

Roanoke County Public Schools

# PreAlgebra 8

CURRICULUM GUIDE

2019

## Mathematics Curriculum Guide

Revised 2019. Available at [www.rcps.us](http://www.rcps.us).

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### Roanoke County Public Schools Administration

Dr. Ken Nicely  
Superintendent

James Soltis  
Director of Secondary Instruction

Dr. Rebecca Eastwood  
Director of Elementary Instruction

Terry Hartley  
Mathematics Supervisor

## Preface

This guide will assist the mathematics teacher in preparing students for the challenges of the twenty-first century. As established by the National Council of Teachers of Mathematics *Principles and Standards for School Mathematics*, educational goals for students are changing. A comprehensive and coherent set of mathematics standards for each and every student from prekindergarten through grade 12, *Principles and Standards* is the first set of rigorous, college and career readiness standards for the 21st century. Students should have many and varied experiences in their mathematical training to help them learn to value mathematics, become confident in their ability to do mathematics, become problem solvers, and learn to communicate and reason mathematically. This guide, along with the available division resources, VDOE resources, professional literature, alternative assessment methods, and in-service activities will assist the mathematics teacher in continuing to integrate these student goals into the curriculum.

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## Introduction/General Comments

This curriculum guide follows the 2016 Virginia Math 8 SOLs as adopted by the Virginia Department of Education. It is extremely important and required that the Sequence of Instruction and Pacing be followed as presented in this guide. The textbook adopted as a resource for this course is *enVisionmath 2.0* (for Math 8) by Pearson, 2019 edition.

Students will take three formative assessments during the year (dates to be determined annually). Each teacher-designed test will assess skill levels of the SOLs as presented in the Sequence of Instruction and Pacing and the formative assessment blueprint. The data collected from the formative assessments will help teachers determine students' strengths and weaknesses, and inform instructional decisions.

The Mapping for Instruction is based on specified SOLs which are to be taught in the predetermined order. Note, some SOLs (or their parts) may be taught over multiple 9-week periods.

Refer to the Mathematics 2016 Standards of Learning Math 8 Curriculum Framework during every lesson. It is located at the back of this guide. This will provide valuable information for the teacher (Understanding the Standard) and desired goals for instruction (Essential Knowledge and Skills). Examples of teaching techniques and strategies, definitions, and recommended manipulatives are included in the Curriculum Framework and on the VDOE website under Mathematics Instructional Plans (MIPs)

[http://www.doe.virginia.gov/testing/sol/standards\\_docs/mathematics/2016/mip/index.shtml](http://www.doe.virginia.gov/testing/sol/standards_docs/mathematics/2016/mip/index.shtml).

## Resources Overview

### **Resources for all SOLs**

IXL  
 PowerSchool  
 BrainPop  
 VDOE  
 Promethean Planet  
 Number Talks  
 Performance Tasks  
 Learning Resource Zone in Blackboard  
[get2math](#)

Sequence of Instruction and Pacing												
First Nine Weeks			Second Nine Weeks			Third Nine Weeks			Fourth Nine Weeks			
SOL	Instructional Focus	Blks	SOL	Instructional Focus	Blks	SOL	Instructional Focus	Blks	SOL	Instructional Focus	Blks	
	Algebra Readiness Pretest (mandatory)	1	<b>8.16</b>	Review characteristics of the coordinate plane	1	<b>8.5</b>	Identify and describe angle pairs (vertical, adjacent, supplementary, complementary)	4	<b>7.4a</b>	Review finding surface area and volume of rectangular prisms and cylinders	1	
<b>6.2b</b> <b>6.3bc</b> <b>6.5</b> <b>7.1a-e</b>	Review real numbers	4	<b>8.15ab</b> <b>8.16c</b> <b>A.7bf</b>	Relation, function, domain, range, independent/dependent variable  Domain and range of linear relationships	5	<b>8.5</b>	Find the measure of an unknown angle using relationships of angle pairs	5	<b>8.6a</b>	Surface area and volume of cones and squared based pyramids	5	
<b>8.1</b> <b>8.3ab</b> <b>A.3ab</b>	Positive and negative square roots  Simplify square and cube roots	3	<b>8.16e</b>  <b>A.7cf</b>	Multiple Representations of Linear Equations  Write equation of linear function in $y=mx+b$ form  Zeros, and connections between and among multiple linear representations	4	<b>8.7ab</b>  <b>A.6c</b>	Transformations: - Translations - Reflections - Dilations  Practical applications  Describe transformations of linear equations	6	<b>8.6b</b>	Effect of changing one attribute on volume and surface area of a rectangular prism	4	
<b>8.1</b>	Compare and order real numbers	3	<b>8.16ab</b> <b>A.6a</b>	Slope: - Describe as pos/neg/zero - Identify from a table, equation, or graph  Slope: -Determine given two points	2	<b>8.9ab</b> <b>A.3a</b>	Pythagorean Theorem: - Verify - Apply  Apply simplifying radicals with irrational solutions	5	<b>8.12abc</b>	Boxplots: - Display data - Make observations - Compare data of 2 boxplots	5	
<b>8.2</b>	Relationships among the subsets of the real number system	3	<b>8.16bd</b> <b>A.6b</b> <b>A.8</b>	Slope-Intercept Form: - Identify the $y$ -intercept from a table, equation, or graph - Graph a line given the equation in $y=mx+b$ form  Write the equation of a line given a graph or a table (y-intercept included)  Direct variation (only)	2  2	<b>8.10</b>	Review formulas for area, perimeter, and circumference	3	<b>8.13abc</b> <b>A.6b</b>	Scatterplots: - Display data - Make observations - Estimate line of best fit  Write an equation for the line of best fit	5	

<b>8.17</b>	Write verbal/algebraic expressions	1	<b>8.4</b>	Review solving proportions and determining ratios	4	<b>8.10</b>	Composite figures: Subdivide plane figure into triangles, rectangles, squares, trapezoids, parallelograms, and semicircles  Calculate perimeter, area, and circumference of composite figures  Practical problems	8	<b>8.11ab</b>	Probability: - Independent and dependent events - Compare and contrast ind/dep events - Probability of 2 ind events - Probability of 2 dep events	5
<b>8.14a</b>	Apply order of operations and the properties of real numbers to evaluate expressions	4	<b>8.4</b>	Determine percent increase/decrease	4	<b>8.8</b>	2D/3D drawings and models	4			
<b>8.14b</b>	Simplify expressions	3	<b>8.4</b>	Calculate discount, markup, and sale price	4						
<b>8.17</b>	Combine like terms										
<b>8.17</b>	Solve equations (variable on one side)	4	<b>8.4</b>	Sales tax, tip, simple interest	4						
<b>8.17</b>	Write verbal/algebraic equations	1	<b>8.4</b>	Reconcile account balance Include practical problems	4						
<b>8.17</b> <b>A.4ce</b>	Solve equations (variable on both sides)  Literal equations for a specified variable  Practical problems limited to equations in one variable	3  2									
<b>8.18</b> <b>A.5c</b>	Inequalities: - Solve (variable on one side and both sides) - Graph - Write verbal/algebraic inequalities  Solve practical problems involving inequalities	6									
	Remediation, Review, Assessment	7		Remediation, Review, Assessment	9		Remediation, Review, Assessment	10		Remediation, Review, Assessment	20
	<b>Total blocks</b>	<b>45</b>		<b>Total blocks</b>	<b>45</b>		<b>Total blocks</b>	<b>45</b>		<b>Total blocks</b>	<b>45</b>

**DESMOS CALCULATOR**The Desmos [Virginia Scientific Calculator](#) will be used for instruction and assessment.

## Mapping for Instruction - First Nine Weeks

- SOLs**
- 8.1** The student will compare and order real numbers.
- 8.2** The student will describe the relationships between the subsets of the real number system.
- 8.3** The student will
- estimate and determine the two consecutive integers between which a square root lies; and
  - determine both the positive and negative square roots of a given perfect square.
- 8.14** The student will
- evaluate an algebraic expression for given replacement values of the variables; and
  - simplify algebraic expressions in one variable.
- 8.17** The student will solve multistep linear equations in one variable with the variable on one or both sides of the equation, including practical problems that require the solution of a multistep linear equation in one variable.
- 8.18** The student will solve multistep linear inequalities in one variable with the variable on one or both sides of the inequality symbol, including practical problems, and graph the solution on a number line.
- A.3** The student will simplify
- square roots of whole numbers ~~and monomial algebraic expressions~~
  - cube roots of integers
- A.4** The student will solve
- literal equations for a specified variable
  - practical problems involving equations ~~and systems of equations~~
- A.5** The student will
- solve practical problems involving inequalities

	Instructional Focus	Vocabulary	Comments	Blocks
	Algebra Readiness Pretest (required)		<i>All Math 8 students must be evaluated for their readiness for algebra.</i>	1
<b>6.2b</b> <b>7.1a-e</b>	Review real numbers: - fractions, decimals, and percents	Real number, numerator, denominator, proper fraction, improper fraction, mixed number, decimal, place value, percent		1
<b>6.5</b>	Operations of fractions	Numerator, denominator, proper fraction, improper fraction, mixed number		1
<b>6.3b</b>	Review integers	Integer, positive numbers, negative numbers, number line		1
<b>6.3c</b> <b>7.1e</b>	Absolute value	Absolute value		0.5
<b>7.1a-c</b>	Exponents & scientific notation	Exponent, base, power, standard form, exponential form, expanded form, scientific notation, product, factor		0.5
<b>8.1</b> <b>8.3ab</b>  <b>A.3 ab</b>	Square roots & perfect squares  Simplify square and cube roots (no variables)	Square root (positive and negative), perfect square, radical, consecutive integers Symbols: $\sqrt{\quad}$ and $-\sqrt{\quad}$  Cube root, cubing, perfect cube, inverse	  <i>Simplify non-perfect radicals without variables (Ex. <math>\sqrt{20} = 2\sqrt{5}</math> )</i>	2  1

8.1	<b>Compare and order real numbers:</b> <ul style="list-style-type: none"> <li>- fractions</li> <li>- integers</li> <li>- decimals</li> <li>- mixed numbers</li> <li>- percents</li> <li>- scientific notation</li> <li>- radicals</li> <li>- pi (<math>\pi</math>)</li> </ul>	Integer, fractions (proper and improper), decimals, mixed numbers, percent, scientific notation, radicals, square root, pi, ascending order, descending order Symbol: $\pi$		3
8.2	<b>Relationships within the Real number system and its subsets</b> <b>Sums and products of rational and irrational numbers</b>	Real numbers, rational numbers, irrational numbers, integers, whole numbers, natural numbers (counting numbers), subset, classify	<i>Emphasize rational approximations of irrational numbers to compare numbers.</i>	3
8.17	<b>Write expressions:</b> <ul style="list-style-type: none"> <li>- Verbal to algebraic</li> <li>- Algebraic to verbal</li> </ul>	Verbal expression, algebraic expression, sum, product, difference, quotient		1
8.14a	<b>Evaluate expressions</b> <b>Apply order of operations</b>	Expression, variable, substitution, order of operations		4
8.14b 8.17	<b>Simplify expressions</b> <b>Apply properties of real numbers</b> <b>Combine like terms</b>	Inverses, commutative property, associative property, distributive property, identity properties, inverse property of addition/multiplication, substitution property, like terms		3
8.17	<b>Solve multistep equations with variable on one side:</b> <ul style="list-style-type: none"> <li>- Algebraically</li> <li>- Using concrete materials and pictorial representations</li> </ul> <b>Apply properties of real numbers</b> <b>Practical problems in one variable</b>	Equation, linear equation, variable, properties of equality (addition, subtraction, multiplication, division), inverses, commutative property, associative property, distributive property, identity properties, inverse property of addition/multiplication, substitution property, like terms		4
8.17	<b>Write equations:</b> <ul style="list-style-type: none"> <li>- Verbal to algebraic</li> <li>- Algebraic to verbal</li> </ul>	Verbal equation, algebraic equation, sum, product, difference, quotient		1
8.17	<b>Solve multistep equations with variables on both sides:</b> <ul style="list-style-type: none"> <li>- Algebraically</li> <li>- Using concrete materials and pictorial representations</li> </ul> <b>Apply properties of real numbers</b> <b>Practical problems in one variable</b>	Equation, linear equation, variable, properties of equality (addition, subtraction, multiplication, division), inverses, commutative property, associative property, distributive property, identity properties, inverse property of addition/multiplication, substitution property, like terms		3
A.4ce	<b>Literal equations for a specified variable</b>		<i>Limit problems to one or two step literal equations.</i>	2

	<b>Practical problems limited to equations with one variable</b>			
<b>8.18</b>	<b>Write inequalities:</b> - Verbal to algebraic - Algebraic to verbal	(see above)		1
<b>8.18</b>	<b>Solve inequalities with a variable on one side</b> <b>Apply properties of real numbers</b> <b>Graph solution on a number line</b> <b>Identify a value that is part of the solution set</b> <b>Practical problems</b>	Inequality, variable, properties of inequality (addition, subtraction, multiplication, division), inverse, commutative property, associative property, distributive property, identity properties, inverse property of addition/multiplication, substitution property, like terms, number line Symbols: $\leq$ , $\geq$ , $<$ , $>$	<i>Make sure to solve inequalities with the variable on either side of the inequality symbol.</i>	2
<b>8.18</b>	<b>Solve inequalities with a variable on both sides</b> <b>Apply properties of real numbers</b> <b>Graph solution on a number line</b> <b>Identify a value that is part of the solution set</b> <b>Practical problems</b>	Inequality, variable, properties of inequality (addition, subtraction, multiplication, division), inverse, commutative property, associative property, distributive property, identity properties, inverse property of addition/multiplication, substitution property, like terms, number line Symbols: $\leq$ , $\geq$ , $<$ , $>$	<i>Make sure to solve inequalities with the variables on one or both sides of the inequality symbol.</i>	2
<b>A.5c</b>	<b>Solve practical problems involving inequalities</b>		<i>Real world problems</i>	1
			Remediation, Review, Assessments	7
			<b>Total blocks</b>	<b>45</b>



