.
### SOL Reporting Category
Measurement and Geometry

### Focus
Problem Solving with Area, Perimeter, Volume, and Surface Area

### Virginia SOL 6.9
The student will make ballpark comparisons between measurements in the U.S. Customary System of measurement and measurements in the metric system.

<table>
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<td>In everyday life, most people are actually interested in determining an object’s mass, although they use the term weight, as shown by the questions: “How much does it weigh?” versus “What is its mass?”</td>
</tr>
<tr>
<td>The degree of accuracy of measurement required is determined by the situation.</td>
</tr>
<tr>
<td>Whether to use an underestimate or an overestimate is determined by the situation.</td>
</tr>
<tr>
<td>Physically measuring objects along with using visual and symbolic representations improves student understanding.</td>
</tr>
<tr>
<td>The symbol ≈ is read as “approximately equal to” (e.g., 6.9 ≈ 7) and may be used to express a relationship.</td>
</tr>
<tr>
<td>Using benchmarks is a strategy used to make measurement estimates.</td>
</tr>
<tr>
<td>Benchmarks such as the two-meter height of a standard doorway can be used to estimate height of a room.</td>
</tr>
</tbody>
</table>

[Return to Course Outline]
## STANDARD 6.9

### STRAND: MEASUREMENT

### GRADE LEVEL 6

#### 6.9 The student will make ballpark comparisons between measurements in the U.S. Customary System of measurement and measurements in the metric system.

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<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
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</table>
| • Making sense of various units of measure is an essential life skill, requiring reasonable estimates of what measurements mean, particularly in relation to other units of measure.  
  – 1 inch is about 2.5 centimeters.  
  – 1 foot is about 30 centimeters.  
  – 1 meter is a little longer than a yard, or about 40 inches.  
  – 1 mile is slightly farther than 1.5 kilometers.  
  – 1 kilometer is slightly farther than half a mile.  
  – 1 ounce is about 28 grams.  
  – 1 nickel has the mass of about 5 grams.  
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  – Normal body temperature is about 37°C and 98°F.  
  – Room temperature is about 20°C and 70°F.  
| • What is the difference between weight and mass?  
Weight and mass are different. Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location.  
• How do you determine which units to use at different times?  
Units of measure are determined by the attributes of the object being measured. Measures of length are expressed in linear units, measures of area are expressed in square units, and measures of volume are expressed in cubic units.  
• Why are there two different measurement systems?  
Measurement systems are conventions invented by different cultures to meet their needs. The U.S. Customary System is the preferred method in the United States. The metric system is the preferred system worldwide.  
• Estimate the conversion of units of length, weight/mass, volume, and temperature between the U.S. Customary system and the metric system by using ballpark comparisons.  
Ex: 1 L ≈ 1qt.  
Ex: 4L ≈ 4 qts.  
• Estimate measurements by comparing the object to be measured against a benchmark.  
| • Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object’s mass, although they use the term weight, as shown by the questions: “How much does it weigh?” versus “What is its mass?”  
• The degree of accuracy of measurement required is determined by the situation.  

Mathematics Standards of Learning Curriculum Framework 2009: Grade 6
The student will make ballpark comparisons between measurements in the U.S. Customary System of measurement and measurements in the metric system.

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<td>(Background Information for Instructor Use Only)</td>
<td>• Whether to use an underestimate or an overestimate is determined by the situation.</td>
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<td></td>
<td>• Physically measuring objects along with using visual and symbolic representations improves student understanding of both the concepts and processes of measurement.</td>
<td></td>
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</table>
The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:
- Derive an approximation for pi (3.14 or \(\frac{22}{7}\)) by gathering data and comparing the circumference to the diameter of various circles, using concrete materials or computer models.
- Find the circumference of a circle by substituting a value for the diameter or the radius into the formula \(C = \pi d\) or \(C = 2\pi r\).
- Find the area of a circle by using the formula \(A = \pi r^2\).
- Create and solve problems that involve finding the circumference and area of a circle when given the diameter or radius.
- Derive formulas for area and perimeter of triangles, and parallelograms.
- Apply formulas to solve practical problems involving area and perimeter of triangles, rectangles and parallelograms.
- Develop a procedure and formula for finding the surface area of a rectangular prism using concrete objects, nets, diagrams, and computation methods.
- Develop a procedure and formula for finding the volume of a rectangular prism using concrete objects, nets, diagrams, and computation methods.
- Solve problems that require finding the surface area of a rectangular prism, given a diagram of the prism with the necessary dimensions labeled.

**Teacher Notes and Elaborations**
- Perimeter of a polygon is determined by measuring the distance around the polygon.
- The perimeter of a square whose side measures \(s\) is \(4s\), and its area is \(s^2\).
- The perimeter of a rectangle is the sum of twice the length and twice the width \([P = 2l + 2w, \text{ or } P = 2(l + w)]\), and its area is the product of the length and the width \((A = lw)\).
- Circumference is the distance around a circle.
  - The circumference of a circle is computed using \(C = \pi d\) or \(C = 2\pi r\), where \(d\) is the diameter and \(r\) is the radius of the circle.
- The area of a circle is computed using the formula \(A = \pi r^2\) where \(r\) is the radius of the circle.
- The ratio of the circumference to the diameter of a circle is a constant value \(\pi\) which can be approximated by measuring various sizes of circles.
  - The fractional approximation of \(\pi\) generally used is \(\frac{22}{7}\).
  - The decimal approximation of \(\pi\) generally used is 3.14.

(continued)
### SOL Reporting Category
- **Measurement and Geometry**

### Focus
- Problem Solving with Area, Perimeter, Volume, and Surface Area

### Virginia SOL 6.10
- The student will:
  a. define pi (π) as the ratio of the circumference of a circle to its diameter;
  b. solve practical problems involving circumference and area of a circle, given the diameter or radius;
  c. solve practical problems involving area and perimeter; and
  d. describe and determine the volume and surface area of a rectangular prism.

#### Key Vocabulary
- area
- base
- chord
- circle
- circumference
- cube
- diameter
- edge
- face
- formula
- height
- length
- net
- parallelogram
- perimeter
- pi
- plane figure (two-dimensional)
- radius
- ratio
- rectangle
- rectangular prism
- side
- solid figure (three-dimensional)
- square
- surface area
- trapezoid
- triangle
- vertex
- volume
- width

#### Essential Knowledge and Skills
- Solve problems that require finding the volume of a rectangular prism given a diagram of the prism with the necessary dimensions labeled.

#### Essential Questions and Understandings
- The surface area of a rectangular prism is the sum of the areas of all six faces ($SA = 2lw + 2lh + 2wh$).
- The volume of a rectangular prism is computed by multiplying the area of the base, $B$, (length x width) by the height of the prism ($V = lwh = Bh$).
- The base of a solid figure is the bottom, side or face of the solid figure. In a prism the two parallel congruent faces are called bases.
- To promote an understanding of the formulas, experiences in deriving the formulas for area, perimeter, and volume should include the use of the following manipulatives:
  - tiles
  - one-inch cubes
  - adding machine tape
  - graph paper
  - geoboards
  - tracing paper
6.10 The student will
a) define pi (π) as the ratio of the circumference of a circle to its diameter;
b) solve practical problems involving circumference and area of a circle, given the diameter or radius;
c) solve practical problems involving area and perimeter; and
d) describe and determine the volume and surface area of a rectangular prism.

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<td>• Experiences in deriving the formulas for area, perimeter, and volume using manipulatives such as tiles, one-inch cubes, adding machine tape, graph paper, geoboards, or tracing paper, promote an understanding of the formulas and facility in their use.†</td>
<td>• What is the relationship between the circumference and diameter of a circle? The circumference of a circle is about 3 times the measure of the diameter.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• The perimeter of a polygon is the measure of the distance around the polygon.</td>
<td>• What is the difference between area and perimeter? Perimeter is the distance around the outside of a figure while area is the measure of the amount of space enclosed by the perimeter.</td>
<td>• Derive an approximation for pi (3.14 or (\frac{22}{7})) by gathering data and comparing the circumference to the diameter of various circles, using concrete materials or computer models.</td>
</tr>
<tr>
<td>• Circumference is the distance around or perimeter of a circle.</td>
<td>• What is the relationship between area and surface area? Surface area is calculated for a three-dimensional figure. It is the sum of the areas of the two-dimensional surfaces that make up the three-dimensional figure.</td>
<td>• Find the circumference of a circle by substituting a value for the diameter or the radius into the formula (C = \pi d) or (C = 2\pi r).</td>
</tr>
<tr>
<td>• The area of a closed curve is the number of nonoverlapping square units required to fill the region enclosed by the curve.</td>
<td>• The perimeter of a square whose side measures (s) is 4 times (s) ((P = 4s)), and its area is side times side ((A = s^2)).</td>
<td>• Find the area of a circle by using the formula (A = \pi r^2).</td>
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<td>• The perimeter of a rectangle is the sum of twice the length and twice the width ([P = 2l + 2w), or (P = 2(l + w))], and its area is the product of the length and the width ((A = lw)).</td>
<td>• The value of pi ((\pi)) is the ratio of the circumference of a circle to its diameter.</td>
<td>• Apply formulas to solve practical problems involving area and perimeter of triangles and rectangles.</td>
</tr>
<tr>
<td>• The value of pi ((\pi)) is the ratio of the circumference of a circle to its diameter.</td>
<td>• The ratio of the circumference to the diameter of a circle is a constant value, pi ((\pi)), which can be approximated by measuring various sizes of circles.</td>
<td>• Create and solve problems that involve finding the circumference and area of a circle when given the diameter or radius.</td>
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6.10 The student will
a) define \( \pi \) as the ratio of the circumference of a circle to its diameter;
b) solve practical problems involving circumference and area of a circle, given the diameter or radius;
c) solve practical problems involving area and perimeter; and
d) describe and determine the volume and surface area of a rectangular prism.

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<td>The circumference of a circle is computed using ( C = \pi d ) or ( C = 2\pi r ), where ( d ) is the diameter and ( r ) is the radius of the circle.</td>
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<td>The area of a circle is computed using the formula ( A = \pi r^2 ), where ( r ) is the radius of the circle.</td>
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<td>The surface area of a rectangular prism is the sum of the areas of all six faces ( ( SA = 2lw + 2lh + 2wh ) ).</td>
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<td>The volume of a rectangular prism is computed by multiplying the area of the base, ( B ), (length x width) by the height of the prism ( ( V = lwh = Bh ) ).</td>
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### ESSENTIAL KNOWLEDGE AND SKILLS

- Solve problems that require finding the surface area of a rectangular prism, given a diagram of the prism with the necessary dimensions labeled.
- Solve problems that require finding the volume of a rectangular prism given a diagram of the prism with the necessary dimensions labeled.

†Revised March 2011
In the middle grades, the focus of mathematics learning is to
- build on students’ concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students expand the informal experiences they have had with geometry in the elementary grades and develop a solid foundation for the exploration of geometry in high school. Spatial reasoning skills are essential to the formal inductive and deductive reasoning skills required in subsequent mathematics learning.
- Students learn geometric relationships by visualizing, comparing, constructing, sketching, measuring, transforming, and classifying geometric figures. A variety of tools such as geoboards, pattern blocks, dot paper, patty paper, miras, and geometry software provides experiences that help students discover geometric concepts. Students describe, classify, and compare plane and solid figures according to their attributes. They develop and extend understanding of geometric transformations in the coordinate plane.
- Students apply their understanding of perimeter and area from the elementary grades in order to build conceptual understanding of the surface area and volume of prisms, cylinders, pyramids, and cones. They use visualization, measurement, and proportional reasoning skills to develop an understanding of the effect of scale change on distance, area, and volume. They develop and reinforce proportional reasoning skills through the study of similar figures.
- Students explore and develop an understanding of the Pythagorean Theorem. Mastery of the use of the Pythagorean Theorem has far-reaching impact on subsequent mathematics learning and life experiences.

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)
• **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking algebra.)

• **Level 4: Deduction.** Students can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. Students should be able to supply reasons for steps in a proof. (Students should transition to this level before taking geometry.)
## SOL Reporting Category
Measurement and Geometry

### Focus
Properties and Relationships

### Virginia SOL 6.11
The student will
- identify the coordinates of a point in a coordinate plane; and
- graph ordered pairs in a coordinate plane.

## HCPS Website
SOL 6.11 – Coordinate Graph

## DOE Lesson Plans
What’s the Point? (PDF) - Identifying coordinates of a point and graphing ordered pairs (Word)

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## Key Vocabulary
- coordinate plane
- ordered pair
- origin
- plane
- quadrants
- x-axis
- x-coordinate
- y-axis
- y-coordinate
- perpendicular
- number line
- roman numeral

---

### Essential Knowledge and Skills
The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:
- Identify and label the axes of a coordinate plane.
- Identify and label the quadrants of a coordinate plane.
- Identify the quadrant or the axis on which a point is positioned by examining the coordinates (ordered pair) of the point.
- Graph ordered pairs in the four quadrants and on the axes of a coordinate plane.
- Identify ordered pairs represented by points in the four quadrants and on the axes of the coordinate plane.
- Relate the coordinate of a point to the distance from each axis and relate the coordinates of a single point to another point on the same horizontal or vertical line.

### Essential Questions and Understandings
- Can any given point be represented by more than one ordered pair? The coordinates of a point define its unique location in a coordinate plane. Any given point is defined by only one ordered pair.
- In naming a point in the plane, does the order of the two coordinates matter? Yes. The first coordinate tells the location of the point to the left or right of the y-axis and the second coordinate tells the location of the point above or below the x-axis. Point (0, 0) is at the origin.

### Teacher Notes and Elaborations
- In naming a point in the plane, does the order of the two coordinates matter?
  - Yes. The first coordinate tells the location of the point to the left or right of the y-axis and the second coordinate tells the location of the point above or below the x-axis. Point (0, 0) is at the origin.
- In a coordinate plane, the coordinates of a point are typically represented by the ordered pair \((x, y)\), where \(x\) is the first coordinate and \(y\) is the second coordinate.
  - The \(x\)-coordinate is the distance from the origin along the \(x\)-axis (horizontal axis).
  - The \(y\)-coordinate is the distance along the \(y\)-axis (vertical axis).
- The quadrants of a coordinate plane are the four regions created by the two intersecting perpendicular number lines.
  - Quadrants are named in counterclockwise order.
    - The signs on the ordered pairs for quadrant I are (+,+)
    - for quadrant II, (−,+)
    - for quadrant III, (−,−)
    - for quadrant IV, (+,−).
- In a coordinate plane, the origin is the point at the intersection of the \(x\)-axis and \(y\)-axis; the coordinates of this point are \((0, 0)\).
  - For all points on the \(x\)-axis, the \(y\)-coordinate is 0.
  - For all points on the \(y\)-axis, the \(x\)-coordinate is 0.
- The coordinates may also be used to describe the distance (using absolute value) from both the \(x\)- and \(y\)-axis.
  - Example: The point \((3, -7)\) is 3 units from the \(y\)-axis and 7 units from the \(x\)-axis.
### UNDERSTANDING THE STANDARD

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### ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Identify and label the axes of a coordinate plane.
- Identify and label the quadrants of a coordinate plane.
- Identify the quadrant or the axis on which a point is positioned by examining the coordinates (ordered pair) of the point.
- Graph ordered pairs in the four quadrants and on the axes of a coordinate plane.
- Identify ordered pairs represented by points in the four quadrants and on the axes of the coordinate plane.
- Relate the coordinate of a point to the distance from each axis and relate the coordinates of a single point to another point on the same horizontal or vertical line.

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6.11 The student will
a) identify the coordinates of a point in a coordinate plane; and
b) graph ordered pairs in a coordinate plane.

- In a coordinate plane, the coordinates of a point are typically represented by the ordered pair (x, y), where x is the first coordinate and y is the second coordinate. However, any letters may be used to label the axes and the corresponding ordered pairs.

- The quadrants of a coordinate plane are the four regions created by the two intersecting perpendicular number lines. Quadrants are named in counterclockwise order. The signs on the ordered pairs for quadrant I are (+, +); for quadrant II, (–, +); for quadrant III, (–, –); and for quadrant IV, (+, –).

- In a coordinate plane, the origin is the point at the intersection of the x-axis and y-axis; the coordinates of this point are (0, 0).