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Resources – First Nine Weeks			
SOL	Textbook	Links	Supplemental Materials
<b>Review</b> <b>6.2b</b> <b>6.3bc</b> <b>6.5</b> <b>7.1a-e</b>		Fractions, Decimals and Percents <a href="#">Converting between Percents, Fractions, &amp; Decimals Khan Academy interactive note sheet</a> <a href="#">Converting Decimals to Fractions Khan Academy Video</a> <a href="#">Convert Fractions to Decimals Math is Fun Notes and Practice</a> <a href="#">Convert Decimals to Fractions Math is Fun Notes and Practice</a> <a href="#">Convert Decimals to Percents Math is Fun Notes and Practice</a> <a href="#">Convert Percents to Decimals Math is Fun Notes and Practice</a> <a href="#">Decimals, Fractions, Percentages Conversions Math is Fun Notes</a> Adding and Subtracting Fractions with like denominators <a href="#">Fractions in Lowest Terms Khan Academy Video</a> <a href="#">Adding Fractions with Like Denominators Khan Academy Video</a> <a href="#">Subtracting Fractions with Like Denominator Khan Academy Video</a>  Adding and Subtracting Fractions with unlike denominators <a href="#">Adding Fractions with Unlike Denominators Khan Academy Video</a> <a href="#">Subtracting Fractions with Unlike Denominators Khan Academy Video</a>  Multiplying Fractions <a href="#">Multiplying Unit Fractions and Whole Numbers Khan Academy Video</a> <a href="#">Multiplying Fractions Khan Academy Video</a>  Dividing Fractions <a href="#">Dividing Fractions Khan Academy Video</a>  Absolute Value <a href="#">Absolute Value Math is Fun Notes and Practice</a>	See MIPS: <a href="#">7.1a - Powers of Ten (Word) / PDF Version</a> <a href="#">7.1b - Scientific Notation / PDF Version</a> <a href="#">7.1c - Ordering Fractions, Decimals, and Percents (Word) / PDF Version</a> <a href="#">7.1d - Square Roots (Word) / PDF Version</a> <a href="#">7.1e - Absolute Value (Word) / PDF Version</a>  IXL Math 8 under “Percents” <ul style="list-style-type: none"> <li>- Convert between percents, fractions, and decimals</li> <li>- Compare percents to fractions and decimals</li> </ul> IXL Math 8 under “Rational Numbers” <ul style="list-style-type: none"> <li>- Convert between decimals and fractions or mixed numbers</li> </ul> IXL Math 8 under “Integers” <ul style="list-style-type: none"> <li>- Absolute value and opposite integers</li> </ul> IXL Math 8 under “Rational numbers” <ul style="list-style-type: none"> <li>- Absolute value of rational numbers</li> </ul>
<b>8.1</b> <b>8.3ab</b>	Lesson 1-1 1-4 1-5	Square Roots & Perfect Squares <a href="#">Exponents &amp; Square Roots Math Antics Video</a> <a href="#">Square Roots Khan Academy Video</a>	See MIPS: 8.1 - Ordering Numbers (Word) / PDF Version 8.3 - Where Do They Lie? (Word) / PDF Version  IXL Math 8 under “Exponents and roots” <ul style="list-style-type: none"> <li>- Square roots and perfect squares</li> <li>- Positive and negative square roots</li> <li>- Estimate positive and negative square roots</li> </ul>
<b>A.3ab</b>	HMH 807-814  Virginia SOL Success 504A-50I	<a href="#">Quizizz: Perfect Squares</a> <a href="#">Quizizz: Perfect Squares and Cubes</a> <a href="#">Quia: Perfect Squares and Square Roots (Practice)</a> <a href="#">Quiz: Perfect Squares and Square Roots (Quiz)</a> <a href="#">Quizlet: Perfect Squares</a>	See MIPS: <a href="#">A.3a - Simplifying Square Roots of Whole Numbers (Word) / PDF Version</a> <a href="#">A.3a - Simplifying Square Roots of Monomial Expressions (Word) / PDF Version</a> <a href="#">A.3b - Simplify Cube Roots of Integers (Word) / PDF Version</a>
<b>8.1</b>	Lesson 1-1 1-3	Compare and Order <a href="#">Comparing Fractions Math is Fun Note and Practice</a> <a href="#">Ordering Numeric Expressions Khan Academy Video</a>	See MIPS: 8.1 - Ordering Numbers (Word) / PDF Version  IXL Math 8 under “Rational numbers”

			<ul style="list-style-type: none"> <li>- Compare rational numbers</li> <li>- Put rational numbers in order</li> </ul> IXL Math 8 under "Integers" <ul style="list-style-type: none"> <li>- Integers on number line</li> <li>- Compare and order integers</li> </ul> IXL Math 8 under "Scientific Notation" <ul style="list-style-type: none"> <li>- Compare numbers written in scientific notation</li> </ul> IXL Math 8 under "Percents" <ul style="list-style-type: none"> <li>- Compare percents to fractions and decimals</li> </ul>
<b>8.2</b>	Lesson 1-2	Real Number System/Subsets <a href="#">Real Numbers Math is Fun Notes and Practice</a> <a href="#">Irrational Numbers Math is Fun Notes and Practice</a> <a href="#">Rational Numbers Math is Fun Notes and Practice</a> <a href="#">Whole Numbers and Integers Math is Fun Notes and Practice</a> <a href="#">Whole Number Math is Fun Notes and Practice</a> <a href="#">Counting Number Math is Fun Notes and Practice</a> <a href="#">Natural Number Math is Fun Notes and Practice</a> <a href="#">Definition of Rational Number Math is Fun</a> <a href="#">Definition of an Irrational Number Math is Fun</a> <a href="#">Definition of an Integer Math is Fun</a> <a href="#">Irrational Math is Fun</a>	See MIPS: <a href="#">8.2 - Organizing Numbers (Word) / PDF Version</a>  IXL Math 8 under "Rational numbers" <ul style="list-style-type: none"> <li>- Write fractions in lowest terms</li> </ul> IXL Math 8 under "Operations with rational numbers" <ul style="list-style-type: none"> <li>- Reciprocals and multiplicative inverses</li> <li>- Add and subtract rational numbers</li> <li>- Apply addition and subtraction rules</li> </ul> IXL Math 8 under "Rational numbers" <ul style="list-style-type: none"> <li>- Identify rational and irrational numbers</li> </ul> IXL Math 8 under "Number Theory" <ul style="list-style-type: none"> <li>- Classify numbers</li> </ul> Roanoke County Performance Task: <i>Simplify and Classify Real Numbers</i> <ul style="list-style-type: none"> <li>- Roanoke County Share Fair Folder</li> <li>- Add and subtract rational numbers: word problems</li> <li>- Multiply and divide rational numbers</li> <li>- Multiply and divide rational numbers: word problems</li> <li>- Apply multiplication and division rules</li> <li>- Apply addition, subtraction, multiplication, and division rules</li> </ul> Roanoke County Performance Task: <i>Pen Pal letters (operations with fractions)</i>
<b>8.17</b>	Lesson 2-1 2-1 2-3 2-4	Writing Verbal & Algebraic Expressions <a href="#">Writing Algebraic Expressions MooMoo Math Video</a>	See MIPS: <a href="#">8.17 - Sort and Verify Multistep Equations (Word) / PDF Version</a>  IXL Math 8 under "Expressions and properties" <ul style="list-style-type: none"> <li>- Write variable expressions</li> <li>- Write variable expressions from diagrams</li> <li>- Write variable expressions: word problems</li> </ul> IXL Math 8 under "Number Sequences" <ul style="list-style-type: none"> <li>- Write variable expressions for arithmetic sequences</li> </ul>
<b>8.14a</b>	VA-1	Properties <a href="#">Commutative, Associative and Distributive Math is Fun Notes and Practice</a>  commutative	See MIPS: <a href="#">8.14a - Evaluating Algebraic Expressions / PDF Version</a>  IXL Math 8 under "Exponents and roots"

		<p><a href="#">Commutative Khan Academy Video</a></p> <p>associative properties  <a href="#">Associative Addition Khan Academy Video</a>  <a href="#">Associative Multiplication Khan Academy Video</a></p> <p>distributive property  <a href="#">Distributive 1 Khan Academy Video</a>  <a href="#">Distributive 2 Khan Academy Video</a></p> <p>Exponents  <a href="#">Exponents Math is Fun Notes and Practice</a>  <a href="#">Intro to Exponents Khan Academy Video</a>  <a href="#">Raising a Number to 0 &amp; 1 Power Khan Academy Video</a>  <a href="#">Raising a Fraction to a Power Khan Academy Video</a>  <a href="#">Raising 1 and -1 to a power Khan Academy Video</a>  <a href="#">Negative Exponents Khan Academy Video</a></p> <p>Scientific Notation  <a href="#">Scientific Notation Math is Fun Notes and Practice</a>  <a href="#">Introduction to Scientific Notation Khan Academy Video</a>  <a href="#">Scientific Notation Examples Khan Academy Video</a></p>	<ul style="list-style-type: none"> <li>- Understanding exponents</li> <li>- Evaluate exponents</li> <li>- Understanding negative exponents</li> <li>- Evaluate negative exponents</li> </ul> <p>IXL Math 8 under "Scientific Notation"</p> <ul style="list-style-type: none"> <li>- Convert between standard and scientific notation</li> <li>- Multiply numbers written in scientific notation</li> <li>- Divide numbers written in scientific notation</li> </ul>
<b>8.14b</b>	VA-1	<p>Evaluating Expressions  <a href="#">Substitution Math is Fun Notes and Practice</a>  <a href="#">Evaluating Expressions YouTube Video</a></p> <p>Order of Operations  <a href="#">Order of Operations Introduction Khan Academy Video</a>  <a href="#">Order of Operations Problem Solving Example Khan Academy Video</a>  <a href="#">Order of Operations Problem Solving Example 2 Khan Academy Video</a></p> <p>Combine Like Terms &amp; Simplify Expressions  <a href="#">Combine Like Terms Math is Fun Notes and Practice</a>  <a href="#">Combining Like Terms Videos</a></p>	<p>See MIPS:  <a href="#">8.14b - Simplifying Algebraic Expressions (Word) / PDF Version</a></p> <p>IXL Math 8 under "Expressions and properties"</p> <ul style="list-style-type: none"> <li>- Evaluate one variable expressions</li> <li>- Evaluate multi variable expressions</li> <li>- Evaluate absolute value expressions</li> <li>- Evaluate radical expressions</li> <li>- Evaluate rational expressions</li> </ul> <p>IXL Math 8 under "Number Sequences"</p> <ul style="list-style-type: none"> <li>- Evaluate variable expressions for number sequences</li> </ul> <p>IXL Math 8 under "Operations with integers"</p> <ul style="list-style-type: none"> <li>- Evaluate numerical expressions involving integers</li> </ul> <p>IXL Math 8 under "Operations with rational numbers"</p> <ul style="list-style-type: none"> <li>- Evaluate numerical expressions involving rational numbers</li> </ul> <p>IXL Math 8 under "One variable equations"</p> <ul style="list-style-type: none"> <li>- Which x satisfies an equation?</li> </ul> <p>Roanoke County Performance Task: <i>Order of Operations to evaluate expressions</i></p> <p>IXL Math 8 under "Expressions and properties"</p> <ul style="list-style-type: none"> <li>- Properties of addition and multiplication</li> <li>- Multiply using distributive property</li> <li>- Write equivalent expressions using properties</li> </ul> <p>IXL Math 8 under "One variable equations"</p> <ul style="list-style-type: none"> <li>- Properties of equality</li> </ul>
<b>8.17</b>	Lesson 2-1 2-2 2-3	<p>Solve Equations (variable on one side)                      one-step using addition or subtraction  <a href="#">Solving One Step Equations by Adding and Subtracting Video</a>                      one-step using multiplication or division</p>	<p>See MIPS:  <a href="#">8.17 - Sort and Verify Multistep Equations (Word) / PDF Version</a></p> <p>IXL Math 8 under "One variable equations"</p>

	<p>2-4</p>	<p><a href="#">Solving One Step Equations by Multiplying and Dividing</a>                      two-step  <a href="#">Intro to Solving Two Step Equations Khan Academy Video</a>  <a href="#">Two Step Equations Khan Academy Video</a>  <a href="#">Two Step Equations Example Khan Academy Video</a>                      two-step equations practical problems  <a href="#">Solving Equations Word Problems Khan Academy Video</a>                      multi-step  <a href="#">Solving Equations with Distributive Property Video</a>  <a href="#">Solving Equations with Distributive Property 2 Video</a>                      Solve Equations (variables on both sides)  <a href="#">Solving Equations with Variables on Both Sides YouTube Video</a>  <a href="#">Solving Equations with a variable on both sides video</a></p>	<ul style="list-style-type: none"> <li>- Write an equation from words</li> <li>- Model and solve equations using algebra tiles</li> <li>- Solve one step equations</li> <li>- Solve two step equations</li> <li>- Solve multi step equations</li> <li>- Solve equations involving like terms</li> </ul> <p>IXL Math 8 under "One variable equations"</p> <ul style="list-style-type: none"> <li>- Solve equations with variables on both sides</li> <li>- Solve equations: mixed review</li> </ul> <p>Solve equations: word problems</p>
<p><b>A.4ce</b></p>	<p>HMH                      5-10, 45-54, 55-60, 251-258, 387-394, 395-404, 405-412, 413-422, 429-440, 447-454, 751-758, 771-780, 781-790, 791-800, 807-814, 815-826, 827-834, 835-844                      Virginia SOL Success                      10A-10C, 54A-54B</p>	<p><i>These are Algebra I resources that can be adapted to Pre-Algebra 8.</i>  <a href="#">Quizizz: Solving Equations</a>  <a href="#">Quia: 2-player jeopardy game</a>  <a href="#">Quia: Rags to Riches Individual Game</a>  <a href="#">Math Bits Notebook: Solving Equations</a>  <a href="#">Algebra Four game</a>  <a href="#">Quizizz: Literal Equations</a>  <a href="#">Quizlet: Literal Equations</a></p>	<p>See MIPS:  <a href="#">A.4c - Literal Equations and Formulas (Word) / PDF Version</a>  <a href="#">A.4de - Road Trip: Applying Systems of Linear Equations (Word) / PDF Version</a>  <a href="#">A.4de - Spring Fling Carnival: Applying Systems of Linear Equations (Word) / PDF Version</a></p>
<p><b>8.18</b></p>	<p>VA-5</p>	<p>Solve Inequalities (variables on one side)                      one-step using addition or subtraction  <a href="#">Solving One Step Inequalities with Addition Khan Academy Video</a>  <a href="#">Inequalities using Addition or Subtraction khan Academy Video</a>                      one-step using multiplication or division  <a href="#">Solving One-Step Inequality with Multiplication or Division Khan Academy Video</a>                      Solve Inequalities (variables on both sides)  <a href="#">Solving Inequalities with a variable on both sides video</a></p>	<p>See MIPS:  <a href="#">8.18 - Solve Multistep Inequalities and Graph the Solution (Word) / PDF Version</a>                      IXL Math 8 under "Inequalities"</p> <ul style="list-style-type: none"> <li>- Solutions to inequalities</li> <li>- Graph inequalities on a number line</li> <li>- Write inequalities from number lines</li> <li>- Solve one step inequalities</li> <li>- Graph solutions to one step inequalities</li> <li>- Solve two step inequalities</li> <li>- Graph solutions to two step inequalities</li> <li>- Solve multi step inequalities</li> <li>- Graph solutions to multi step inequalities</li> </ul> <p>Roanoke County Performance Task: <i>Solving Inequalities and graphing solutions</i></p>
<p><b>A.5c</b></p>	<p>HMH                      61-66, 67-74, 259-264                      Virginia SOL Success                      258A-258C</p>	<p><a href="#">Inequality word problems</a></p>	<p>See MIPS:  <a href="#">A.5ac - Lemonade Stand: Solving Practical Problems Using Linear Inequalities in One Variable (Word) / PDF Version</a></p>

**Mapping for Instruction - Second Nine Weeks**

- SOLs**
- 8.4** The student will solve practical problems involving consumer applications.
- 8.15** The student will
- a) determine whether a given relation is a function; and
  - b) determine the domain and range of a function.
- 8.16** The student will
- a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
  - b) identify the slope and  $y$ -intercept of a linear function, given a table of values, a graph, or an equation in  $y = mx + b$  form;
  - c) determine the independent and dependent variable, given a practical situation modeled by a linear function;
  - d) graph a linear function given the equation in  $y = mx + b$  form; and
  - e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.
- A.6** The student will
- a) determine the slope of a line when given an equations of the line, the graph of a line, or two points on the line
  - b) write the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line
- A.7** The student will investigate and analyze linear and quadratic function families and their characteristics both algebraically and graphically, including
- b) domain and range
  - c) zeros
  - f) connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs.
- A.8** The student, given a data set or practical situation, will analyze a relation to determine whether a direct or inverse-variation exists, and represent a direct variation algebraically and graphically and ~~an inverse-variation algebraically.~~

SOL	Instructional Focus	Vocabulary	Comments	Blocks
6.8 8.16	Review coordinate plane	Coordinate plane, ordered pair, origin, quadrants, x-axis, x-coordinate, y-axis, y-coordinate		1
8.15ab 8.16c	Relations: Is it a function? Identify domain and range Determine the dependent and independent variable	Continuous function, dependent variable, discrete function, domain, horizontal line, independent variable, input, linear function, output, range, relation, set of ordered pairs, vertical line, x-value, y-value		3
A.7bf	Domain and range of linear relationships	Set notation Symbols: Example of set notation – $\{y : y > 3\}$	Limit to linear functions or components of linear functions.	2
8.16e	Make connections between multiple representations of linear equations Write the equation of a linear function in $y = mx + b$ form given: - slope (m) and y-intercept - verbal descriptions of slope (m) and y-intercept	Domain, equation, graph, linear function, range, table, x-value, y-value, slope, y-intercept		2
A.7cf	Zeros: define, identify Connections between and among multiple linear representations	Zeros	Include using verbal descriptions between and among graphs, tables, and equations.	2