- For all points on the x-axis, the y-coordinate is 0. For all points on the y-axis, the x-coordinate is 0.

- The coordinates may be used to name the point. (e.g., the point (2, 7)). It is not necessary to say “the point whose coordinates are (2, 7)”.

- Can any given point be represented by more than one ordered pair? The coordinates of a point define its unique location in a coordinate plane. Any given point is defined by only one ordered pair.

- In naming a point in the plane, does the order of the two coordinates matter? Yes. The first coordinate tells the location of the point to the left or right of the y-axis and the second point tells the location of the point above or below the x-axis. Point (0, 0) is at the origin.
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<td><strong>Essential Questions and Understandings</strong></td>
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|                        | - Characterize polygons as congruent or non-congruent according to the measures of their sides and angles. | • Given two congruent figures, what inferences can be drawn about how the figures are related?  
  The congruent figures will have exactly the same size and shape. |
|                        | - Determine the congruence of segments, angles, and polygons, given their attributes. | • Given two congruent polygons, what inferences can be drawn about how the polygons are related?  
  Corresponding angles of congruent polygons will have the same measure.  
  Corresponding sides of congruent polygons will have the same measure. |
|                        | - Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving practical and mathematical problems. | |

**Key Vocabulary**
- acute angle
- angle
- congruent
- coordinate
- coordinate plane
- correspondence
- corresponding angles
- corresponding sides
- hatch mark
- line segment
- non-congruent
- obtuse angle
- polygon
- ray
- right angle
- segments
- straight angle
- vertex

**Teacher Notes and Elaborations**
- A polygon is a closed plane figure constructed of three or more straight-line segments.
- Congruent figures have exactly the same size and the same shape.
- Noncongruent figures may have the same shape but not the same size.
- The symbol for congruency is ≈.
- Correspondence is the matching of members in one set with members in another set.
- The corresponding angles of congruent polygons have the same measure.
- The corresponding sides of congruent polygons have the same measure.
- The determination of the congruence or non-congruence of two figures can be accomplished by placing one figure on top of the other or by comparing the measurements of all sides and all angles.
- Construction of congruent line segments, angles, and polygons helps students understand congruency.
6.12 The student will determine congruence of segments, angles, and polygons.

<table>
<thead>
<tr>
<th>UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)</th>
<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Congruent figures have exactly the same size and the same shape.</td>
<td>• Given two congruent figures, what inferences can be drawn about how the figures are related? The congruent figures will have exactly the same size and shape.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• Noncongruent figures may have the same shape but not the same size.</td>
<td>• Given two congruent polygons, what inferences can be drawn about how the polygons are related? Corresponding angles of congruent polygons will have the same measure. Corresponding sides of congruent polygons will have the same measure.</td>
<td>• Characterize polygons as congruent and noncongruent according to the measures of their sides and angles.</td>
</tr>
<tr>
<td>• The symbol for congruency is ( \cong ).</td>
<td></td>
<td>• Determine the congruence of segments, angles, and polygons given their attributes.</td>
</tr>
<tr>
<td>• The corresponding angles of congruent polygons have the same measure, and the corresponding sides of congruent polygons have the same measure.</td>
<td></td>
<td>• Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving practical and mathematical problems.†</td>
</tr>
<tr>
<td>• The determination of the congruence or noncongruence of two figures can be accomplished by placing one figure on top of the other or by comparing the measurements of all sides and angles.</td>
<td></td>
<td>†Revised March 2011</td>
</tr>
<tr>
<td>• Construction of congruent line segments, angles, and polygons helps students understand congruency.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SOL Reporting Category
Measurement and Geometry

### Focus
Properties and Relationships

### Virginia SOL 6.13
The student will describe and identify properties of quadrilaterals.

### HCPS Website
**SOL 6.13 – Properties of Quadrilaterals**

### DOE Lesson Plans
**Exploring Quadrilaterals (PDF)** - Sorting quadrilaterals to describe and identify properties (Word)

### Essential Knowledge and Skills

#### Key Vocabulary
- adjacent
- angle
- bases
- bisect
- congruent
- diagonal
- intersect
- isosceles trapezoid
- kite
- legs
- parallel
- parallelogram
- perpendicular
- perpendicular bisector
- plane figure
- quadrilateral
- rectangle
- right angle
- rhombus
- square
- sum
- trapezoid
- two dimensional

#### Essential Questions and Understandings
- Can a figure belong to more than one subset of quadrilaterals?
  - Any figure that has the attributes of more than one subset of quadrilaterals can belong to more than one subset. For example, rectangles have opposite sides of equal length. Squares have all 4 sides of equal length thereby meeting the attributes of both subsets.

### Teacher Notes and Elaborations
- A quadrilateral is a closed planar (two-dimensional) figure with four sides that are line segments.
- A parallelogram is a quadrilateral whose opposite sides are parallel and opposite angles are congruent.
- A rectangle is a parallelogram with four right angles.
- Rectangles have special characteristics (such as diagonals are bisectors) that are true for any rectangle.
- A rhombus is a parallelogram with four congruent sides.
- A square is a parallelogram with four congruent sides or a rhombus with four right angles.
- A trapezoid is a quadrilateral with exactly one pair of parallel sides.
  - The parallel sides are called bases, and the nonparallel sides are called legs.
  - If the legs have the same length, then the trapezoid is an isosceles trapezoid.
- A kite is a quadrilateral with two pairs of adjacent congruent sides.
  - One pair of opposite angles is congruent

(continued)
In the middle grades, the focus of mathematics learning is to
- build on students’ concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.
- Students develop an awareness of the power of data analysis and probability by building on their natural curiosity about data and making predictions.
- Students explore methods of data collection and use technology to represent data with various types of graphs. They learn that different types of graphs represent different types of data effectively. They use measures of center and dispersion to analyze and interpret data.
- Students integrate their understanding of rational numbers and proportional reasoning into the study of statistics and probability.
- Students explore experimental and theoretical probability through experiments and simulations by using concrete, active learning activities.
### SOL Reporting Category
Measurement and Geometry

### Focus
Properties and Relationships

#### Virginia SOL  6.13
The student will describe and identify properties of quadrilaterals.

<table>
<thead>
<tr>
<th>Quadrilaterals can be sorted according to common attributes, using a variety of materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>o By the number of parallel sides</td>
</tr>
<tr>
<td>• a parallelogram, rectangle, rhombus, and square each have two pairs of parallel sides</td>
</tr>
<tr>
<td>• a trapezoid has only one pair of parallel sides</td>
</tr>
<tr>
<td>• other quadrilaterals have no parallel sides.</td>
</tr>
<tr>
<td>o By the measures of their angles</td>
</tr>
<tr>
<td>• a rectangle has four 90° angles</td>
</tr>
<tr>
<td>• a trapezoid may have zero or two 90° angles.</td>
</tr>
<tr>
<td>o By the number of congruent sides</td>
</tr>
<tr>
<td>• a rhombus has four congruent sides</td>
</tr>
<tr>
<td>• a square, which is a rhombus with four right angles, also has four congruent sides</td>
</tr>
<tr>
<td>• a parallelogram and a rectangle each have two pairs of congruent sides.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The sum of the measures of the angles of a quadrilateral is 360°.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane figures are 2-dimensional figures that lie entirely in a single plane.</td>
</tr>
<tr>
<td>Parallel lines do not intersect; they are everywhere the same distance from each other and have no points in common.</td>
</tr>
<tr>
<td>Perpendicular lines are two lines that intersect to form right angles.</td>
</tr>
<tr>
<td>To bisect means to divide into two equal parts.</td>
</tr>
<tr>
<td>• A perpendicular bisector is a line, ray, or line segment that divides a segment into two congruent segments forming right angles and is perpendicular to the segment.</td>
</tr>
<tr>
<td>A chart, graphic organizer, or Venn Diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles.</td>
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6.13 The student will describe and identify properties of quadrilaterals.

### UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- A quadrilateral is a closed planar (two-dimensional) figure with four sides that are line segments.
- A parallelogram is a quadrilateral whose opposite sides are parallel and opposite angles are congruent.
- A rectangle is a parallelogram with four right angles.
- Rectangles have special characteristics (such as diagonals are bisectors) that are true for any rectangle.
- To bisect means to divide into two equal parts.
- A square is a rectangle with four congruent sides or a rhombus with four right angles.
- A rhombus is a parallelogram with four congruent sides.
- A trapezoid is a quadrilateral with exactly one pair of parallel sides. The parallel sides are called bases, and the nonparallel sides are called legs. If the legs have the same length, then the trapezoid is an isosceles trapezoid.
- A kite is a quadrilateral with two pairs of adjacent congruent sides. One pair of opposite angles is congruent.
- Quadrilaterals can be sorted according to common attributes, using a variety of materials.
- Quadrilaterals can be classified by the number of parallel sides: a parallelogram, rectangle, rhombus, and square each have two pairs of parallel sides; a trapezoid has only one pair of parallel sides; other quadrilaterals have no parallel sides.

### ESSENTIAL UNDERSTANDINGS

- Can a figure belong to more than one subset of quadrilaterals? Any figure that has the attributes of more than one subset of quadrilaterals can belong to more than one subset. For example, rectangles have opposite sides of equal length. Squares have all 4 sides of equal length thereby meeting the attributes of both subsets.

### ESSENTIAL KNOWLEDGE AND SKILLS

- The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
  - Sort and classify polygons as quadrilaterals, parallelograms, rectangles, trapezoids, kites, rhombi, and squares based on their properties. Properties include number of parallel sides, angle measures and number of congruent sides.
  - Identify the sum of the measures of the angles of a quadrilateral as 360°.
6.13 The student will describe and identify properties of quadrilaterals.

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<td>• Quadrilaterals can be classified by the measures of their angles: a rectangle has four 90° angles; a trapezoid may have zero or two 90° angles.</td>
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<tr>
<td>• Quadrilaterals can be classified by the number of congruent sides: a rhombus has four congruent sides; a square, which is a rhombus with four right angles, also has four congruent sides; a parallelogram and a rectangle each have two pairs of congruent sides.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• A square is a special type of both a rectangle and a rhombus, which are special types of parallelograms, which are special types of quadrilaterals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The sum of the measures of the angles of a quadrilateral is 360°.</td>
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<td>• A chart, graphic organizer, or Venn Diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles.</td>
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**Curriculum Information**

<table>
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<tr>
<th>SOL Reporting Category</th>
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<th>Essential Questions and Understandings</th>
</tr>
</thead>
</table>
| Probability, Statistics, Patterns, Functions, and Algebra | The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:  
- Collect, organize and display data in circle graphs by depicting information as fractional parts.  
- Draw conclusions and make predictions about data presented in a circle graph.  
- Compare and contrast data presented in a circle graph with the same data represented in other graphical forms.  
- Decide which type of graph is appropriate for a given situation. | Essential Questions and Understandings  
- What types of data are best presented in a circle graph?  
  Circle graphs are best used for data showing a relationship of the parts to the whole. |
| **Focus** | **Key Vocabulary** | **Teacher Notes and Elaborations** |
| Practical Applications of Statistics | bar graph  
central angle  
circle graph  
compass  
data  
experiment  
line graph  
prediction  
protractor  
scale  
survey  
title  
vertex | To collect data for a problem situation, an experiment can be designed, a survey can be conducted, or other data gathering strategies can be used.  
- The data can be organized, displayed, analyzed, and interpreted to answer the problem.  
- A survey is a sampling, or partial collection, of facts, figures, or opinions taken and used to approximate or indicate what a complete collection and analysis might reveal.  
- Different types of graphs are used to display different types of data.  
  - Bar graphs should be utilized to compare counts of different categories. A bar graph uses parallel bars; either horizontal or vertical, to represent counts for several categories. One bar is used for each category with the length of the bar representing the count for that category. There is space before, between, and after the bars. The axis displaying the scale representing the count for the categories should extend one increment above the greatest recorded piece of data. The values should represent equal increments. |

**HCPS Website**  
SOL 6.14 – Circle Graphs

**DOE Lesson Plans**  
May I Have Fries with That? (PDF) - Constructing and using circle graphs (Word)

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(continued)
Different types of graphs are used to display different types of data. (continued)

- Line graphs use continuous data (e.g., temperature and time).
  - A line graph is used when there is a numeric value associated with equally spaced points along a continuous number scale. By looking at a single line graph, it can be determined whether the variable is increasing, decreasing, or staying the same. The data represented on a line graph is referred to as continuous data as it represents data collected over a continuous period of time.

- Circle graphs show a relationship of the parts to a whole.
  - Circle graphs are best used for data showing a relationship of the parts to the whole. To construct a circle graph find the fractional part of the whole. Multiply each fractional part by 360 (the number of degrees in a circle). Using a protractor, make central angles (angles whose vertex is the center of the circle) based on the products of the fractional parts times 360.

All graphs include a title, and data categories should have labels.

- A title is essential to explain what the graph represents.

- A scale should be chosen that is appropriate for the data.

- A key is essential to explain how to read the graph.

- Data are analyzed by describing the various features and elements of a graph.

<table>
<thead>
<tr>
<th>Sport</th>
<th>Number</th>
<th>Fractional part of circle</th>
<th>Measure of central angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>10</td>
<td>$\frac{10}{40} = \frac{1}{4}$</td>
<td>$\frac{1}{4} \times 360^\circ = 90^\circ$</td>
</tr>
<tr>
<td>Soccer</td>
<td>20</td>
<td>$\frac{20}{40} = \frac{1}{2}$</td>
<td>$\frac{1}{2} \times 360^\circ = 180^\circ$</td>
</tr>
<tr>
<td>Baseball</td>
<td>4</td>
<td>$\frac{4}{40} = \frac{1}{10}$</td>
<td>$\frac{1}{10} \times 360^\circ = 36^\circ$</td>
</tr>
<tr>
<td>Basketball</td>
<td>6</td>
<td>$\frac{6}{40} = \frac{3}{20}$</td>
<td>$\frac{3}{20} \times 360^\circ = 54^\circ$</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>$\frac{40}{40} = 1$</td>
<td>$360^\circ$</td>
</tr>
</tbody>
</table>
STANDARD 6.14 STRAND: PROBABILITY AND STATISTICS GRADE LEVEL 6

6.14 The student, given a problem situation, will
   a) construct circle graphs;
   b) draw conclusions and make predictions, using circle graphs; and
   c) compare and contrast graphs that present information from the same data set.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- To collect data for any problem situation, an experiment can be designed, a survey can be conducted, or other data-gathering strategies can be used. The data can be organized, displayed, analyzed, and interpreted to answer the problem.
- Different types of graphs are used to display different types of data.
  - Bar graphs use categorical (discrete) data (e.g., months or eye color).
  - Line graphs use continuous data (e.g., temperature and time).
  - Circle graphs show a relationship of the parts to a whole.
- All graphs include a title, and data categories should have labels.
- A scale should be chosen that is appropriate for the data.
- A key is essential to explain how to read the graph.
- A title is essential to explain what the graph represents.
- Data are analyzed by describing the various features and elements of a graph.

ESSENTIAL UNDERSTANDINGS

- What types of data are best presented in a circle graph?
  Circle graphs are best used for data showing a relationship of the parts to the whole.