8.16ab	<b>Slope:</b> Describe as positive, negative, or zero Identify slope from a table, equation, or graph	Dependent variable, horizontal change, independent variable, negative slope, zero slope, positive slope, rate of change, slope, vertical change, x-intercept, y-intercept		1
A.6a	<b>Slope:</b> Determine given two points		Apply the formula: $m = \frac{y_2 - y_1}{x_2 - x_1}$	1
8.16bd	<b>Slope-Intercept Form:</b> Identify the <i>y-intercept</i> from a table, equation, or graph Graph a line given the equation $y = mx + b$ form	Change in y, constant rate, input, output, vertical change, vertical line		2
A.6b A.8	<b>Writing the equation given a graph or a table of values with the y-intercept included</b> Direct variation	Direct variation, constant of variation, constant of proportionality, directly proportional		2
8.4	Review of ratios and proportions	Cross multiplication, equivalent ratios, fraction, proportion, proportional reasoning, rate, unit rate		4
8.4	Determine percent increase/decrease	Percent decrease, percent increase, percent of change		4
8.4	Calculate discount, markup, and sale price	Discount, markdown, markup, sale price		4
8.4	Sales tax, tip, simple interest	Tax, tip, total bill, simple interest		4
8.4	Reconcile account balance Include practical problems	Account balance, check register, credit, debit, deposit, ending balance, reconcile, transactions, withdrawal, account balance, borrow, earned, interest, interest rate, invested, investment, loan, principle, time (time borrowed or length of the loan)		4
			Remediation, Review, Assessment	10
			<b>Total blocks</b>	<b>45</b>

Resources – Second Nine Weeks			
SOL	Textbook	Links	Supplemental Materials
8.16		Coordinate plane review: <a href="#">Points on the Coordinate Plane Video</a> <a href="#">Battleship Coordinate Plane Game</a> <a href="#">Coordinate Plane Jeopardy</a> <a href="#">Coordinate Grid Games</a> <a href="#">Coordinate Plane Game</a>	see MIPS on VDOE website: <a href="#">MIPS</a>  <a href="#">VDOE: ARI Curriculum Companion – Investigating Patterns, Functions, and Algebra</a>  <a href="#">Mini Unit: Coordinate Plane</a>  <a href="#">NFL Logo Coordinates Game</a>  <a href="#">Coordinate Plane Logos</a>
8.15ab 8.16c	Lesson 3-1 3-2 3-3 3-4 VA-6	Relations, Functions, Domain, Range, Independent, Dependent: <a href="#">8.16 Practice</a> <a href="#">Complete a Function Table Practice</a> <a href="#">Write a Rule for a Function Table Online Practice</a> <a href="#">Graphs and Linear Equations Online Practice</a> <a href="#">Linear Equations and Functions Video</a>	See MIPS: <a href="#">8.15 - Relations and Functions: Domain and Range (Word) / PDF Version</a> <a href="#">8.16c - Independent and Dependent Variables (Word) / PDF Version</a>  <a href="#">VDOE: ARI Curriculum Companion – Investigating Patterns, Functions, and Algebra</a> <a href="#">Investigating Vocabulary</a> <a href="#">Functions Sort</a> <a href="#">Rent a Car Function Activity</a> <a href="#">Function Investigation</a>
A.7bf	HMH 107-112, 165-172, 173-178, 179-188, 195-202, 203-212, 213-220, 221-228, 229-238, 245-250, 251-258, 697-708, 709-716, 717-728, 735-744, 745-750  Virginia SOL Success: 120A-120C	<i>These are Algebra I resources that can be adapted to Pre-Algebra</i>  Domain and range <a href="https://www.quia.com/cb/79585.html">https://www.quia.com/cb/79585.html</a>	See MIPS: <a href="#">A.7abef - Functions 1: Investigating Relations and Functions (Word) / PDF Version</a>
8.16e	Lesson 2.9 3-3 3-4	Multiple Representations of Linear Equations: <a href="#">Graphing Linear Equations Online Practice</a> <a href="#">Graph a Line from an Equation Online Practice</a> <a href="#">Graph Match Online Practice</a> <a href="#">Complete XY Tables and Plot the Points Online Practice</a> <a href="#">Complete the Function Tables and Create a Picture Online Activity</a>	See MIPS: <a href="#">8.16e - Matching Representations (Word) / PDF Version</a>  <a href="#">VDOE: ARI Curriculum Companion – Investigating Patterns, Functions, and Algebra</a>  <a href="#">Matching Functions, Graphs, and Tables</a>
A.7cf	HMH 165-172, 173-178, 179-188, 195-202, 203-212, 213-220, 221-228, 229-238, 245-250, 251-258, 697-	<a href="#">Zeros</a>	See MIPS: <a href="#">A.7bcd - Functions 2: Exploring Quadratic Functions (Word) / PDF Version</a>



	708, 709-716, 717-728, 735-744, 745-750, 751-758  Virginia SOL Success: 120A-120C		
<b>8.16a</b>	Lesson 2-9 3-4	Slope: <a href="#">8.16 Practice</a> <a href="#">Finding the Slope Given 2 Points Video Lesson</a> <a href="#">How to Find Slope Using Two Points Video Lesson</a> <a href="#">Slope Music Video</a> <a href="#">How to Graph a Line Using Slope Intro Video</a> <a href="#">Intro to Slope Video</a>	See MIPs: <a href="#">8.16ab - Slope and y-intercept (Word) / PDF Version</a>  <a href="#">Finding Slope from a Graph Worksheet</a>  <a href="#">Finding Slope from Two Points Worksheet</a>
<b>A.6a</b>	HMH 179-188, 195-202, 203-212, 213- 220	<i>These are Algebra I resources that can be adapted to Pre-Algebra.</i> <a href="https://mathbitsnotebook.com/Algebra1/LinearEquations/LERefreshSlope.html">https://mathbitsnotebook.com/Algebra1/LinearEquations/LERefreshSlope.html</a>  <a href="https://www.geogebra.org/m/CCqSxRkK">https://www.geogebra.org/m/CCqSxRkK</a>  <a href="http://www.crctlessons.com/slope-game.html">http://www.crctlessons.com/slope-game.html</a>	See MIPs: <a href="#">A.6a - Slippery Slope (Word) / PDF Version</a> <a href="#">A.6abc - Slope-2-Slope with Desmos (Word) / PDF Version</a>
<b>8.16bd</b>	Lesson 2-9 3-4	Slope-Intercept form: <a href="#">Graph linear equations using <math>y=mx+b</math> Video</a>	See MIPs: <a href="#">8.16ab - Slope and y-intercept (Word) / PDF Version</a> <a href="#">8.16d - Graphing Linear Functions (Word) / PDF Version</a>  <a href="#">Matching Activity: Match the Equation, Graph, Slope, and Y-intercepts</a>  <a href="#">Graphing Lines Using Slope Intercept Form</a>
<b>A.6b</b>	HMH 195-202, 203-212, 213-220  Virginia SOL Success: 212A-212C, 220A-220C	<i>These are Algebra I resources that can be adapted to Pre-Algebra.</i> <a href="https://www.geogebra.org/m/Evp3A9DK">https://www.geogebra.org/m/Evp3A9DK</a>  <a href="http://www.math.com/school/subject2/lessons/S2U4L2GL.html">http://www.math.com/school/subject2/lessons/S2U4L2GL.html</a>  <a href="https://books.quia.com/rr/379720.html">https://books.quia.com/rr/379720.html</a>  <a href="https://www.geogebra.org/m/fnY6ptWQ">https://www.geogebra.org/m/fnY6ptWQ</a>  <a href="http://www.math.com/school/subject2/lessons/S2U4L3GL.html">http://www.math.com/school/subject2/lessons/S2U4L3GL.html</a>  <a href="https://www.geogebra.org/m/Spq9uhju">https://www.geogebra.org/m/Spq9uhju</a>  <a href="https://www.varsitytutors.com/assets/vt-hotmath-legacy/hotmath_help/games/kp/kp_hotmath_nosound.swf">https://www.varsitytutors.com/assets/vt-hotmath-legacy/hotmath_help/games/kp/kp_hotmath_nosound.swf</a>  <a href="https://www.thatquiz.org/tq/practice.html?algebra">https://www.thatquiz.org/tq/practice.html?algebra</a>	See MIPs: <a href="#">A.6ab - Writing Equations of Lines (Word) / PDF Version</a>  Linear equation card sort <a href="https://mrshclassblog.wikispaces.com/file/view/linear+sort+and+match+game.pdf">https://mrshclassblog.wikispaces.com/file/view/linear+sort+and+match+game.pdf</a>  Stained Glass Graphing project <a href="http://staff.tamhigh.org/wetzel/Stained-Glass-Project%20project.pdf">http://staff.tamhigh.org/wetzel/Stained-Glass-Project%20project.pdf</a>
<b>A.8</b>	HMH Virginia SOL Success: 374A-374F		See MIPs: <a href="#">A.8 - Direct Variation (Word) / PDF Version</a>  IXL's from Algebra I: R.2, R.4, R.5

<p><b>8.4</b></p>	<p>Lesson VA-2 VA-3 VA-4</p>	<p>Ratios and proportions: <a href="#">Dirt Bike Proportions Game</a> <a href="#">Proportions Online Practice</a> <a href="#">Proportions: Word Problem Set-Up Video</a> <a href="#">Percents and Proportions Video</a> <a href="#">Ratios, Rates, and Proportions Game</a> <a href="#">Ratios and Proportions Game</a></p> <p>Scale factor: <a href="#">Scale Factor Game</a> <a href="#">Similar Polygons and Scale Factor Video</a></p> <p>Percent Applications, consumer applications, percent change: <a href="#">Jeopardy Game</a> <a href="#">Review Game</a> <a href="#">Review Games</a> <a href="#">Percent Increase and Decrease Game</a> <a href="#">Math-Percent, Interest, Discount, Sale Price Challenge Board</a> <a href="#">Percent Shopping Game</a> <a href="#">Proportions Online "Quiz"</a> <a href="#">Penguin Waiter - Tip Game</a> <a href="#">Sales Tax Online Quiz</a> <a href="#">Math at the Mall Game</a></p> <p>Simple Interest: <a href="#">Simple Interest Online Practice</a> <a href="#">Simple Interest Battleship Game</a></p> <p>Personal finance: <a href="#">Federal Reserve Education Resources</a> <a href="#">Writing a Check - Online Practice</a> <a href="#">The Mint</a></p>	<p>See MIPs: <a href="#">8.4 - Consumer Applications – Taxes, Tips, and Simple Interest (Word) / PDF Version</a> <a href="#">8.4 - The Scoop-on-Ice-Cream Planning (Word) / PDF Version</a> <a href="#">8.4 - Percent of Increase or Decrease (Word) / PDF Version</a> <a href="#">8.4 - Do You Like to Spend Money? (Word) / PDF Version</a></p> <p><a href="#">VDOE: ARI Curriculum Companion – Working with Ratios and Proportions</a> <a href="#">VDOE: ARI Curriculum Companion – Working with Percents</a></p> <p><a href="#">Dining Out</a> <a href="#">Shopping Activity</a> <a href="#">E-Shopping Activity</a> <a href="#">Percent of Change Sort</a> <a href="#">Practical Problem: Best Buy</a> <a href="#">Simple Interest Card Sort</a> <a href="#">Simple Interest Card Sort Template</a> <a href="#">Checks and Balances Review Activity</a> <a href="#">Checks and Balances</a> <a href="#">Hands On Banking for Teens – Instructor's Guide</a></p>
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### Mapping for Instruction - Third Nine Weeks

**SOLs**

- 8.5** The student will use the relationships among pairs of angles that are vertical angles, adjacent angles, supplementary angles, and complementary angles to determine the measure of unknown angles.
- 8.7** The student will
- given a polygon, apply transformations, to include translations, reflections, and dilations, in the coordinate plane; and
  - identify practical applications of transformations.
- 8.8** The student will construct a three-dimensional model, given the top or bottom, side, and front views.
- 8.9** The student will
- verify the Pythagorean Theorem; and
  - apply the Pythagorean Theorem.
- 8.10** The student will solve area and perimeter problems, including practical problems, involving composite plane figures.
- A.3** The student will simplify
- square roots of whole numbers ~~and monomial algebraic expressions~~
- A.6** The student will
- graph linear equations in two variables

SOL	Instructional Focus	Vocabulary	Comments	Blocks
8.5	Angle pair relationships	vertical angles, adjacent angles, supplementary angles, complementary angles, congruent		4
8.5	Find the measure of an unknown angle using angle relationships	vertical angles, adjacent angles, supplementary angles, complementary angles, congruent		5
8.7ab	<b>Transformations:</b> <b>Identify in the coordinate plane</b> <b>Reflect over the x- or y-axis</b> <b>Composite transformations (reflected then translated or translated then reflected)</b> <b>Scale Factor</b> <b>Similar Figures</b>	translation, reflection, dilation, scale factor, preimage, vertically, horizontally, x-axis, y-axis, enlarge, proportion, reduce, scale drawing, angles ( $\sphericalangle$ ), congruent ( $\cong$ ), corresponding, quadrilateral, similar ( $\sim$ ), triangle ( $\Delta$ )	<i>Dilations limited to scale factors of <math>\frac{1}{4}</math>, <math>\frac{1}{2}</math>, 2, 3, 4 and centered at the origin.</i>	4
A.6c	Describe transformations of linear equations		<i>From EKS: Use the parent function <math>y = x</math> and describe transformations defined by changes in the slope or y-intercept</i>	2



Resources – Third Nine Weeks			
SOL	Textbook	Links	Supplemental Materials
<b>8.5</b>	Lesson 6-8 6-9 6-10 VA-10		See MIPs: <a href="#">8.5 - What Are Your Angles?</a> (Word) / <a href="#">PDF Version</a>  IXL Math 8 under “Two-dimensional figures” - Identify complementary, supplementary, vertical, adjacent, and congruent angles - Find measures of complementary, supplementary, vertical, and adjacent angles
<b>8.7ab</b>	Lesson 6-1 6-2 6-3 6-4 6-5 6-6 6-7	Similar figures: <a href="#">Similar Figures and Proportions Video</a> <a href="#">Similar Figures Video</a> <a href="#">What are Similar Figures? Video</a> <a href="#">Similar Triangles Video</a> <a href="#">Similar Triangles and Missing Measurements Video</a> <a href="#">How to Solve Similar Triangles Video</a> <a href="#">Similar Shapes Game</a> <a href="#">Scale Drawings Activity</a>	See MIPs: <a href="#">8.7ab - Transformations</a> (Word) / <a href="#">PDF Version</a>  IXL Math 8 under “Transformations and Congruence” - Translations: graph the image - Translations: find the coordinates - Reflections: graph the image - Reflections: find the coordinates  IXL Math 8 under “Transformations and Similarity” - Dilations: graph the image - Dilations: find the coordinates - Dilations: scale factor and classification  <a href="#">VDOE: ARI Curriculum Companion – Working with Ratios and Proportions</a> <a href="#">Similar Triangles Worksheet</a> <a href="#">Using Similar Polygons Worksheet</a> - <a href="#">Similar Triangles and Indirect Measurement</a>
<b>A.6c</b>	HMH 113-120, 165-172, 173-178, 195-202, 203-212, 213-220, 221-228, 229-238, 245-250	<a href="#">Transformations of linear functions</a>	See MIPs: <a href="#">A.6c - Rate of Change of Practical Situations</a> (Word) / <a href="#">PDF Version</a>  <a href="#">A.6c - Transformation Investigation</a> (Word) / <a href="#">PDF Version</a>  Linear Transformations Activity in the LRZ share fair folder (5pg pdf)
<b>8.9ab</b>  <b>A.3b</b>	Lesson 7-1 7-2 7-3 7-4  HMH Virginia SOL Success: 504F-504I	<i>(Students will need to display irrational answers in simplified radical form)</i>	See MIPs: 8.9 - Pythagorean Theorem (Word) / <a href="#">PDF Version</a> <a href="#">A.3b - Simplify Cube Roots of Integers</a> (Word) / <a href="#">PDF Version</a>  IXL Math 8 under “Pythagorean theorem” - Pythagorean theorem: find the length of the hypotenuse - Pythagorean theorem: find the missing leg length - Pythagorean theorem: word problems - Converse of the Pythagorean Theorem: is it a right triangle?

			<p>Roanoke County Math 8 Performance Task: <i>Pythagorean Theorem</i></p> <p>Kahoot titled "Pythagorean Theorem" by aktravis (10 questions)</p> <p><a href="#">Pythagorean Theorem fence activity</a></p>
<b>8.10</b>	Lesson VA-11	<p>Perimeter: <a href="#">Basic Perimeter tutorial 1</a> <a href="#">Basic Perimeter tutorial 2</a> <a href="#">Basic Perimeter activity</a></p> <p>Area: <a href="#">Area of composites activity</a> <a href="#">Challenging Area of composites activity</a></p>	<p>See MIPs: <a href="#">8.10 - Composite Figures: Area and Perimeter (Word) / PDF Version</a></p> <p>Roanoke County Math 8 Performance Task: <i>Pizza Crust – Area, Perimeter, Circumference</i></p>
<b>8.8</b>	Lesson VA-12	<p><a href="#">Isometric Drawing tool from Illuminations</a> <a href="#">Nets of a Cube exploration from Illuminations</a></p>	<p>See MIPs: <a href="#">8.8 - 3-D Figures (Word) / PDF Version</a></p> <p>IXL Math 8 under "Three-dimensional figures"</p> <ul style="list-style-type: none"> <li>- Nets of three-dimensional figures</li> <li>- Front, side, and top view</li> <li>- Base plans</li> </ul>

### Mapping for Instruction - Fourth Nine Weeks

#### SOLs

- 8.6** The student will
- solve problems, including practical problems, involving volume and surface area of cones and square-based pyramids; and
  - describe how changing one measured attribute of a rectangular prism affects the volume and surface area.
- 8.11** The student will
- compare and contrast the probability of independent and dependent events; and
  - determine probabilities for independent and dependent events.
- 8.12** The student will
- represent numerical data in boxplots;
  - make observations and inferences about data represented in boxplots; and
  - compare and analyze two data sets using boxplots.
- 8.13** The student will
- represent data in scatterplots;
  - make observations about data represented in scatterplots; and
  - use a drawing to estimate the line of best fit for data represented in a scatterplot.
- A.6** The student will
- write the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line

SOL	Instructional Focus	Vocabulary	Comments	Blocks
7.4a	Review finding surface area of a rectangular prisms and cylinders	Volume, surface area, rectangular prism, prism, length (l), width (W), height (h). diameter, radius, circumference	<i>This review will be helpful before introducing SOL 8.6a.</i>	1
8.6a	Determine which situations require computation of surface area and those which require volume  Surface area and volume (use concrete objects, nets, diagrams, and formulas):  - square-based pyramids  - cones	Volume, surface area, pyramid, square-based pyramid, cone, two-dimensional, three-dimensional, net, base, area of base (B), perimeter of base (p), slant height (l), height (h), radius (r), diameter		5
8.6b	Describe how surface area of a rectangular prism is affected when one attribute is multiplied by a factor of $\frac{1}{2}$ or 2.  Describe how volume of a rectangular prism is affected when one attribute is multiplied by a factor of $\frac{1}{4}, \frac{1}{3}, \frac{1}{2}, 2, 3, 4$	Volume, surface area, attribute, rectangular prism, length (l), width (w), height (h), double, triple, half		4



8.12abc	<b>Boxplots (box-and-whisker plot):</b> <b>Display data</b> <b>Make observations and inferences</b> <b>Compare data of 2 boxplots</b>	boxplot (box-and-whisker plot), median, range, lower extreme (minimum), upper extreme (maximum), lower quartile, upper quartile, quartile, interquartile range (IQR), five number summary, inference		5
8.13abc	<b>Scatterplots:</b> <b>Display data</b> <b>Make observations</b> <b>Estimate line of best fit</b>	Scatterplot, correlation, positive relationship, negative relationship, no relationship, line of best fit, linear, trend, estimate, predict		4
A.6b	<b>Write an equation for the line of best fit</b>		<i>Write the equation for the line of best fit using the y-intercept and another point within the scatterplot to calculate a "slope."</i>	1
8.11ab	<b>Probability:</b> <b>Determine whether two events are independent or dependent</b> <b>Compare and contrast ind/dep events</b> <b>Determine probability of 2 ind events</b> <b>Determine probability of 2 dep events</b>	theoretical probability, dependent probability, dependent events, independent probability, independent events, event, with replacement, without replacement, sample space, outcome, fraction, numerator, denominator, simplest form, simplify, reduce, decimal, percent, number cube, die, dice, spinner, even, odd, prime		5
			Remediation, Review, Assessment	20
			<b>Total blocks</b>	<b>45</b>

Resources – Fourth Nine Weeks			
SOL	Textbook	Links	Supplemental Materials
<b>7.4a</b> (Review)	Lesson 8-1 8-2	<a href="#">Khan Academy Volume &amp; Surface Area</a>  <a href="#">Virtual Nerd Video: Surface Area of Rectangular Prism from Net</a>  <a href="#">Brain Pop Volume of Prisms</a> <a href="#">Brain Pop Volume of Cylinders</a>  <a href="#">Math Playground Area Blocks Game</a>  <a href="#">Shmoop Video: Volume</a> <a href="#">Shmoop Video: Surface Area of Cylinders</a> <a href="#">Shmoop Video: Volume of Prisms &amp; Cylinders</a>  <a href="#">LearnZillion: Real-World Problems Involving Volumes of Cylinders</a>	See MIPS: 7.4ab - Volume and Surface Area of <a href="#">Rectangular Prisms and Cylinders</a> (Word) / <a href="#">PDF Version</a>  IXL Math 7 under “Geometric Measurement” <ul style="list-style-type: none"> <li>- Volume</li> <li>- Surface Area</li> </ul> <a href="#">Illuminations: Popcorn, Anyone?</a> <a href="#">Illuminations: Cubed Cans</a>
<b>8.6a</b>	Lesson 8-1 8-2 8-3	Surface Area & Volume of Pyramids & Cones: <a href="#">Khan Academy Volume &amp; Surface Area</a>  <a href="#">Kooshball Volume &amp; Surface Area</a>  <a href="#">MashUp Math Video: Volume of a Cone</a> <a href="#">Shmoop Video: Volume of Pyramids &amp; Cones</a>  <a href="#">LearnZillion: Real-World Problems Involving Volumes of Cones</a>	See MIPS: 8.6a - <a href="#">Volume and Surface Area of Cones and Pyramids</a> (Word) / <a href="#">PDF Version</a>  IXL Math 8 under “Geometric Measurement” <ul style="list-style-type: none"> <li>- Volume of Cones</li> <li>- Surface Area of Cones</li> </ul> <a href="#">Angry Birds SA &amp; V Rounds</a>  <a href="#">Surface Area and Volume Review Worksheet</a>  <a href="#">ARI Curriculum Companion: 3D Geometry</a>
<b>8.6b</b>	See curriculum framework and the VDOE website.	Changing Attributes: <a href="#">Class Flow: Volume &amp; Surface Area of Prisms</a>  <a href="#">Changing an Attribute with Examples</a>	See MIPS: 8.6b - <a href="#">Changing Attributes</a> (Word) / <a href="#">PDF Version</a>  <a href="#">Interactivate Changing Attributes Lesson</a>
<b>8.12abc</b>	Lesson VA-7	Data Displays Box-and-Whisker plots: <a href="#">Khan Academy Constructing a Box-and-Whisker Plot</a>  <a href="#">Class Flow: Box-and-Whisker</a>  <a href="#">Box-and-Whisker with Examples</a>  <a href="#">MashUp Math Video: Intro to Box-and-Whisker Plots</a> <a href="#">Shmoop Video: Box-and-Whisker Plots</a>  <a href="#">Braining Camp Lesson Box-and-Whisker Plots</a>	See MIPS: 8.12 - <a href="#">Representing Data Using Boxplots</a> (Word) / <a href="#">PDF Version</a>  IXL Math 8 under “Data and Graphs” <ul style="list-style-type: none"> <li>- Interpret box-and-whisker plots</li> </ul> <a href="#">LearnZillion: Create a Box Plot 1</a> <a href="#">LearnZillion: Create a Box Plot 2</a>

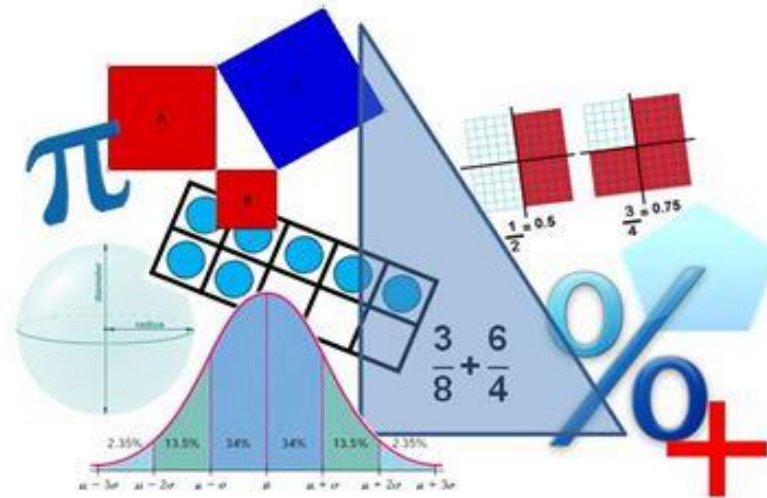
			<p><a href="#">Illuminations: Using NBA Statistics for Box and Whisker Plots</a></p> <p><a href="#">Free TPT: Creating a Box-and-Whisker Plot Step-by-Step</a></p> <p><a href="#">Box-and-Whisker Practice</a></p>
<p><b>8.13abc</b></p> <p><b>A.6b</b></p>	<p>Lesson 4-1 4-2 4-3 4-4</p> <p>HMH 195-202, 203-212, 213-220</p> <p>Virginia SOL Success: 212A-212C, 220A-220C</p> <p><i>(apply writing equations to line of best fit)</i></p>	<p>Data Displays Scatterplots:  <a href="#">Khan Academy Constructing Scatter Plots</a>  <a href="#">Khan Academy Interpreting Scatter Plots</a>  <a href="#">Khan Academy Estimating the Line of Best Fit</a></p> <p><a href="#">XP Math Line of Best Fit</a></p> <p><a href="#">Class Flow: Scatterplots</a></p> <p><a href="#">Correlations</a></p> <p><a href="#">Shmoop Video: Scatter Plots and Equations of Lines</a></p>	<p>See MIPS:  <b>8.13ab - Constructing and Analyzing Scatterplots</b> (Word) / <a href="#">PDF Version</a>  <b>8.13c - Scatterplots: Estimating the Line of Best Fit</b> (Word) / <a href="#">PDF Version</a>  <a href="#">A.6ab - Writing Equations of Lines</a> (Word) / <a href="#">PDF Version</a></p> <p>IXL Math 8 under "Data and Graphs"          - Scatter plots  <a href="#">Scatterplots Worksheet</a></p> <p><a href="#">LearnZillion: Find Patterns of Association</a></p> <p><a href="#">Multiple Choice Scatterplot Questions Worksheet</a></p> <p><a href="#">Scatterplot &amp; Line of Best Fit Worksheet</a></p> <p><a href="#">Bubble Blowing Contest</a></p>
<p><b>8.11ab</b></p>	<p>Lesson VA-8 VA-9</p>	<p>Probability:  <a href="#">Khan Academy Independent Probability</a>  <a href="#">Khan Academy Dependent Probability</a></p> <p><a href="#">Virtual Nerd Video: Compound Events</a>  <a href="#">Virtual Nerd Video: Identifying Independent &amp; Dependent Events</a>  <a href="#">Virtual Nerd Video: Independent Events</a></p> <p><a href="#">Brain Pop Compound Events</a>  <a href="#">Brain Pop Independent and Dependent Events</a></p> <p><a href="#">Probability Jeopardy</a>  <a href="#">Independent/Dependent Probability Vocab &amp; Practice</a></p> <p><a href="#">MashUp Math Video: Probability Real World Practice</a>  <a href="#">Shmoop Video: Independent and Dependent Events</a></p>	<p>See MIPS:  <b>8.11 - Probability</b> (Word) / <a href="#">PDF Version</a></p> <p>IXL Math 8 under "Probability"          - Probability of Independent and Dependent Events</p> <p><a href="#">LearnZillion: Probability of Compound Events</a></p> <p><a href="#">Probability BINGO</a></p> <p><a href="#">Two Independent Events Draw a Card Activity</a></p> <p><a href="#">M&amp;M Dependent Probability</a></p>

# Mathematics

## 2016 Standards of Learning

### Grade 8

### Curriculum Framework



Board of Education  
Commonwealth of Virginia

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P.O. Box 2120  
Richmond, Virginia 23218-2120  
<http://www.doe.virginia.gov>

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**Superintendent of Public Instruction**  
Steven R. Staples

**Assistant Superintendent Chief Academic Officer/Assistant Superintendent for Instruction**  
Steven M. Constantino

**Office of Mathematics and Governor's Schools**  
Debra Delozier, Mathematics Specialist  
Tina Mazzacane, Mathematics and Science Specialist  
Christa Southall, Mathematics Specialist

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# Virginia 2016 *Mathematics Standards of Learning Curriculum Framework*

## Introduction

The 2016 *Mathematics Standards of Learning Curriculum Framework*, a companion document to the 2016 *Mathematics Standards of Learning*, amplifies the *Mathematics Standards of Learning* and further defines the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The standards and *Curriculum Framework* are not intended to encompass the entire curriculum for a given grade level or course. School divisions are encouraged to incorporate the standards and Curriculum Framework into a broader, locally designed curriculum. The *Curriculum Framework* delineates in greater specificity the minimum content that all teachers should teach and all students should learn. Teachers are encouraged to go beyond the standards as well as to select instructional strategies and assessment methods appropriate for all students.

The *Curriculum Framework* also serves as a guide for Standards of Learning assessment development. Students are expected to continue to connect and apply knowledge and skills from Standards of Learning presented in previous grades as they deepen their mathematical understanding. Assessment items may not and should not be a verbatim reflection of the information presented in the *Curriculum Framework*.

Each topic in the 2016 *Mathematics Standards of Learning Curriculum Framework* is developed around the Standards of Learning. The format of the *Curriculum Framework* facilitates teacher planning by identifying the key concepts, knowledge, and skills that should be the focus of instruction for each standard. The *Curriculum Framework* is divided into two columns: Understanding the Standard and Essential Knowledge and Skills. The purpose of each column is explained below.

### *Understanding the Standard*

This section includes mathematical content and key concepts that assist teachers in planning standards-focused instruction. The statements may provide definitions, explanations, examples, and information regarding connections within and between grade level(s)/course(s).

### *Essential Knowledge and Skills*

This section provides a detailed expansion of the mathematics knowledge and skills that each student should know and be able to demonstrate. This is not meant to be an exhaustive list of student expectations.

## **Mathematical Process Goals for Students**

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The content of the mathematics standards is intended to support the following five process goals for students: becoming mathematical problem solvers, communicating mathematically, reasoning mathematically, making mathematical connections, and using mathematical representations to model and interpret practical situations. Practical situations include real-world problems and problems that model real-world situations.

### **Mathematical Problem Solving**

Students will apply mathematical concepts and skills and the relationships among them to solve problem situations of varying complexities. Students also will recognize and create problems from real-world data and situations within and outside mathematics and then apply appropriate strategies to determine acceptable solutions. To accomplish this goal, students will need to develop a repertoire of skills and strategies for solving a variety of problems. A major goal of the mathematics program is to help students apply mathematics concepts and skills to become mathematical problem solvers.