ESSENTIAL KNOWLEDGE AND SKILLS

- The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
  - Collect, organize and display data in circle graphs by depicting information as fractional.
  - Draw conclusions and make predictions about data presented in a circle graph.
  - Compare and contrast data presented in a circle graph with the same data represented in other graphical forms.
<table>
<thead>
<tr>
<th>SOL Reporting Category</th>
<th>Essential Knowledge and Skills</th>
<th>Essential Questions and Understandings</th>
<th>Teacher Notes and Elaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability, Statistics, Patterns, Functions, and Algebra</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:</td>
<td>What does the phrase “measure of center” mean?</td>
<td>Measures of center are types of averages for a data set.</td>
</tr>
<tr>
<td>Focus</td>
<td>- Find the mean for a set of data.</td>
<td>This is a collective term for the 3 types of averages for a set of data – mean, median, and mode.</td>
<td>o They represent numbers that describe a data set.</td>
</tr>
<tr>
<td>Practical Applications of Statistics</td>
<td>- Describe the three measures of center and a situation in which each would best represent a set of data.</td>
<td>What is meant by mean as balance point?</td>
<td>o Mean works well for sets of data with no very high or very low numbers (outliers).</td>
</tr>
<tr>
<td>Virginia SOL 6.15</td>
<td>- Identify and draw a number line that demonstrates the concept of mean as balance point for a set of data.</td>
<td>Mean can be defined as the point on a number line where the data distribution is balanced. This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean. This is the concept of mean as the balance point.</td>
<td>▪ Example: The average age in years of students at Center Middle School is 12. Mean is a better measure of the average because the set of data has no very high or very low numbers.</td>
</tr>
<tr>
<td>The student will</td>
<td></td>
<td></td>
<td>o Median is a good choice when data sets have a couple of values much higher or much lower than most of the others.</td>
</tr>
<tr>
<td>a. describe mean as balance point; and</td>
<td>Key Vocabulary</td>
<td>▪ Example: The president of a small company has a salary of $320,000. The rest of the employees have salaries less than $100,000. Median is a better measure for the average salary of this company because one value is so much higher than the others.</td>
<td>▪ Example: Mode can be used to determine the average shoe size of students in a class. Shoe sizes are standardized and not conducive to computation.</td>
</tr>
<tr>
<td>b. decide which measure of center is appropriate for a given purpose.</td>
<td>average</td>
<td>o Mode is a good descriptor to use when the set of data has some identical values or when data are not conducive to computation of other measures of central tendency, as when working with data in a yes or no survey.</td>
<td>□ The mean is the numerical average of the data set and is found by adding the numbers in the data set together and dividing the sum by the number of data pieces in the set.</td>
</tr>
<tr>
<td>HCPS Website</td>
<td>balance point</td>
<td>▪ Example: Mode can be used to determine the average shoe size of students in a class. Shoe sizes are standardized and not conducive to computation.</td>
<td>o In grade 5 mathematics, mean is defined as fair share.</td>
</tr>
<tr>
<td>SOL 6.15 – Measures of Central Tendency</td>
<td>bimodal</td>
<td>□ Measures of center are types of averages for a data set.</td>
<td></td>
</tr>
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<tr>
<td>------------------------</td>
<td>----------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability, Statistics, Patterns, Functions, and Algebra</td>
<td>Mean can be defined as the point on a number line where the data distribution is balanced.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td>o This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical Applications of Statistics</td>
<td>o This is the concept of mean as the balance point.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia SOL 6.15</td>
<td>o Defining mean as balance point is a prerequisite for understanding standard deviation, which is introduced in Algebra I.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- a. describe mean as balance point; and
- b. decide which measure of center is appropriate for a given purpose.

<table>
<thead>
<tr>
<th>SOL 6.15</th>
<th>The student will</th>
</tr>
</thead>
</table>
- a. | The *mode* is the piece of data that occurs most frequently. |
- b. | o If no value occurs more often than any other, there is no mode. |
- | o If there is more than one value that occurs most often, all these most-frequently-occurring values are modes. |
- | o When there are exactly two modes, the data set is *bimodal*. |

[Return to Course Outline]
6.15 The student will
a) describe mean as balance point; and
b) decide which measure of center is appropriate for a given purpose.

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<td><strong>(Background Information for Instructor Use Only)</strong></td>
<td></td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>Measures of center are types of averages for a data set. They represent numbers that describe a data set. Mean, median, and mode are measures of center that are useful for describing the average for different situations.</td>
<td>• What does the phrase “measure of center” mean? This is a collective term for the 3 types of averages for a set of data – mean, median, and mode.</td>
<td>• Find the mean for a set of data.</td>
</tr>
<tr>
<td>– Mean works well for sets of data with no very high or low numbers.</td>
<td>• What is meant by mean as balance point? Mean can be defined as the point on a number line where the data distribution is balanced. This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean. This is the concept of mean as the balance point.</td>
<td>• Describe the three measures of center and a situation in which each would best represent a set of data.</td>
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<tr>
<td>– Median is a good choice when data sets have a couple of values much higher or lower than most of the others.</td>
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<td>• Identify and draw a number line that demonstrates the concept of mean as balance point for a set of data.</td>
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<td>– Mode is a good descriptor to use when the set of data has some identical values or when data are not conducive to computation of other measures of central tendency, as when working with data in a yes or no survey.</td>
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<td>The mean is the numerical average of the data set and is found by adding the numbers in the data set together and dividing the sum by the number of data pieces in the set.</td>
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<td>In grade 5 mathematics, mean is defined as fair-share.</td>
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<td>Defining mean as balance point is a prerequisite for understanding standard deviation.</td>
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6.15 The student will
   a) describe mean as balance point; and
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<tr>
<td>The median is the middle value of a data set in ranked order. If there are an odd number of pieces of data, the median is the middle value in ranked order. If there is an even number of pieces of data, the median is the numerical average of the two middle values.</td>
<td></td>
<td></td>
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<td>The mode is the piece of data that occurs most frequently. If no value occurs more often than any other, there is no mode. If there is more than one value that occurs most often, all these most-frequently-occurring values are modes. When there are exactly two modes, the data set is bimodal.</td>
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| Probability, Statistics, Patterns, Functions, and Algebra | The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:  
- Determine whether two events are dependent or independent.  
- Compare and contrast dependent and independent events.  
- Determine the probability of two dependent events.  
- Determine the probability of two independent events. | How can you determine if a situation involves dependent or independent events?  
Events are independent when the outcome of one has no effect on the outcome of the other. Events are dependent when the outcome of one event is influenced by the outcome of the other. |

**Focus**  
Practical Applications of Statistics

**Virginia SOL 6.16**  
The student will  
a. compare and contrast dependent and independent events; and  
b. determine probabilities for dependent and independent events

**HCPS Website**  
SOL 6.16 – Event Probability

**DOE Lesson Plans**  
It Could Happen (PDF) -  
Differentiating between dependent and independent events (Word)

**Key Vocabulary**  
- compound event  
- decimal  
- dependent event  
- fraction  
- independent event  
- outcome  
- percent  
- probability  
- product  
- sample space  
- simple event  
- simplify

**Teacher Notes and Elaborations**  
- The probability of an event occurring is equal to the ratio of desired outcomes to the total number of possible outcomes (sample space).  
  ○ In probability the outcome is any of the possible results in an experiment.  
  ○ The probability of an event occurring can be represented as a ratio or the equivalent fraction, decimal, or a percent.

- A sample space is the set of all possible outcomes of an experiment.  
  ○ A sample space may be organized by using a list, chart, picture, or tree diagram.  
    - Example: The sample space for tossing 2 coins is (H, H), (H, T), (T, H) and (T, T).

- The probability of an event occurring is a ratio between 0 and 1.  
  ○ A probability of 0 means the event will never occur.  
  ○ A probability of 1 means the event will always occur.

- A *simple event* is one event.  
  ○ Example: pulling one sock out of a drawer and examining the probability of getting one color.

- A *compound event* combines two or more simple events (dependent or independent).  
  ○ *Events are independent* when the outcome of one has no effect on the outcome of the other.  
    - The probability of two independent events is found by using the following formula:  
      \[ P(A \text{ and } B) = P(A) \cdot P(B) \]  
      
      - Example: When rolling two number cubes simultaneously, what is the probability of rolling a 3 on one cube and a 4 on the other?  
        \[ P(3 \text{ and } 4) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36} \]
### SOL Reporting Category

**Probability, Statistics, Patterns, Functions, and Algebra**

### Focus

**Practical Applications of Statistics**

### Virginia SOL 6.16

The student will

- compare and contrast dependent and independent events; and
- determine probabilities for dependent and independent events

<table>
<thead>
<tr>
<th>SOL Reporting Category</th>
<th>Essential Questions and Understandings</th>
<th>Teacher Notes and Elaborations (continued)</th>
</tr>
</thead>
</table>
| **SOL 6.16**           | o *Events are dependent* when the outcome of one event is influenced by the outcome of the other.  
|                        | • The probability of two dependent events is found by using the following formula:  
|                        | \[
P(A \text{ and } B) = P(A) \cdot P(B \text{ after } A)\]
|                        | • *Example:* If a bag holds a blue ball, a red ball, and a yellow ball, what is the probability of picking a blue ball out of the bag on the first pick and then without replacing the blue ball in the bag, picking a red ball on the second pick?  
|                        | • \[
P(\text{blue and red}) = P(\text{blue}) \cdot P(\text{red after blue}) = \frac{1}{3} \cdot \frac{1}{2} = \frac{1}{6}\]
STANDARD 6.16 STRAND: PROBABILITY AND STATISTICS GRADE LEVEL 6

6.16 The student will
a) compare and contrast dependent and independent events; and
b) determine probabilities for dependent and independent events.