### **Mathematical Communication**

Students will communicate thinking and reasoning using the language of mathematics, including specialized vocabulary and symbolic notation, to express mathematical ideas with precision. Representing, discussing, justifying, conjecturing, reading, writing, presenting, and listening to mathematics will help students clarify their thinking and deepen their understanding of the mathematics being studied. Mathematical communication becomes visible where learning involves participation in mathematical discussions.

### **Mathematical Reasoning**

Students will recognize reasoning and proof as fundamental aspects of mathematics. Students will learn and apply inductive and deductive reasoning skills to make, test, and evaluate mathematical statements and to justify steps in mathematical procedures. Students will use logical reasoning to analyze an argument and to determine whether conclusions are valid. In addition, students will use number sense to apply proportional and spatial reasoning and to reason from a variety of representations.

### **Mathematical Connections**

Students will build upon prior knowledge to relate concepts and procedures from different topics within mathematics and see mathematics as an integrated field of study. Through the practical application of content and process skills, students will make connections among different areas of mathematics and between mathematics and other disciplines, and to real-world contexts. Science and mathematics teachers and curriculum writers are encouraged to develop mathematics and science curricula that support, apply, and reinforce each other.

### **Mathematical Representations**

Students will represent and describe mathematical ideas, generalizations, and relationships using a variety of methods. Students will understand that representations of mathematical ideas are an essential part of learning, doing, and communicating mathematics. Students should make connections among different representations – physical, visual, symbolic, verbal, and contextual – and recognize that representation is both a process and a product.

## **Instructional Technology**

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The use of appropriate technology and the interpretation of the results from applying technology tools must be an integral part of teaching, learning, and assessment. However, facility in the use of technology shall not be regarded as a substitute for a student’s understanding of quantitative and algebraic concepts and relationships or for proficiency in basic computations. Students must learn to use a variety of methods and tools to compute, including paper and pencil, mental arithmetic, estimation, and calculators. In addition, graphing utilities, spreadsheets, calculators, dynamic applications, and other technological tools are now standard for mathematical problem solving and application in science, engineering, business and industry, government, and practical affairs.

Calculators and graphing utilities should be used by students for exploring and visualizing number patterns and mathematical relationships, facilitating reasoning and problem solving, and verifying solutions. However, according to the National Council of Teachers of Mathematics, “... the use of calculators does not supplant the need for students to develop proficiency with efficient, accurate methods of mental and pencil-and-paper calculation and in making reasonable estimations.” State and local assessments may restrict the use of calculators in measuring specific student objectives that focus on number sense and computation. On the grade three state assessment, all objectives are assessed without the use of a calculator. On the state assessments for grades four through seven, objectives that are assessed without the use of a calculator are indicated with an asterisk (\*).

## **Computational Fluency**

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Mathematics instruction must develop students’ conceptual understanding, computational fluency, and problem-solving skills. The development of related conceptual understanding and computational skills should be balanced and intertwined, each supporting the other and reinforcing learning.

Computational fluency refers to having flexible, efficient and accurate methods for computing. Students exhibit computational fluency when they demonstrate strategic thinking and flexibility in the computational methods they choose, understand and can explain, and produce accurate answers efficiently.

The computational methods used by a student should be based on the mathematical ideas that the student understands, including the structure of the base-ten number system, number relationships, meaning of operations, and properties. Computational fluency with whole numbers is a goal of mathematics instruction in the elementary grades. Students should be fluent with the basic number combinations for addition and subtraction to 20 by the end of grade two and those for multiplication and division by the end of grade four. Students should be encouraged to use computational methods and tools that are appropriate for the context and purpose.



## **Algebra Readiness**

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The successful mastery of Algebra I is widely considered to be the gatekeeper to success in the study of upper-level mathematics. “Algebra readiness” describes the mastery of, and the ability to apply, the *Mathematics Standards of Learning*, including the Mathematical Process Goals for Students, for kindergarten through grade eight. The study of algebraic thinking begins in kindergarten and is progressively formalized prior to the study of the algebraic content found in the Algebra I Standards of Learning. Included in the progression of algebraic content is patterning, generalization of arithmetic concepts, proportional reasoning, and representing mathematical relationships using tables, symbols, and graphs. The K-8 *Mathematics Standards of Learning* form a progression of content knowledge and develop the reasoning necessary to be well-prepared for mathematics courses beyond Algebra I, including Geometry and Statistics.

## **Equity**

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“Addressing equity and access includes both ensuring that all students attain mathematics proficiency and increasing the numbers of students from all racial, ethnic, linguistic, gender, and socioeconomic groups who attain the highest levels of mathematics achievement.”

– National Council of Teachers of Mathematics

Mathematics programs should have an expectation of equity by providing all students access to quality mathematics instruction and offerings that are responsive to and respectful of students’ prior experiences, talents, interests, and cultural perspectives. Successful mathematics programs challenge students to maximize their academic potential and provide consistent monitoring, support, and encouragement to ensure success for all. Individual students should be encouraged to choose mathematical programs of study that challenge, enhance, and extend their mathematical knowledge and future opportunities.

Student engagement is an essential component of equity in mathematics teaching and learning. Mathematics instructional strategies that require students to think critically, to reason, to develop problem-solving strategies, to communicate mathematically, and to use multiple representations engages students both mentally and physically. Student engagement increases with mathematical tasks that employ the use of relevant, applied contexts and provide an appropriate level of cognitive challenge. All students, including students with disabilities, gifted learners, and English language learners deserve high-quality mathematics instruction that addresses individual learning needs, maximizing the opportunity to learn.

Mathematics instruction in grades six through eight continues to focus on the development of number sense, with emphasis on rational and real 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 many middle school mathematics topics.

Students develop an understanding of integers and rational numbers 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 real numbers and the properties of operations on real numbers through experiences with rational and irrational numbers and apply the order of operations.

## 8.1 The student will compare and order real numbers.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• Real numbers can be represented as integers, fractions (proper or improper), decimals, percents, numbers written in scientific notation, radicals, and <math>\pi</math>. It is often useful to convert numbers to be compared and/or ordered to one representation (e.g., fractions, decimals or percents).</li> <li>• Proper fractions, improper fractions, and mixed numbers are terms often used to describe fractions. A proper fraction is a fraction whose numerator is less than the denominator. An improper fraction is a fraction whose numerator is equal to or greater than the denominator. An improper fraction may be expressed as a mixed number. A mixed number is written with two parts: a whole number and a proper fraction (e.g., <math>3\frac{5}{8}</math>). Fractions can have a positive or negative value.</li> <li>• The density property states that between any two real numbers lies another real number. For example, between 3 and 5 we can find 4; between 4.0 and 4.2 we can find 4.16; between 4.16 and 4.17 we can find 4.165; between 4.165 and 4.166 we can find 4.1655, etc. Thus, we can always find another number between two numbers. Students are not expected to know the term <i>density property</i> but the concept allows for a deeper understanding of the set of real numbers.</li> <li>• Scientific notation is used to represent very large or very small numbers.</li> <li>• A number written in scientific notation is the product of two factors: a decimal greater than or equal to one but less than 10 multiplied by a power of 10 (e.g., <math>3.1 \times 10^5 = 310,000</math> and <math>3.1 \times 10^{-5} = 0.000031</math>).</li> <li>• Any real number raised to the zero power is 1. The only exception to this rule is zero itself. Zero raised to the zero power is undefined.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Compare and order no more than five real numbers expressed as integers, fractions (proper or improper), decimals, mixed numbers, percents, numbers written in scientific notation, radicals, and <math>\pi</math>. Radicals may include both positive and negative square roots of values from 0 to 400. Ordering may be in ascending or descending order.</li> <li>• Use rational approximations (to the nearest hundredth) of irrational numbers to compare and order, locating values on a number line. Radicals may include both positive and negative square roots of values from 0 to 400 yielding an irrational number.</li> </ul>

## 8.2 The student will describe the relationships between the subsets of the real number system.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• The subsets of real numbers include natural numbers (counting numbers), whole numbers, integers, rational and irrational numbers.</li> <li>• Some numbers can belong to more than one subset of the real numbers (e.g., 4 is a natural number, a whole number, an integer, and a rational number). The attributes of one subset can be contained in whole or in part in another subset. The relationships between the subsets of the real number system can be illustrated using graphic organizers (that may include, but not be limited to, Venn diagrams), number lines, and other representations.</li> <li>• The set of natural numbers is the set of counting numbers {1, 2, 3, 4...}.</li> <li>• The set of whole numbers includes the set of all the natural numbers and zero {0, 1, 2, 3...}.</li> <li>• The set of integers includes the set of whole numbers and their opposites {... -2, -1, 0, 1, 2...}. Zero has no opposite and is neither positive nor negative.</li> <li>• The set of rational numbers includes the set of all numbers that can be expressed as fractions in the form <math>\frac{a}{b}</math> where <math>a</math> and <math>b</math> are integers and <math>b</math> does not equal zero. The decimal form of a rational number can be expressed as a terminating or repeating decimal. A few examples of rational numbers are <math>\sqrt{25}</math>, <math>\frac{1}{4}</math>, <math>-2.3</math>, <math>75\%</math>, and <math>4.\overline{59}</math>.</li> <li>• The set of irrational numbers is the set of all nonrepeating, nonterminating decimals. An irrational number cannot be written in fraction form (e.g., <math>\pi</math>, <math>\sqrt{2}</math>, <math>1.232332333...</math>).</li> <li>• The real number system is comprised of all rational and irrational numbers.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Describe and illustrate the relationships among the subsets of the real number system by using representations (graphic organizers, number lines, etc.). Subsets include rational numbers, irrational numbers, integers, whole numbers, and natural numbers.</li> <li>• Classify a given number as a member of a particular subset or subsets of the real number system, and explain why.</li> <li>• Describe each subset of the set of real numbers and include examples and non-examples.</li> <li>• Recognize that the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.</li> </ul>

- 8.3 The student will**
- estimate and determine the two consecutive integers between which a square root lies; and**
  - determine both the positive and negative square roots of a given perfect square.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>A perfect square is a whole number whose square root is an integer.</li> <li>The square root of a given number is any number which, when multiplied times itself, equals the given number.</li> <li>Both the positive and negative roots of whole numbers, except zero, can be determined. The square root of zero is zero. The value is neither positive nor negative. Zero (a whole number) is a perfect square.</li> <li>The positive and negative square root of any whole number other than a perfect square lies between two consecutive integers (e.g., <math>\sqrt{57}</math> lies between 7 and 8 since <math>7^2 = 49</math> and <math>8^2 = 64</math>; <math>-\sqrt{11}</math> lies between -4 and -3 since <math>(-4)^2 = 16</math> and <math>(-3)^2 = 9</math>).</li> <li>The symbol <math>\sqrt{\quad}</math> may be used to represent a positive (principal) root and <math>-\sqrt{\quad}</math> may be used to represent a negative root.</li> <li>The square root of a whole number that is not a perfect square is an irrational number (e.g., <math>\sqrt{2}</math> is an irrational number). An irrational number cannot be expressed exactly as a fraction <math>\frac{a}{b}</math> where <math>b</math> does not equal 0.</li> <li>Square root symbols may be used to represent solutions to equations of the form <math>x^2 = p</math>. Examples may include: <ul style="list-style-type: none"> <li>If <math>x^2 = 36</math>, then <math>x</math> is <math>\sqrt{36} = 6</math> or <math>-\sqrt{36} = -6</math>.</li> <li>If <math>x^2 = 5</math>, then <math>x</math> is <math>\sqrt{5}</math> or <math>-\sqrt{5}</math>.</li> </ul> </li> <li>Students can use grid paper and estimation to determine what is needed to build a perfect square. The square root of a positive number is usually defined as the side length of a square with the area equal to the given number. If it is not a perfect square, the area provides a means for estimation.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Estimate and identify the two consecutive integers between which the positive or negative square root of a given number lies. Numbers are limited to natural numbers from 1 to 400. (a)</li> <li>Determine the positive or negative square root of a given perfect square from 1 to 400. (b)</li> </ul>

The computation and estimation strand in grades six through eight focuses on developing conceptual and algorithmic understanding of operations with integers and rational numbers through concrete activities and discussions that bring an understanding as to why procedures work and make sense.

Students develop and refine estimation strategies based on an understanding of number concepts, properties and relationships. The development of problem solving, using operations with integers and rational numbers, builds upon the strategies developed in the elementary grades. Students will reinforce these skills and build on the development of proportional reasoning and more advanced mathematical skills.

Students learn to make sense of the mathematical tools available by making valid judgments of the reasonableness of answers. Students will balance the ability to make precise calculations through the application of the order of operations with knowing when calculations may require estimation to obtain appropriate solutions to practical problems.

## 8.4 The student will solve practical problems involving consumer applications.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• Rational numbers may be expressed as whole numbers, integers, fractions, percents, and numbers written in scientific notation.</li> <li>• Practical problems may include, but are not limited to, those related to economics, sports, science, social science, transportation, and health. Some examples include problems involving the amount of a pay check per month, commissions, fees, the discount price on a product, temperature, simple interest, sales tax and installment buying.</li> <li>• A percent is a ratio with a denominator of 100.</li> <li>• Reconciling an account is a process used to verify that two sets of records (usually the balances of two accounts) are in agreement. Reconciliation is used to ensure that the balance of an account matches the actual amount of money deposited and/or withdrawn from the account.</li> <li>• A discount is a percent of the original price. The discount price is the original price minus the discount.</li> <li>• Simple interest (<math>I</math>) for a number of years is determined by finding the product of the principal (<math>p</math>), the annual rate of interest (<math>r</math>), and the number of years (<math>t</math>) of the loan or investment using the formula <math>I = prt</math>.</li> <li>• The total value of an investment is equal to the sum of the original investment and the interest earned.</li> <li>• The total cost of a loan is equal to the sum of the original cost and the interest paid.</li> <li>• Percent increase and percent decrease are both percents of change measuring the percent a quantity increases or decreases.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Solve practical problems involving consumer applications by using proportional reasoning and computation procedures for rational numbers.</li> <li>• Reconcile an account balance given a statement with five or fewer transactions.</li> <li>• Compute a discount or markup and the resulting sale price for one discount or markup.</li> <li>• Compute the sales tax or tip and resulting total.</li> <li>• Compute the simple interest and new balance earned in an investment or on a loan given the principal amount, interest rate, and time period in years.</li> <li>• Compute the percent increase or decrease found in a practical situation.</li> </ul>

Measurement and geometry in the middle grades provide a natural context and connection among many mathematical concepts. Students expand informal experiences with geometry and measurement in the elementary grades and develop a solid foundation for further exploration of these concepts in high school. Spatial reasoning skills are essential to the formal inductive and deductive reasoning skills required in subsequent mathematics learning.

Students develop measurement skills through exploration and estimation. Physical exploration to determine length, weight/mass, liquid volume/capacity, and angle measure are essential to develop a conceptual understanding of measurement. 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, square-based pyramids, and cones.

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 and geometry software provide 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, square-based 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. Understanding how the Pythagorean Theorem can be applied in practical situations has a 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 kindergarten and grade one).

**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 two and three.)

**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 five and six 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.)



- 8.5 The student will use the relationships among pairs of angles that are vertical angles, adjacent angles, supplementary angles, and complementary angles to determine the measure of unknown angles.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• Vertical angles are a pair of nonadjacent angles formed by two intersecting lines. Vertical angles are congruent and share a common vertex.</li> <li>• Complementary angles are any two angles such that the sum of their measures is <math>90^\circ</math>.</li> <li>• Supplementary angles are any two angles such that the sum of their measures is <math>180^\circ</math>.</li> <li>• Complementary and supplementary angles may or may not be adjacent.</li> <li>• Adjacent angles are any two non-overlapping angles that share a common ray and a common vertex.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Identify and describe the relationship between pairs of angles that are vertical, adjacent, supplementary, and complementary.</li> <li>• Use the relationships among supplementary, complementary, vertical, and adjacent angles to solve problems, including practical problems, involving the measure of unknown angles.</li> </ul>

8.6

The student will

- a) solve problems, including practical problems, involving volume and surface area of cones and square-based pyramids; and  
 b) describe how changing one measured attribute of a rectangular prism affects the volume and surface area.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• A polyhedron is a solid figure whose faces are all polygons.</li> <li>• Nets are two-dimensional representations of a three-dimensional figure that can be folded into a model of the three-dimensional figure.</li> <li>• Surface area of a solid figure is the sum of the areas of the surfaces of the figure.</li> <li>• Volume is the amount a container holds.</li> <li>• A rectangular prism is a polyhedron that has a congruent pair of parallel rectangular bases and four faces that are rectangles. A rectangular prism has eight vertices and twelve edges. In this course, prisms are limited to right prisms with bases that are rectangles.</li> <li>• The surface area of a rectangular prism is the sum of the areas of the faces and bases, found by using the formula <math>S.A. = 2lw + 2lh + 2wh</math>. All six faces are rectangles.</li> <li>• The volume of a rectangular prism is calculated by multiplying the length, width and height of the prism or by using the formula <math>V = lwh</math>.</li> <li>• A cube is a rectangular prism with six congruent, square faces. All edges are the same length. A cube has eight vertices and twelve edges.</li> <li>• A cone is a solid figure formed by a face called a base that is joined to a vertex (apex) by a curved surface. In this grade level, cones are limited to right circular cones.</li> <li>• The surface area of a right circular cone is found by using the formula, <math>S.A. = \pi r^2 + \pi rl</math>, where <math>l</math> represents the slant height of the cone. The area of the base of a circular cone is <math>\pi r^2</math>.</li> <li>• The volume of a cone is found by using <math>V = \frac{1}{3}\pi r^2 h</math>, where <math>h</math> is the height and <math>\pi r^2</math> is the area of the base.</li> <li>• A square-based pyramid is a polyhedron with a square base and four faces that are triangles with a common vertex (apex) above the base. In this grade level, pyramids are limited to right regular pyramids with a square base.</li> <li>• The volume of a pyramid is <math>\frac{1}{3} Bh</math>, where <math>B</math> is the area of the base and <math>h</math> is the height.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Distinguish between situations that are applications of surface area and those that are applications of volume. (a)</li> <li>• Determine the surface area of cones and square-based pyramids by using concrete objects, nets, diagrams and formulas. (a)</li> <li>• Determine the volume of cones and square-based pyramids, using concrete objects, diagrams, and formulas. (a)</li> <li>• Solve practical problems involving volume and surface area of cones and square-based pyramids. (a)</li> <li>• Describe how the volume of a rectangular prism is affected when one measured attribute is multiplied by a factor of <math>\frac{1}{4}</math>, <math>\frac{1}{3}</math>, <math>\frac{1}{2}</math>, 2, 3, or 4. (b)</li> <li>• Describe how the surface area of a rectangular prism is affected when one measured attribute is multiplied by a factor of <math>\frac{1}{2}</math> or 2. (b)</li> </ul>

## 8.6

## The student will

- a) solve problems, including practical problems, involving volume and surface area of cones and square-based pyramids; and  
 b) describe how changing one measured attribute of a rectangular prism affects the volume and surface area.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• The surface area of a pyramid is the sum of the areas of the triangular faces and the area of the base, found by using the formula <math>S.A. = \frac{1}{2}lp + B</math> where <math>l</math> is the slant height, <math>p</math> is the perimeter of the base and <math>B</math> is the area of the base.</li> <li>• The volume of a pyramid is found by using the formula <math>V = \frac{1}{3}Bh</math>, where <math>B</math> is the area of the base and <math>h</math> is the height.</li> <li>• The volume of prisms can be found by determining the area of the base and multiplying that by the height.</li> <li>• The formula for determining the volume of cones and cylinders are similar. For cones, you are determining <math>\frac{1}{3}</math> of the volume of the cylinder with the same size base and height. The volume of a cone is found by using <math>V = \frac{1}{3}\pi r^2 h</math>. The volume of a cylinder is the area of the base of the cylinder multiplied by the height, found by using the formula, <math>V = \pi r^2 h</math>, where <math>h</math> is the height and <math>\pi r^2</math> is the area of the base.</li> <li>• The calculation of determining surface area and volume may vary depending upon the approximation for pi. Common approximations for <math>\pi</math> include 3.14, <math>\frac{22}{7}</math>, or the pi button on the calculator.</li> <li>• When the measurement of one attribute of a rectangular prism is changed through multiplication or division the volume increases by the same factor by which the attribute increased. For example, if a prism has a volume of <math>2 \cdot 3 \cdot 4</math>, the volume is 24 cubic units. However, if one of the attributes is doubled, the volume doubles. That is, <math>2 \cdot 3 \cdot 8</math>, the volume is 48 cubic units or 24 doubled.</li> <li>• When one attribute of a rectangular prism is changed through multiplication or division, the surface area is affected differently than the volume. The formula for surface area of a rectangular prism is <math>2(lw) + 2(lh) + 2(wh)</math> when the width is doubled then four faces are affected. For example, a rectangular prism with length = 7 in., width = 4 in., and height = 3 in. would have a surface area of <math>2(7 \cdot 4) + 2(7 \cdot 3) + 2(4 \cdot 3)</math> or 122 square inches. If the height is doubled to 6 inches then the surface area would be found by <math>2(7 \cdot 4) + 2(7 \cdot 6) + 2(4 \cdot 6)</math> or 188 square inches.</li> </ul>	

- 8.7 The student will**
- given a polygon, apply transformations, to include translations, reflections, and dilations, in the coordinate plane; and
  - identify practical applications of transformations.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• Translations and reflections maintain congruence between the preimage and image but change location. Dilations by a scale factor other than 1 produce an image that is not congruent to the preimage but is similar. Reflections change the orientation of the image.</li> <li>• A transformation of a figure, called preimage, changes the size, shape, and/or position of the figure to a new figure, called the image.</li> <li>• A transformation of preimage point <math>A</math> can be denoted as the image <math>A'</math> (read as “A prime”).</li> <li>• A reflection is a transformation in which an image is formed by reflecting the preimage over a line called the line of reflection. Each point on the image is the same distance from the line of reflection as the corresponding point in the preimage.</li> <li>• A translation is a transformation in which an image is formed by moving every point on the preimage the same distance in the same direction.</li> <li>• A dilation is a transformation in which an image is formed by enlarging or reducing the preimage proportionally by a scale factor from the center of dilation (limited to the origin in grade eight). A dilation of a figure and the original figure are similar. The center of dilation may or may not be on the preimage.</li> <li>• The result of first translating and then reflecting over the <math>x</math>- or <math>y</math>-axis may not result in the same transformation of reflecting over the <math>x</math>- or <math>y</math>-axis and then translating.</li> <li>• Practical applications may include, but are not limited to, the following: <ul style="list-style-type: none"> <li>– A reflection of a boat in water shows an image of the boat flipped upside down with the water line being the line of reflection;</li> <li>– A translation of a figure on a wallpaper pattern shows the same figure slid the same distance in the same direction; and</li> <li>– A dilation of a model airplane is the production model of the airplane.</li> </ul> </li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Given a preimage in the coordinate plane, identify the coordinate of the image of a polygon that has been translated vertically, horizontally, or a combination of both. (a)</li> <li>• Given a preimage in the coordinate plane, identify the coordinates of the image of a polygon that has been reflected over the <math>x</math>- or <math>y</math>-axis. (a)</li> <li>• Given a preimage in the coordinate plane, identify the coordinates of the image of a right triangle or a rectangle that has been dilated. Scale factors are limited to <math>\frac{1}{4}</math>, <math>\frac{1}{2}</math>, 2, 3, or 4. The center of the dilation will be the origin. (a)</li> <li>• Given a preimage in the coordinate plane, identify the coordinates of the image of a polygon that has been translated and reflected over the <math>x</math>- or <math>y</math>-axis, or reflected over the <math>x</math>- or <math>y</math>-axis and then translated. (a)</li> <li>• Sketch the image of a polygon that has been translated vertically, horizontally, or a combination of both. (a)</li> <li>• Sketch the image of a polygon that has been reflected over the <math>x</math>- or <math>y</math>-axis. (a)</li> <li>• Sketch the image of a dilation of a right triangle or a rectangle limited to a scale factor of <math>\frac{1}{4}</math>, <math>\frac{1}{2}</math>, 2, 3, or 4. The center of the dilation will be the origin. (a)</li> <li>• Sketch the image of a polygon that has been translated and reflected over the <math>x</math>- or <math>y</math>-axis, or reflected over the <math>x</math>- or <math>y</math>-axis and then translated. (a)</li> </ul>

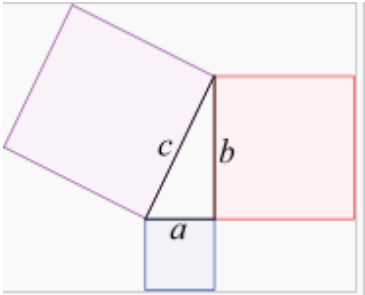
- 8.7**      **The student will**
- a) given a polygon, apply transformations, to include translations, reflections, and dilations, in the coordinate plane; and
  - b) identify practical applications of transformations.

Understanding the Standard	Essential Knowledge and Skills
	<ul style="list-style-type: none"><li>• Identify the type of translation in a given example. (a, b)</li><li>• Identify practical applications of transformations including, but not limited to, tiling, fabric, wallpaper designs, art, and scale drawings. (b)</li></ul>

**8.8 The student will construct a three-dimensional model, given the top or bottom, side, and front views.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• A three-dimensional object can be represented as a two-dimensional model with views of the object from different perspectives.</li> <li>• Three-dimensional models of geometric solids can be used to understand perspective and provide tactile experiences in determining two-dimensional perspectives.</li> <li>• Three-dimensional models of geometric solids can be represented on isometric paper.</li> <li>• The top view is a mirror image of the bottom view.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Construct three-dimensional models, given the top or bottom, side, and front views.</li> <li>• Identify three-dimensional models given a two-dimensional perspective.</li> <li>• Identify the two-dimensional perspective from the top or bottom, side, and front view, given a three-dimensional model.</li> </ul>

- 8.9 The student will
- verify the Pythagorean Theorem; and
  - apply the Pythagorean Theorem.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>The Pythagorean Theorem is essential for solving problems involving right triangles.</li> <li>The relationship between the sides and angles of right triangles are useful in many applied fields.</li> <li>In a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the legs. This relationship is known as the Pythagorean Theorem: <math>a^2 + b^2 = c^2</math>.</li> </ul>  <ul style="list-style-type: none"> <li>The Pythagorean Theorem is used to determine the measure of any one of the three sides of a right triangle if the measures of the other two sides are known.</li> <li>The converse of the Pythagorean Theorem states that if the square of the length of the hypotenuse equals the sum of the squares of the legs in a triangle, then the triangle is a right triangle. This can be used to determine whether a triangle is a right triangle given the measures of its three sides.</li> <li>Whole number triples that are the measures of the sides of right triangles, such as (3, 4, 5), (6, 8, 10), (9, 12, 15), and (5, 12, 13), are commonly known as Pythagorean triples.</li> <li>The hypotenuse of a right triangle is the side opposite the right angle.</li> <li>The hypotenuse of a right triangle is always the longest side of the right triangle.</li> <li>The legs of a right triangle form the right angle.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Verify the Pythagorean Theorem, using diagrams, concrete materials, and measurement. (a)</li> <li>Determine whether a triangle is a right triangle given the measures of its three sides. (b)</li> <li>Determine the measure of a side of a right triangle, given the measures of the other two sides. (b)</li> <li>Solve practical problems involving right triangles by using the Pythagorean Theorem. (b)</li> </ul>

## 8.10 The student will solve area and perimeter problems, including practical problems, involving composite plane figures.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• A plane figure is any two-dimensional shape that can be drawn in a plane.</li> <li>• A polygon is a closed plane figure composed of at least three line segments that do not cross.</li> <li>• The perimeter is the path or distance around any plane figure. The perimeter of a circle is called the circumference.</li> <li>• The area of a composite figure can be found by subdividing the figure into triangles, rectangles, squares, trapezoids, parallelograms, circles, and semicircles, calculating their areas, and combining the areas together by addition and/or subtraction based upon the given composite figure.</li> <li>• The area of a rectangle is computed by multiplying the lengths of two adjacent sides (<math>A = lw</math>).</li> <li>• The area of a triangle is computed by multiplying the measure of its base by the measure of its height and dividing the product by 2 or multiplying by <math>\frac{1}{2}</math> (<math>A = \frac{bh}{2}</math> or <math>A = \frac{1}{2}bh</math>).</li> <li>• The area of a parallelogram is computed by multiplying the measure of its base by the measure of its height (<math>A = bh</math>).</li> <li>• The area of a trapezoid is computed by taking the average of the measures of the two bases and multiplying this average by the height (<math>A = \frac{1}{2}h(b_1 + b_2)</math>).</li> <li>• The area of a circle is computed by multiplying pi times the radius squared (<math>A = \pi r^2</math>).</li> <li>• The circumference of a circle is found by multiplying pi by the diameter or multiplying pi by 2 times the radius (<math>C = \pi d</math> or <math>C = 2\pi r</math>).</li> <li>• The area of a semicircle is half the area of a circle with the same diameter or radius.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Subdivide a plane figure into triangles, rectangles, squares, trapezoids, parallelograms, and semicircles. Determine the area of subdivisions and combine to determine the area of the composite plane figure.</li> <li>• Subdivide a plane figure into triangles, rectangles, squares, trapezoids, parallelograms, and semicircles. Use the attributes of the subdivisions to determine the perimeter of the composite plane figure.</li> <li>• Apply perimeter, circumference, and area formulas to solve practical problems involving composite plane figures.</li> </ul>



In the middle grades, students develop an awareness of the power of data analysis and the application of probability through fostering their natural curiosity about data and making predictions.

The exploration of various methods of data collection and representation allows students to become effective at using different types of graphs to represent different types of data. Students 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. Through experiments and simulations, students build on their understanding of the Fundamental Counting Principle from elementary mathematics to learn more about probability in the middle grades.