<table>
<thead>
<tr>
<th>UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)</th>
<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The probability of an event occurring is equal to the ratio of desired outcomes to the total number of possible outcomes (sample space).</td>
<td>• How can you determine if a situation involves dependent or independent events? Events are independent when the outcome of one has no effect on the outcome of the other. Events are dependent when the outcome of one event is influenced by the outcome of the other.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• The probability of an event occurring can be represented as a ratio or the equivalent fraction, decimal, or percent.</td>
<td>• Determine whether two events are dependent or independent.</td>
<td></td>
</tr>
<tr>
<td>• The probability of an event occurring is a ratio between 0 and 1. − A probability of 0 means the event will never occur. − A probability of 1 means the event will always occur.</td>
<td>• Compare and contrast dependent and independent events.</td>
<td></td>
</tr>
<tr>
<td>• A simple event is one event (e.g., pulling one sock out of a drawer and examining the probability of getting one color).</td>
<td>• Determine the probability of two dependent events.</td>
<td></td>
</tr>
<tr>
<td>• Events are independent when the outcome of one has no effect on the outcome of the other. For example, rolling a number cube and flipping a coin are independent events.</td>
<td>• Determine the probability of two independent events.</td>
<td></td>
</tr>
<tr>
<td>• The probability of two independent events is found by using the following formula: $P(A \text{ and } B) = P(A) \cdot P(B)$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ex: When rolling two number cubes simultaneously, what is the probability of rolling a 3 on one cube and a 4 on the other?

$P(3 \text{ and } 4) = P(3) \cdot P(4) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$
6.16 The student will
a) compare and contrast dependent and independent events; and
b) determine probabilities for dependent and independent events.

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<tr>
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</thead>
<tbody>
<tr>
<td>• Events are dependent when the outcome of one event is influenced by the outcome of the other. For example, when drawing two marbles from a bag, not replacing the first after it is drawn affects the outcome of the second draw.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The probability of two dependent events is found by using the following formula: $P(A \text{ and } B) = P(A) \cdot P(B \text{ after } A)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex: You have a bag holding a blue ball, a red ball, and a yellow ball. What is the probability of picking a blue ball out of the bag on the first pick and then without replacing the blue ball in the bag, picking a red ball on the second pick?</td>
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<tr>
<td>$P(\text{blue and red}) = P(\text{blue}) \cdot P(\text{red after blue}) = \frac{1}{3} \cdot \frac{1}{2} = \frac{1}{6}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the middle grades, the focus of mathematics learning is to
- build on students’ concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.
- Students extend their knowledge of patterns developed in the elementary grades and through life experiences by investigating and describing functional relationships.
- Students learn to use algebraic concepts and terms appropriately. These concepts and terms include variable, term, coefficient, exponent, expression, equation, inequality, domain, and range. Developing a beginning knowledge of algebra is a major focus of mathematics learning in the middle grades.
- Students learn to solve equations by using concrete materials. They expand their skills from one-step to two-step equations and inequalities.
- Students learn to represent relations by using ordered pairs, tables, rules, and graphs. Graphing in the coordinate plane linear equations in two variables is a focus of the study of functions.
### SOL Reporting Category
Probability, Statistics, Patterns, Functions, and Algebra

### Focus
Variable Equations and Properties

### Virginia SOL 6.17
The student will identify and extend geometric and arithmetic sequences

### HCPS Website
SOL 6.17 – Arithmetic and Geometric Sequences

### DOE Lesson Plans
Growing Patterns and Sequences (PDF)
- Identifying and extending arithmetic and geometric sequences (Word)

### Essential Knowledge and Skills
#### Key Vocabulary
- Arithmetic Sequence
- Geometric Sequence
- Common Difference
- Common Ratio
- Consecutive Term
- Numerical Pattern
- Factor

The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:
- Investigate and apply strategies to recognize and describe the change between terms in arithmetic patterns.
- Investigate and apply strategies to recognize and describe geometric patterns.
- Describe verbally and in writing the relationships between consecutive terms in an arithmetic or geometric sequence.
- Extend and apply arithmetic and geometric sequences to similar situations.
- Extend arithmetic and geometric sequences in a table by using a given rule or mathematical relationship.
- Compare and contrast arithmetic and geometric sequences.
- Identify the common difference for a given arithmetic sequence.
- Identify the common ratio for a given geometric sequence.

### Essential Questions and Understandings
- What is the difference between an arithmetic and a geometric sequence?
  While both are numerical patterns, arithmetic sequences are additive and geometric sequences are multiplicative.

### Teacher Notes and Elaborations
- **Arithmetic and geometric sequences are types of numerical patterns.**
  - In an arithmetic sequence, students must determine the difference, called the common difference, between each succeeding number in order to determine what is added to each previous number to obtain the next number.
    - Sample numerical patterns are 6, 9, 12, 15, 18, …; and 5, 7, 9, 11, 13, ….
  - In geometric number patterns, students must determine what each number is multiplied by to obtain the next number in the geometric sequence. This multiplier is called the common ratio.
    - Sample geometric number patterns include 2, 4, 8, 16, 32, …; 1, 5, 25, 125, 625, …; and 80, 20, 5, 1.25, …
- Numerical patterns may include linear and exponential growth, perfect squares, triangular and other polygonal numbers, or Fibonacci numbers.
- Strategies to recognize and describe the differences between terms in numerical patterns include, but are not limited to, examining the change between consecutive terms, and finding common factors.
  - An example is the pattern 1, 2, 4, 7, 11, 16, …
- Classroom experiences should include building patterns and describing how the patterns can be extended in a logical manor.
  - Building the patterns with physical materials such as tiles, counters, or flat toothpicks allows students to make changes if necessary and to build on to one step to make a new step. (Teaching Student-Centered Mathematics, Grades 5-8, 2006, John Van de Walle and LouAnn Lovin).
6.17 The student will identify and extend geometric and arithmetic sequences.

<table>
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<tr>
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<tbody>
<tr>
<td>• Numerical patterns may include linear and exponential growth, perfect squares, triangular and other polygonal numbers, or Fibonacci numbers.</td>
<td>• What is the difference between an arithmetic and a geometric sequence? While both are numerical patterns, arithmetic sequences are additive and geometric sequences are multiplicative.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• Arithmetic and geometric sequences are types of numerical patterns.</td>
<td></td>
<td>• Investigate and apply strategies to recognize and describe the change between terms in arithmetic patterns.</td>
</tr>
<tr>
<td>• In the numerical pattern of an arithmetic sequence, students must determine the difference, called the common difference, between each succeeding number in order to determine what is added to each previous number to obtain the next number. Sample numerical patterns are 6, 9, 12, 15, 18, …; and 5, 7, 9, 11, 13, ….</td>
<td></td>
<td>• Investigate and apply strategies to recognize and describe geometric patterns.</td>
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<tr>
<td>• In geometric number patterns, students must determine what each number is multiplied by to obtain the next number in the geometric sequence. This multiplier is called the common ratio. Sample geometric number patterns include 2, 4, 8, 16, 32, …; 1, 5, 25, 125, 625, …; and 80, 20, 5, 1.25, ….</td>
<td></td>
<td>• Describe verbally and in writing the relationships between consecutive terms in an arithmetic or geometric sequence.</td>
</tr>
<tr>
<td>• Strategies to recognize and describe the differences between terms in numerical patterns include, but are not limited to, examining the change between consecutive terms, and finding common factors. An example is the pattern 1, 2, 4, 7, 11, 16, ….</td>
<td></td>
<td>• Extend and apply arithmetic and geometric sequences to similar situations.</td>
</tr>
</tbody>
</table>

Mathematics Standards of Learning Curriculum Framework 2009: Grade 6
### SOL Reporting Category

Probability, Statistics, Patterns, Functions, and Algebra

### Focus

Variable Equations and Properties

### Virginia SOL 6.18

The student will solve one-step linear equations in one variable involving whole number coefficients and positive rational solutions.

### HCPS Website

SOL 6.18 - Equations

### DOE Lesson Plans

- [Equation Vocabulary (PDF)] - Solving one-step linear equations in one variable (Word)
- [Balanced (PDF)] - Solving one-step linear equations in one variable (Word)

### Key Vocabulary

- coefficient
- equation
- expression
- numerical expression
- term
- variable
- variable expression
- operation
- sum
- difference
- product
- quotient
- inverse operation

### Essential Knowledge and Skills

The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:

- Represent and solve a one-step equation, using a variety of concrete materials such as colored chips, algebra tiles, or weights on a balance scale.
- Solve a one-step equation by demonstrating the steps algebraically.
- Identify and use the following algebraic terms appropriately: *expression, equation, variable, term, and coefficient.*

### Essential Questions and Understandings

- When solving an equation, why is it necessary to perform the same operation on both sides of an equal sign?
  
  To maintain equality, an operation performed on one side of an equation must be performed on the other side.

### Teacher Notes and Elaborations

- When solving an equation, why is it necessary to perform the same operation on both sides of an equal sign?
  - To maintain equality, an operation performed on one side of an equation must be performed on the other side.

- To solve a one-step equation algebraically students must maintain equality by performing the same operation on both sides of the equation.
  - A one-step linear equation is an equation that requires one operation to solve.

- Positive rational solutions are limited to the whole numbers and positive fractions and decimals.

- An equation is a mathematical sentence stating that two expressions are equal.
  - An equation has only one equal sign.

- A mathematical expression contains a variable or a combination of variables, numbers, and/or operation symbols and represents a mathematical relationship.
  - An expression is like a phrase and does not have a verb, so an expression does not have an equal sign (=).
  - A numerical expression is an expression that contains only numbers
    - Example: 7 + 4
  - A variable expression contains a variable
    - Example: n + 12

- A term is a number, variable, product, or quotient in an expression of sums and/or differences.
  - In $7x^2+5x+3$, there are three terms $7x^2$, $5x$, and $3$.

- A coefficient is the numerical factor in a term.
  - For example, in the term $3xy^2$, $3$ is the coefficient.

- A variable is a symbol (placeholder) used to represent an unspecified member of a set.
6.18 The student will solve one-step linear equations in one variable involving whole number coefficients and positive rational solutions.

<table>
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<tbody>
<tr>
<td>• A one-step linear equation is an equation that requires one operation to solve.</td>
<td>• When solving an equation, why is it necessary to perform the same operation on both sides of an equal sign? To maintain equality, an operation performed on one side of an equation must be performed on the other side.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to</td>
</tr>
<tr>
<td>• A mathematical expression contains a variable or a combination of variables, numbers, and/or operation symbols and represents a mathematical relationship. An expression cannot be solved.</td>
<td>• A term is a number, variable, product, or quotient in an expression of sums and/or differences. In $7x^2 + 5x - 3$, there are three terms, $7x^2$, $5x$, and $3$.</td>
<td>• Represent and solve a one-step equation, using a variety of concrete materials such as colored chips, algebra tiles, or weights on a balance scale.</td>
</tr>
<tr>
<td>• A coefficient is the numerical factor in a term. For example, in the term $3xy^2$, $3$ is the coefficient; in the term $z$, $1$ is the coefficient.</td>
<td>• Positive rational solutions are limited to whole numbers and positive fractions and decimals.</td>
<td>• Solve a one-step equation by demonstrating the steps algebraically.</td>
</tr>
<tr>
<td>• Identifying and using the following algebraic terms appropriately: equation, variable, expression, term, and coefficient.</td>
<td>• An equation is a mathematical sentence stating that two expressions are equal.</td>
<td>• Identify and use the following algebraic terms appropriately: equation, variable, expression, term, and coefficient.</td>
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<tr>
<td>• A variable is a symbol (placeholder) used to represent an unspecified member of a set.</td>
<td></td>
<td></td>
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<tr>
<td>SOL Reporting Category</td>
<td>Essential Knowledge and Skills</td>
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<tr>
<td>------------------------</td>
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</tr>
</tbody>
</table>
| Probability, Statistics, Patterns, Functions, and Algebra | The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to:  
- Identify the real number equation that represents each property of operations with real numbers, when given several real number equations.  
- Test the validity of properties by using examples of the properties of operations on real numbers.  
- Identify the property of operations with real numbers that is illustrated by a real number equation. | How are the identity properties for multiplication and addition the same? Different?  
- For each operation the identity elements are numbers that combine with other numbers without changing the value of the other numbers. The additive identity is zero (0). The multiplicative identity is one (1).  
- What is the result of multiplying any real number by zero? The product is always zero.  
- Do all real numbers have a multiplicative inverse? No. Zero has no multiplicative inverse because there is no real number that can be multiplied by zero resulting in a product of one. |
| Focus | | |
| Variable Equations and Properties | | |
| Virginia SOL 6.19 | The student will investigate and recognize  
a. the identity properties for addition and multiplication;  
b. the multiplicative property of zero; and  
c. the inverse property for multiplication. | |
| HCPS Website | | |
| SOL 6.19 - Properties | | |
| DOE Lesson Plans | | |
| Pick and Choose (PDF) - Exploring properties of real numbers (Word) | | |
| Key Vocabulary | The additive identity property  
associative property of addition  
associative property of multiplication  
commutative property of addition  
commutative property of multiplication  
distributive property  
identity elements  
inverses  
multiplicative identity property  
multiplicative inverse property  
multiplicative property of zero  
reciprocal  
Undefined  
Product  
Factor | undefined  
Product  
Factor | |

(Note: The commutative, associative and distributive properties are taught in previous grades.)

Key Vocabulary
- additive identity property
- associative property of addition
- associative property of multiplication
- commutative property of addition
- commutative property of multiplication
- distributive property
- identity elements
- inverses
- multiplicative identity property
- multiplicative inverse property
- multiplicative property of zero
- reciprocal
- Undefined
- Product
- Factor

Teacher Notes and Elaborations
- The additive identity property states that the sum of any real number and zero is equal to the given real number.
  - Example: \( 5 + 0 = 5 \)
- The multiplicative identity property states that the product of any real number and one is equal to the given real number.
  - Example: \( 8 \cdot 1 = 8 \)
- Identity elements are numbers that combine with other numbers without changing the other numbers.
  - The additive identity element is zero (0).
  - The multiplicative identity element is one (1).
  - Inverses are numbers that combine with other numbers and result in identity elements.
- The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one.
  - Example: \( 4 \cdot \frac{1}{4} = 1 \)
  - Zero has no multiplicative inverse.
- The multiplicative property of zero states that the product of any real number and zero is zero.
  - Division by zero is not a possible arithmetic operation.
  - Division by zero is undefined.

(continued)
<table>
<thead>
<tr>
<th>SOL Reporting Category</th>
<th>Properties that have been taught in previous grades that should be revisited:</th>
</tr>
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<tbody>
<tr>
<td>Probability, Statistics, Patterns, Functions, and Algebra</td>
<td>□ The <strong>commutative property of addition</strong> states that changing the order of the addends does not change the sum.</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td>○ Example: $5 + 4 = 4 + 5$</td>
</tr>
<tr>
<td>Variable Equations and Properties</td>
<td>□ The <strong>commutative property of multiplication</strong> states that changing the order of the factors does not change the product.</td>
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<td></td>
<td>○ Example: $5 \cdot 4 = 4 \cdot 5$</td>
</tr>
<tr>
<td><strong>Virginia SOL 6.19</strong></td>
<td>□ The <strong>associative property of addition</strong> states that regrouping the addends does not change the sum.</td>
</tr>
<tr>
<td>The student will investigate and recognize</td>
<td>○ Example: $5 + (4 + 3) = (5 + 4) + 3$</td>
</tr>
<tr>
<td>a. the identity properties for addition and multiplication;</td>
<td>□ The <strong>associative property of multiplication</strong> states that regrouping the factors does not change the product.</td>
</tr>
<tr>
<td>and</td>
<td>○ Example: $5 \cdot (4 \cdot 3) = (5 \cdot 4) \cdot 3$</td>
</tr>
<tr>
<td>b. the multiplicative property of zero; and</td>
<td>□ The <strong>distributive property</strong> states that the product of a number and the sum (or difference) of two other numbers equals the sum (or difference) of the products of the number and each other number.</td>
</tr>
<tr>
<td>and</td>
<td>○ Example: $5 \cdot (3 + 7) = (5 \cdot 3) + (5 \cdot 7)$, or $5 \cdot (3 - 7) = (5 \cdot 3) - (5 \cdot 7)$</td>
</tr>
<tr>
<td>c. the inverse property for multiplication.</td>
<td></td>
</tr>
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</table>
6.19 The student will investigate and recognize
a) the identity properties for addition and multiplication;
b) the multiplicative property of zero; and
c) the inverse property for multiplication.