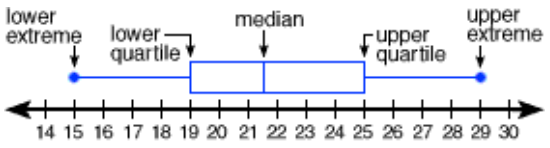
- 8.11 The student will**
- compare and contrast the probability of independent and dependent events; and**
  - determine probabilities for independent and dependent events.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>A simple event is one event (e.g., pulling one sock out of a drawer and examining the probability of getting one color).</li> <li>If all outcomes of an event are equally likely, the theoretical probability of an event occurring is equal to the ratio of desired outcomes to the total number of possible outcomes in the sample space.</li> <li>The probability of an event occurring can be represented as a ratio or the equivalent fraction, decimal, or percent.</li> <li>The probability of an event occurring is a ratio between 0 and 1. A probability of zero means the event will never occur. A probability of one means the event will always occur.</li> <li>Two events are either dependent or independent.</li> <li>If the outcome of one event does not influence the occurrence of the other event, they are called independent. If two events are independent, then the probability of the second event does not change regardless of whether the first occurs. For example, the first roll of a number cube does not influence the second roll of the number cube. Other examples of independent events are, but not limited to: flipping two coins; spinning a spinner and rolling a number cube; flipping a coin and selecting a card; and choosing a card from a deck, replacing the card and selecting again.</li> <li>The probability of two independent events is found by using the following formula:  <math>P(A \text{ and } B) = P(A) \cdot P(B)</math> <ul style="list-style-type: none"> <li>Example: When rolling a six-sided number cube and flipping a coin, simultaneously, what is the probability of rolling a 3 on the cube and getting a heads on the coin?  <math>P(3 \text{ and heads}) = \frac{1}{6} \cdot \frac{1}{2} = \frac{1}{12}</math></li> </ul> </li> <li>If the outcome of one event has an impact on the outcome of the other event, the events are called dependent. If events are dependent then the second event is considered only if the first event has already occurred. For example, if you choose a blue card from a set of nine different colored cards that has a total of four blue cards and you do not place that blue card back in the set before selecting a second card, the chance of selecting a blue card the second time is diminished because there are now only three blue cards remaining in the set. Other examples of dependent events</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Determine whether two events are independent or dependent. (a)</li> <li>Compare and contrast the probability of independent and dependent events. (a)</li> <li>Determine the probability of two independent events. (b)</li> <li>Determine the probability of two dependent events. (b)</li> </ul>

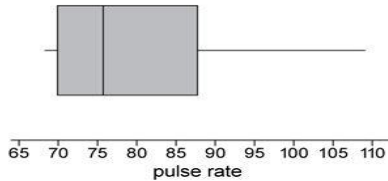
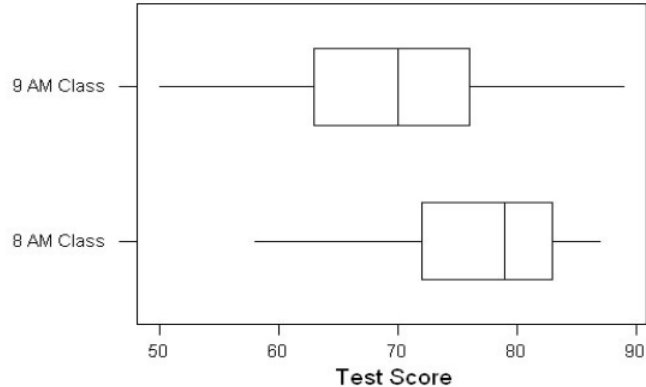
- 8.11 The student will**
- a) compare and contrast the probability of independent and dependent events; and**
  - b) determine probabilities for independent and dependent events.**

Understanding the Standard	Essential Knowledge and Skills
<p>include, but are not limited to: choosing two marbles from a bag but not replacing the first after selecting it; determining the probability that it will snow and that school will be cancelled.</p> <ul style="list-style-type: none"> <li>• The probability of two dependent events is found by using the following formula: <math>P(A \text{ and } B) = P(A) \cdot P(B \text{ after } A)</math> <ul style="list-style-type: none"> <li>– Example: 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 then <i>without</i> replacing the blue ball in the bag, picking a red ball on the second pick?  <math display="block">P(\text{blue and red}) = P(\text{blue}) \cdot P(\text{red after blue}) = \frac{1}{3} \cdot \frac{1}{2} = \frac{1}{6}</math> </li> </ul> </li> </ul>	

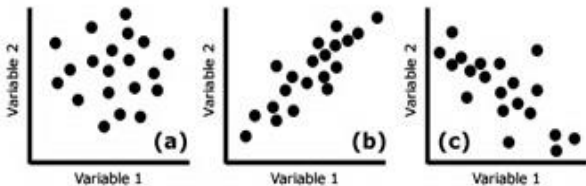
- 8.12 The student will**
- represent numerical data in boxplots;
  - make observations and inferences about data represented in boxplots; and
  - compare and analyze two data sets using boxplots.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>A boxplot (box-and-whisker plot) is a convenient and informative way to represent single-variable (univariate) data.</li> <li>Boxplots are effective at giving an overall impression of the shape, center, and spread of the data. It does not show a distribution in as much detail as a stem and leaf plot or a histogram.</li> <li>A boxplot will allow you to quickly analyze a set of data by identifying key statistical measures (median and range) and major concentrations of data.</li> <li>A boxplot uses a rectangle to represent the middle half of a set of data and lines (whiskers) at both ends to represent the remainder of the data. The median is marked by a vertical line inside the rectangle.</li> <li>The five critical points in a boxplot, commonly referred to as the five-number summary, are lower extreme (minimum), lower quartile, median, upper quartile, and upper extreme (maximum). Each of these points represents the bounds for the four quartiles. In the example below, the lower extreme is 15, the lower quartile is 19, the median is 21.5, the upper quartile is 25, and the upper extreme is 29.</li> </ul>  <ul style="list-style-type: none"> <li>The range is the difference between the upper extreme and the lower extreme. The interquartile range (IQR) is the difference between the upper quartile and the lower quartile. Using the example above, the range is 14 or <math>29 - 15</math>. The interquartile range is 6 or <math>25 - 19</math>.</li> <li>When there are an odd number of data values in a set of data, the median will not be considered when calculating the lower and upper quartiles. <ul style="list-style-type: none"> <li>Example: Calculate the median, lower quartile, and upper quartile for the following data values:  3 5 6 7 8 9 11 13 13  Median: 8; Lower Quartile: 5.5; Upper Quartile: 12</li> </ul> </li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Collect and display a numeric data set of no more than 20 items, using boxplots. (a)</li> <li>Make observations and inferences about data represented in a boxplot. (b)</li> <li>Given a data set represented in a boxplot, identify and describe the lower extreme (minimum), upper extreme (maximum), median, upper quartile, lower quartile, range, and interquartile range. (b)</li> <li>Compare and analyze two data sets represented in boxplots. (c)</li> </ul>

- 8.12 The student will**
- represent numerical data in boxplots;
  - make observations and inferences about data represented in boxplots; and
  - compare and analyze two data sets using boxplots.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>In the pulse rate example, shown below, many students incorrectly interpret that longer sections contain more data and shorter ones contain less. It is important to remember that roughly the same amount of data is in each section. The numbers in the left whisker (lowest of the data) are spread less widely than those in the right whisker.</li> </ul>  <ul style="list-style-type: none"> <li>Boxplots are useful when comparing information about two data sets. This example compares the test scores for a college class offered at two different times.</li> </ul>  <p>Using these boxplots, comparisons could be made about the two sets of data, such as comparing the median score of each class or the Interquartile Range (IQR) of each class.</p>	

- 8.13 The student will**
- represent data in scatterplots;**
  - make observations about data represented in scatterplots; and**
  - use a drawing to estimate the line of best fit for data represented in a scatterplot.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>A scatterplot illustrates the relationship between two sets of numerical data represented by two variables (bivariate data). A scatterplot consists of points on the coordinate plane. The coordinates of the point represent the measures of the two attributes of the point.</li> <li>In a scatterplot, each point may represent an independent and dependent variable. The independent variable is graphed on the horizontal axis and the dependent is graphed on the vertical axis.</li> <li>Scatterplots can be used to predict linear trends and estimate a line of best fit.</li> <li>A line of best fit helps in making interpretations and predictions about the situation modeled in the data set. Lines and curves of best fit are explored more in Algebra I to make interpretations and predictions.</li> <li>A scatterplot can suggest various kinds of linear relationships between variables. For example, weight and height, where weight would be on y-axis and height would be on the x-axis. Linear relationships may be positive (rising) or negative (falling). If the pattern of points slopes from lower left to upper right, it indicates a positive linear relationship between the variables being studied. If the pattern of points slopes from upper left to lower right, it indicates a negative linear relationship.             <ul style="list-style-type: none"> <li>For example: The following scatterplots illustrate how patterns in data values may indicate linear relationships.</li> </ul> </li> </ul> <div style="text-align: center; margin-top: 10px;"> <p>No relationship      Positive relationship      Negative relationship</p>  </div>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Collect, organize, and represent a data set of no more than 20 items using scatterplots. (a)</li> <li>Make observations about a set of data points in a scatterplot as having a positive linear relationship, a negative linear relationship, or no relationship. (b)</li> <li>Estimate the line of best fit with a drawing for data represented in a scatterplot. (c)</li> </ul>

- 8.13**      **The student will**
- a) represent data in scatterplots;**
  - b) make observations about data represented in scatterplots; and**
  - c) use a drawing to estimate the line of best fit for data represented in a scatterplot.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"><li>• A linear relationship between variables does not necessarily imply causation. For example, as the temperature at the beach increases, the sales at an ice cream store increase. If data were collected for these two variables, a positive linear relationship would exist, however, there is no causal relationship between the variables (i.e., the temperature outside does not cause ice cream sales to increase, but there is a relationship between the two).</li><li>• The relationship between variables is not always linear, and may be modeled by other types of functions that are studied in high school and college level mathematics.</li></ul>	

Patterns, functions and algebra become a larger mathematical focus in the middle grades as students extend their knowledge of patterns developed in the elementary grades.

Students make connections between the numeric concepts of ratio and proportion and the algebraic relationships that exist within a set of equivalent ratios. Students use variable expressions to represent proportional relationships between two quantities and begin to connect the concept of a constant of proportionality to rate of change and slope. Representation of relationships between two quantities using tables, graphs, equations, or verbal descriptions allow students to connect their knowledge of patterns to the concept of functional relationships. Graphing linear equations in two variables in the coordinate plane is a focus of the study of functions which continues in high school mathematics.

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 multistep equations and inequalities through their application in practical situation.



- 8.14 The student will**
- evaluate an algebraic expression for given replacement values of the variables; and**
  - simplify algebraic expressions in one variable.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>An expression is a representation of a quantity. It may contain numbers, variables, and/or operation symbols. It does not have an “equal sign (=)” (e.g., <math>\frac{3}{4}</math>, <math>5x</math>, <math>140 - 38.2</math>, <math>-18 \cdot 21</math>, <math>(5 + 2x) \cdot 4</math>). An expression cannot be solved.</li> <li>A numerical expression contains only numbers, the operations symbols, and grouping symbols.</li> <li>Expressions are simplified using the order of operations.</li> <li>Simplifying an algebraic expression means to write the expression as a more compact and equivalent expression. This usually involves combining like terms.</li> <li>Like terms are terms that have the same variables and exponents. The coefficients do not need to match (e.g., <math>12x</math> and <math>-5x</math>; <math>45</math> and <math>-5\frac{2}{3}</math>; <math>9y</math>, <math>-51y</math> and <math>\frac{4}{9}y</math>.)</li> <li>Like terms may be added or subtracted using the distributive and other properties. For example,           <ul style="list-style-type: none"> <li><math>2(x - \frac{1}{2}) + 5x = 2x - 1 + 5x = 2x + 5x - 1 = 7x - 1</math></li> <li><math>w + w - 2w = (1 + 1)w - 2w = 2w - 2w = (2 - 2)w = 0</math></li> </ul> </li> <li>The order of operations is as follows:           <ul style="list-style-type: none"> <li>First, complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols, do the innermost operation first.</li> <li>Second, evaluate all exponential expressions.</li> <li>Third, multiply and/or divide in order from left to right.</li> <li>Fourth, add and/or subtract in order from left to right.</li> </ul> <p>* Parentheses ( ), brackets [ ], braces { }, absolute value                (i.e., <math> 3(-5 + 2)  - 7</math>), and the division bar (i.e., <math>\frac{3+4}{5+6}</math>) should be treated as grouping symbols.</p> </li> <li>Properties of real numbers can be used to express simplification. Students should use the following properties, where appropriate, to further develop flexibility and fluency in problem solving (limitations may exist for the values of <math>a</math>, <math>b</math>, or <math>c</math> in this standard):</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Use the order of operations and apply the properties of real numbers to evaluate algebraic expressions for the given replacement values of the variables. Exponents are limited to whole numbers and bases are limited to integers. Square roots are limited to perfect squares. Limit the number of replacements to no more than three per expression. (a)</li> <li>Represent algebraic expressions using concrete materials and pictorial representations. Concrete materials may include colored chips or algebra tiles. (a)</li> <li>Simplify algebraic expressions in one variable. Expressions may need to be expanded (using the distributive property) or require combining like terms to simplify. Expressions will include only linear and numeric terms. Coefficients and numeric terms may be rational. (b)</li> </ul>

- 8.14 The student will**
- evaluate an algebraic expression for given replacement values of the variables; and
  - simplify algebraic expressions in one variable.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>- Commutative property of addition: <math>a + b = b + a</math>.</li> <li>- Commutative property of multiplication: <math>a \cdot b = b \cdot a</math>.</li> <li>- Associative property of addition: <math>(a + b) + c = a + (b + c)</math>.</li> <li>- Associative property of multiplication: <math>(a \cdot b) \cdot c = a \cdot (b \cdot c)</math>.</li> <li>- Subtraction and division are neither commutative nor associative.</li> <li>- Distributive property (over addition/subtraction): <math>a \cdot (b + c) = a \cdot b + a \cdot c</math> and <math>a \cdot (b - c) = a \cdot b - a \cdot c</math>.</li> <li>- The additive identity is zero (0) because any number added to zero is the number. The multiplicative identity is one (1) because any number multiplied by one is the number. There are no identity elements for subtraction and division.</li> <li>- Identity property of addition (additive identity property): <math>a + 0 = a</math> and <math>0 + a = a</math>.</li> <li>- Identity property of multiplication (multiplicative identity property): <math>a \cdot 1 = a</math> and <math>1 \cdot a = a</math>.</li> <li>- Inverses are numbers that combine with other numbers and result in identity elements [e.g., <math>5 + (-5) = 0</math>; <math>\frac{1}{5} \cdot 5 = 1</math>].</li> <li>- Inverse property of addition (additive inverse property): <math>a + (-a) = 0</math> and <math>(-a) + a = 0</math>.</li> <li>- Inverse property of multiplication (multiplicative inverse property): <math>a \cdot \frac{1}{a} = 1</math> and <math>\frac{1}{a} \cdot a = 1</math>.</li> <li>- Zero has no multiplicative inverse.</li> <li>- Multiplicative property of zero: <math>a \cdot 0 = 0</math> and <math>0 \cdot a = 0</math>.</li> <li>- Division by zero is not a possible mathematical operation. It is undefined.</li> <li>- Substitution property: If <math>a = b</math>, then <math>b</math> can be substituted for <math>a</math> in any expression, equation, or inequality.</li> </ul>	

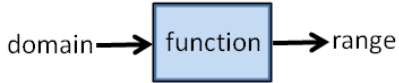
- 8.14 The student will**
- evaluate an algebraic expression for given replacement values of the variables; and**
  - simplify algebraic expressions in one variable.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"><li>A power of a number represents repeated multiplication of the number. For example, <math>(-5)^4</math> means <math>(-5) \cdot (-5) \cdot (-5) \cdot (-5)</math>. The base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In this example, <math>(-5)</math> is the base, and 4 is the exponent. The product is 625. Notice that the base appears inside the grouping symbols. The meaning changes with the removal of the grouping symbols. For example, <math>-5^4</math> means <math>5 \cdot 5 \cdot 5 \cdot 5</math> negated which results in a product of <math>-625</math>. The expression <math>-(5)^4</math> means to take the opposite of <math>5 \cdot 5 \cdot 5 \cdot 5</math> which is <math>-625</math>. Students should be exposed to all three representations.</li><li>An algebraic expression is an expression that contains variables and numbers.</li><li>Algebraic expressions are evaluated by substituting numbers for variables and applying the order of operations to simplify the resulting numeric expression.</li></ul>	

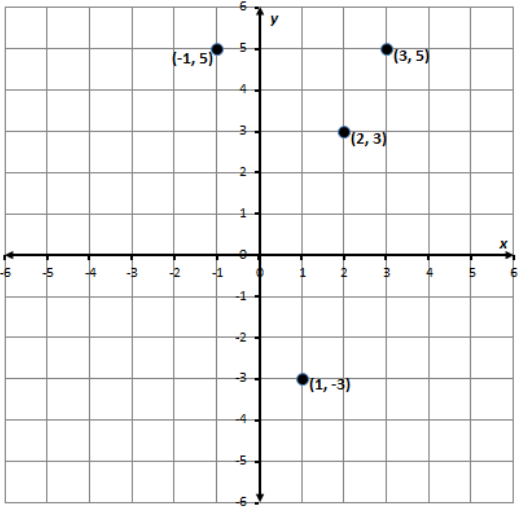
- 8.15 The student will**
- determine whether a given relation is a function; and**
  - determine the domain and range of a function.**