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<tr>
<td><strong>Identity elements are numbers that combine with other numbers without changing the other numbers.</strong> The additive identity is zero (0). The multiplicative identity is one (1). There are no identity elements for subtraction and division.</td>
<td><strong>How are the identity properties for multiplication and addition the same? Different?</strong> For each operation the identity elements are numbers that combine with other numbers without changing the value of the other numbers. The additive identity is zero (0). The multiplicative identity is one (1).</td>
<td><strong>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations</strong> to</td>
</tr>
<tr>
<td><strong>The additive identity property states that the sum of any real number and zero is equal to the given real number (e.g., 5 + 0 = 5).</strong></td>
<td><strong>What is the result of multiplying any real number by zero?</strong> The product is always zero.</td>
<td><strong>Identify a real number equation that represents each property of operations with real numbers, when given several real number equations.</strong></td>
</tr>
<tr>
<td><strong>The multiplicative identity property states that the product of any real number and one is equal to the given real number (e.g., 8 · 1 = 8).</strong></td>
<td><strong>Do all real numbers have a multiplicative inverse? No. Zero has no multiplicative inverse because there is no real number that can be multiplied by zero resulting in a product of one.</strong></td>
<td><strong>Test the validity of properties by using examples of the properties of operations on real numbers.</strong></td>
</tr>
<tr>
<td><strong>Inverses are numbers that combine with other numbers and result in identity elements.</strong> The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one (e.g., 4 · (\frac{1}{4}) = 1).</td>
<td></td>
<td><strong>Identify the property of operations with real numbers that is illustrated by a real number equation.</strong></td>
</tr>
<tr>
<td><strong>Zero has no multiplicative inverse.</strong> The multiplicative property of zero states that the product of any real number and zero is zero.</td>
<td></td>
<td><strong>NOTE: The commutative, associative and distributive properties are taught in previous grades.</strong></td>
</tr>
<tr>
<td><strong>Division by zero is not a possible arithmetic operation. Division by zero is undefined.</strong></td>
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<tr>
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</tr>
<tr>
<td>Probability, Statistics, Patterns, Functions, and Algebra</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representations to: Given a simple inequality with integers, graph the relationship on a number line. Given the graph of a simple inequality with integers, represent the inequality two different ways using the symbols $&lt;$, $&gt;$, $\leq$ and $\geq$.</td>
<td>Essential Questions and Understandings • In an inequality, does the order of the expressions matter? Yes, the order does matter. For example, $x &gt; 5$ is not the same relationship as $5 &gt; x$. However, $x &gt; 5$ is the same relationship as $5 &lt; x$.</td>
</tr>
<tr>
<td>Focus</td>
<td>Key Vocabulary inequality solution set Greater Than Less than Number Line Greater Than or equal to Less than or equal to Inverse Operation</td>
<td>Teacher Notes and Elaborations □ An inequality is a mathematical sentence that states that one quantity is less than, greater than, or not equal to another quantity. o An inequality is a mathematical sentence that compares two expressions using one of the symbols $&lt;$, $&gt;$, $\leq$, or $\geq$. o It is important for students to see inequalities written with the variable before the inequality symbol and after the inequality symbol. ▪ For example $x &gt; -6$ and $7 &gt; y$. □ Inequalities using the $&lt;$ or $&gt;$ symbols are represented on a number line with an open circle on the number and a shaded line over the solution set. o Example: $x &lt; 5$ □ The solution set to an inequality is the set of all numbers that make the inequality true. □ Inequalities using the $\leq$ or $\geq$ symbols are represented on a number line with a closed circle on the number and shaded line in the direction of the solution set. □ When graphing $x \leq 5$ fill in the circle on the number line above the 5 to indicate that the 5 is included. o Note: The graph must be drawn on the number line not above the number line.</td>
</tr>
</tbody>
</table>
6.20 The student will graph inequalities on a number line.

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<tr>
<td>- Inequalities using the &lt; or &gt; symbols are represented on a number line with an open circle on the number and a shaded line over the solution set. Ex: x &lt; 4</td>
<td>- In an inequality, does the order of the elements matter? Yes, the order does matter. For example, x &gt; 5 is not the same relationship as 5 &gt; x. However, x &gt; 5 is the same relationship as 5 &lt; x.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to</td>
</tr>
<tr>
<td><img src="image" alt="Number Line" /></td>
<td>- Given a simple inequality with integers, graph the relationship on a number line.</td>
<td></td>
</tr>
<tr>
<td>- When graphing x ≤ 4 fill in the circle above the 4 to indicate that the 4 is included.</td>
<td>- Given the graph of a simple inequality with integers, represent the inequality two different ways using symbols (&lt;, &gt;, ≤, ≥).</td>
<td></td>
</tr>
<tr>
<td>- Inequalities using the ≤ or ≥ symbols are represented on a number line with a closed circle on the number and shaded line in the direction of the solution set.</td>
<td></td>
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<tr>
<td>- The solution set to an inequality is the set of all numbers that make the inequality true.</td>
<td></td>
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<tr>
<td>- It is important for students to see inequalities written with the variable before the inequality symbol and after. For example x &gt; -6 and 7 &gt; y.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Grade 6 Mathematics Formula Sheet
2009 Mathematics Standards of Learning

Geometric Formulas

- Triangle: \[ A = \frac{1}{2}bh \]
- Rectangle: \[ p = 4s, \quad A = s^2 \]
- Trapezoid: \[ p = 2l + 2w, \quad A = lw \]
- Circle: \[ C = 2\pi r, \quad A = \pi r^2 \]
- Cylinder: \[ V = lwh, \quad S.A. = 2lw + 2lh + 2wh \]

Pi

- \[ \pi \approx 3.14 \]
- \[ \pi \approx \frac{22}{7} \]

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milligram</td>
<td>mg</td>
</tr>
<tr>
<td>Gram</td>
<td>g</td>
</tr>
<tr>
<td>Kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>Milliliter</td>
<td>mL</td>
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<tr>
<td>Liter</td>
<td>L</td>
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<tr>
<td>Kiloliter</td>
<td>kL</td>
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<tr>
<td>Millimeter</td>
<td>mm</td>
</tr>
<tr>
<td>Centimeter</td>
<td>cm</td>
</tr>
<tr>
<td>Meter</td>
<td>m</td>
</tr>
<tr>
<td>Kilometer</td>
<td>km</td>
</tr>
<tr>
<td>Square centimeter</td>
<td>cm²</td>
</tr>
<tr>
<td>Cubic centimeter</td>
<td>cm³</td>
</tr>
<tr>
<td>Ounce</td>
<td>oz</td>
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<tr>
<td>Pound</td>
<td>lb</td>
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<tr>
<td>Quart</td>
<td>qt</td>
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<td>yd</td>
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<tr>
<td>Mile</td>
<td>mi</td>
</tr>
<tr>
<td>Square inch</td>
<td>sq in</td>
</tr>
<tr>
<td>Square foot</td>
<td>sq ft</td>
</tr>
<tr>
<td>Cubic inch</td>
<td>cu in</td>
</tr>
<tr>
<td>Cubic foot</td>
<td>cu ft</td>
</tr>
</tbody>
</table>

Area

- \[ A \]

Circumference

- \[ C \]

Perimeter

- \[ p \]

Surface Area

- \[ S.A. \]

Volume

- \[ V \]

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