Understanding the Standard	Essential Knowledge and Skills																				
<ul style="list-style-type: none"> <li>A relation is any set of ordered pairs. For each first member, there may be many second members.</li> <li>A function is a relation between a set of inputs, called the domain, and a set of outputs, called the range, with the property that each input is related to exactly one output.</li> <li>As a table of values, a function has a unique value assigned to the second variable for each value of the first variable. In the “not a function” example, the input value “1” has two different output values, 5 and <math>-3</math>, assigned to it, so the example is not a function.</li> </ul> <div style="display: flex; justify-content: space-around; align-items: flex-start; margin: 10px 0;"> <div style="text-align: center;"> <p>function</p> <table border="1" style="border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 2px 5px;"><math>x</math></th> <th style="padding: 2px 5px;"><math>y</math></th> </tr> </thead> <tbody> <tr><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">3</td></tr> <tr><td style="padding: 2px 5px;">1</td><td style="padding: 2px 5px;">5</td></tr> <tr><td style="padding: 2px 5px;">0</td><td style="padding: 2px 5px;">3</td></tr> <tr><td style="padding: 2px 5px;">-1</td><td style="padding: 2px 5px;">-3</td></tr> </tbody> </table> </div> <div style="text-align: center;"> <p>not a function</p> <table border="1" style="border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 2px 5px;"><math>x</math></th> <th style="padding: 2px 5px;"><math>y</math></th> </tr> </thead> <tbody> <tr><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">3</td></tr> <tr style="background-color: #e0f0e0;"><td style="padding: 2px 5px;">1</td><td style="padding: 2px 5px;">5</td></tr> <tr><td style="padding: 2px 5px;">0</td><td style="padding: 2px 5px;">4</td></tr> <tr style="background-color: #e0f0e0;"><td style="padding: 2px 5px;">1</td><td style="padding: 2px 5px;">-3</td></tr> </tbody> </table> </div> </div> <ul style="list-style-type: none"> <li>As a set of ordered pairs, a function has a unique or different <math>y</math>-value assigned to each <math>x</math>-value. For example, the set of ordered pairs, <math>\{(1, 2), (2, 4), (3, 2), (4, 8)\}</math> is a function. This set of ordered pairs, <math>\{(1, 2), (2, 4), (3, 2), (2, 3)\}</math>, is not a function because the <math>x</math>-value of “2” has two different <math>y</math>-values.</li> <li>As a graph of discrete points, a relation is a function when, for any value of <math>x</math>, a vertical line passes through no more than one point on the graph.</li> <li>Some relations are functions; all functions are relations.</li> <li>Graphs of functions can be discrete or continuous.</li> <li>In a discrete function graph there are separate, distinct points. You would not use a line to connect these points on a graph. The points between the plotted points have no meaning and cannot be interpreted. For example, the number of pets per household represents a discrete function because you cannot have a fraction of a pet.</li> <li>Functions may be represented as ordered pairs, tables, graphs, equations, physical models, or in words. Any given relationship can be represented using multiple representations.</li> </ul>	$x$	$y$	2	3	1	5	0	3	-1	-3	$x$	$y$	2	3	1	5	0	4	1	-3	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Determine whether a relation, represented by a set of ordered pairs, a table, or a graph of discrete points is a function. Sets are limited to no more than 10 ordered pairs. (a)</li> <li>Identify the domain and range of a function represented as a set of ordered pairs, a table, or a graph of discrete points. (b)</li> </ul>
$x$	$y$																				
2	3																				
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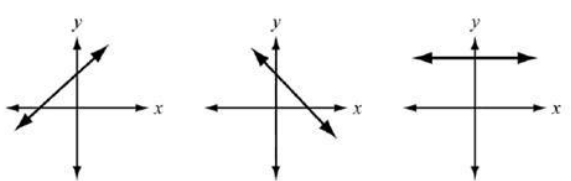
- 8.15 The student will**
- determine whether a given relation is a function; and**
  - determine the domain and range of a function.**

Understanding the Standard	Essential Knowledge and Skills										
<ul style="list-style-type: none"> <li>A discussion about determining whether a continuous graph of a relation is a function using the vertical line test may occur in grade eight, but will be explored further in Algebra I.</li> </ul> <div style="text-align: center;">  <p>domain → function → range</p> </div> <ul style="list-style-type: none"> <li>The domain is the set of all the input values for the independent variable or <math>x</math>-values (first number in an ordered pair).</li> <li>The range is the set of all the output values for the dependent variable or <math>y</math>-values (second number in an ordered pair)</li> <li>If a function is comprised of a discrete set of ordered pairs, then the domain is the set of all the <math>x</math>-coordinates, and the range is the set of all the <math>y</math>-coordinates. These sets of values can be determined given different representations of the function. <ul style="list-style-type: none"> <li>Example: The domain of a function is <math>\{-1, 1, 2, 3\}</math> and the range is <math>\{-3, 3, 5\}</math>. The following are representations of this function: <ul style="list-style-type: none"> <li>The function represented as a table of values: <table border="1" data-bbox="411 1049 573 1281"> <thead> <tr> <th><math>x</math></th> <th><math>y</math></th> </tr> </thead> <tbody> <tr> <td>-1</td> <td>5</td> </tr> <tr> <td>1</td> <td>-3</td> </tr> <tr> <td>2</td> <td>3</td> </tr> <tr> <td>3</td> <td>5</td> </tr> </tbody> </table> </li> <li>The function represented as a set of ordered pairs: <math>\{(-1, 5), (1, -3), (2, 3), (3, 5)\}</math></li> </ul> </li> </ul> </li> </ul>	$x$	$y$	-1	5	1	-3	2	3	3	5	
$x$	$y$										
-1	5										
1	-3										
2	3										
3	5										

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Understanding the Standard	Essential Knowledge and Skills
<p data-bbox="191 435 877 464">○ The function represented as a graph on a coordinate plane:</p>  <p data-bbox="243 496 758 1000">A coordinate plane with x and y axes ranging from -6 to 6. Four points are plotted: (-1, 5), (2, 3), (3, 5), and (1, -3). Each point is labeled with its coordinates.</p>	

- 8.16 The student will**
- recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
  - identify the slope and  $y$ -intercept of a linear function given a table of values, a graph, or an equation in  $y = mx + b$  form;
  - determine the independent and dependent variable, given a practical situation modeled by a linear function;
  - graph a linear function given the equation in  $y = mx + b$  form; and
  - make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>A linear function is an equation in two variables whose graph is a straight line, a type of continuous function.</li> <li>A linear function represents a situation with a constant rate. For example, when driving at a rate of 35 mph, the distance increases as the time increases, but the rate of speed remains the same.</li> <li>Slope (<math>m</math>) represents the rate of change in a linear function or the “steepness” of the line. The slope of a line is a rate of change, a ratio describing the vertical change to the horizontal change.           <math display="block">\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{\text{vertical change}}{\text{horizontal change}}</math> </li> <li>A line is increasing if it rises from left to right. The slope is positive (i.e., <math>m &gt; 0</math>).</li> <li>A line is decreasing if it falls from left to right. The slope is negative (i.e., <math>m &lt; 0</math>).</li> <li>A horizontal line has zero slope (i.e., <math>m = 0</math>).</li> </ul> <div style="text-align: center;">  <p>The image shows three separate coordinate systems, each with a horizontal x-axis and a vertical y-axis. The first system shows a line with a positive slope, slanting upwards from left to right. The second system shows a line with a negative slope, slanting downwards from left to right. The third system shows a horizontal line, representing a slope of zero.</p> </div> <ul style="list-style-type: none"> <li>A discussion about lines with undefined slope (vertical lines) should occur with students in grade eight mathematics to compare undefined slope to lines with a defined slope. Further exploration of this concept will occur in Algebra I.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>Recognize and describe a line with a slope that is positive, negative, or zero (0). (a)</li> <li>Given a table of values for a linear function, identify the slope and <math>y</math>-intercept. The table will include the coordinate of the <math>y</math>-intercept. (b)</li> <li>Given a linear function in the form <math>y = mx + b</math>, identify the slope and <math>y</math>-intercept. (b)</li> <li>Given the graph of a linear function, identify the slope and <math>y</math>-intercept. The value of the <math>y</math>-intercept will be limited to integers. The coordinates of the ordered pairs shown in the graph will be limited to integers. (b)</li> <li>Identify the dependent and independent variable, given a practical situation modeled by a linear function. (c)</li> <li>Given the equation of a linear function in the form <math>y = mx + b</math>, graph the function. The value of the <math>y</math>-intercept will be limited to integers. (d)</li> <li>Write the equation of a linear function in the form <math>y = mx + b</math> given values for the slope, <math>m</math>, and the <math>y</math>-intercept or given a practical situation in which the slope, <math>m</math>, and <math>y</math>-intercept are described verbally.(e)</li> </ul>

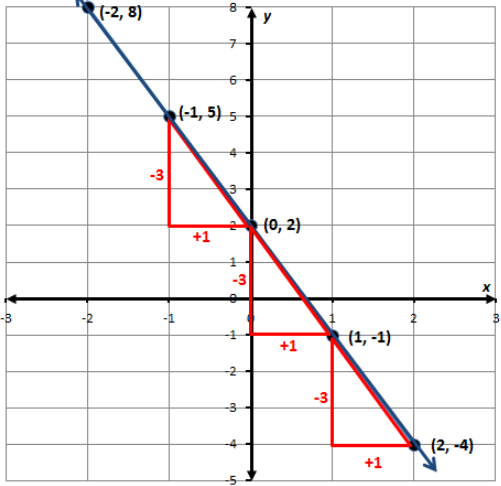
## 8.16 The student will

- recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
- identify the slope and  $y$ -intercept of a linear function given a table of values, a graph, or an equation in  $y = mx + b$  form;
- determine the independent and dependent variable, given a practical situation modeled by a linear function;
- graph a linear function given the equation in  $y = mx + b$  form; and
- make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.

Understanding the Standard	Essential Knowledge and Skills												
<ul style="list-style-type: none"> <li>A linear function can be written in the form <math>y = mx + b</math>, where <math>m</math> represents the slope or rate of change in <math>y</math> compared to <math>x</math>, and <math>b</math> represents the <math>y</math>-intercept of the graph of the linear function. The <math>y</math>-intercept is the point at which the graph of the function intersects the <math>y</math>-axis and may be given as a single value, <math>b</math>, or as the location of a point <math>(0, b)</math>.           <ul style="list-style-type: none"> <li>Example: Given the equation of the linear function <math>y = -3x + 2</math>, the slope is <math>-3</math> or <math>\frac{-3}{1}</math> and the <math>y</math>-intercept is <math>2</math> or <math>(0, 2)</math>.</li> <li>Example: The table of values represents a linear function. In the table, the point <math>(0, 2)</math> represents the <math>y</math>-intercept. The slope is determined by observing the change in each <math>y</math>-value compared to the corresponding change in the <math>x</math>-value.               <div style="text-align: center; margin: 10px 0;"> <table border="1" style="border-collapse: collapse; margin: auto;"> <thead> <tr> <th style="padding: 5px;"><math>x</math></th> <th style="padding: 5px;"><math>y</math></th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">-2</td> <td style="padding: 5px;">8</td> </tr> <tr> <td style="padding: 5px;">-1</td> <td style="padding: 5px;">5</td> </tr> <tr> <td style="padding: 5px;">0</td> <td style="padding: 5px;">2</td> </tr> <tr> <td style="padding: 5px;">1</td> <td style="padding: 5px;">-1</td> </tr> <tr> <td style="padding: 5px;">2</td> <td style="padding: 5px;">-4</td> </tr> </tbody> </table> <p style="text-align: center; margin-top: 5px;"> <math>\left. \begin{array}{l} +1 \\ +1 \\ +1 \\ +1 \end{array} \right\} -3</math> </p> </div> </li> </ul> </li> </ul> <p style="margin-left: 20px;"> <math display="block">\text{slope} = m = \frac{\text{change in } y\text{-value}}{\text{change in } x\text{-value}} = \frac{-3}{+1} = -3</math> </p> <ul style="list-style-type: none"> <li>The slope, <math>m</math>, and <math>y</math>-intercept of a linear function can be determined given the graph of the function.</li> </ul>	$x$	$y$	-2	8	-1	5	0	2	1	-1	2	-4	<ul style="list-style-type: none"> <li>Make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs. (e).</li> </ul>
$x$	$y$												
-2	8												
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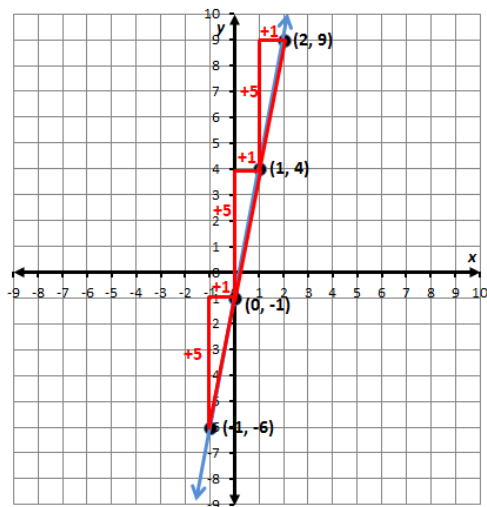
Understanding the Standard	Essential Knowledge and Skills
<p>– Example: Given the graph of the linear function, determine the slope and <math>y</math>-intercept.</p>  <p>Given the graph of a linear function, the <math>y</math>-intercept is found by determining where the line intersects the <math>y</math>-axis. The <math>y</math>-intercept would be 2 or located at the point <math>(0, 2)</math>. The slope can be found by determining the change in each <math>y</math>-value compared to the change in each <math>x</math>-value. Here, we could use slope triangles to help visualize this:</p> $\text{slope} = m = \frac{\text{change in } y\text{-value}}{\text{change in } x\text{-value}} = \frac{-3}{+1} = -3$ <ul style="list-style-type: none"> <li>Graphing a linear function given an equation can be addressed using different methods. One method involves determining a table of ordered pairs by substituting into the equation values for one variable and solving for the other variable, plotting the ordered pairs in the coordinate plane, and connecting the points to form a straight line. Another method involves using slope triangles to</li> </ul>	

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Understanding the Standard	Essential Knowledge and Skills															
<p>determine points on the line.</p> <p>– Example: Graph the linear function whose equation is <math>y = 5x - 1</math>. In order to graph the linear function, we can create a table of values by substituting arbitrary values for <math>x</math> to determining coordinating values for <math>y</math>:</p> <table border="1" data-bbox="552 719 814 906"> <thead> <tr> <th><math>x</math></th> <th><math>5x - 1</math></th> <th><math>y</math></th> </tr> </thead> <tbody> <tr> <td>-1</td> <td><math>5(-1) - 1</math></td> <td>-6</td> </tr> <tr> <td>0</td> <td><math>5(0) - 1</math></td> <td>-1</td> </tr> <tr> <td>1</td> <td><math>5(1) - 1</math></td> <td>4</td> </tr> <tr> <td>2</td> <td><math>5(2) - 1</math></td> <td>9</td> </tr> </tbody> </table> <p>The values can then be plotted as points on a graph.</p> <p>Knowing the equation of a linear function written in <math>y = mx + b</math> provides information about the slope and <math>y</math>-intercept of the function. If the equation is <math>y = 5x - 1</math>, then the slope, <math>m</math>, of the line is 5 or <math>\frac{5}{1}</math> and the <math>y</math>-intercept is <math>-1</math> and can be located at the point <math>(0, -1)</math>. We can graph the line by first plotting the <math>y</math>-intercept. We also know,</p> $\text{slope} = m = \frac{\text{change in } y\text{-value}}{\text{change in } x\text{-value}} = \frac{+5}{+1}$ <p>Other points can be plotted on the graph using the relationship between the <math>y</math> and <math>x</math> values.</p> <p>Slope triangles can be used to help locate the other points as shown in the graph below:</p>	$x$	$5x - 1$	$y$	-1	$5(-1) - 1$	-6	0	$5(0) - 1$	-1	1	$5(1) - 1$	4	2	$5(2) - 1$	9	
$x$	$5x - 1$	$y$														
-1	$5(-1) - 1$	-6														
0	$5(0) - 1$	-1														
1	$5(1) - 1$	4														
2	$5(2) - 1$	9														

- 8.16 The student will
- recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
  - identify the slope and  $y$ -intercept of a linear function given a table of values, a graph, or an equation in  $y = mx + b$  form;
  - determine the independent and dependent variable, given a practical situation modeled by a linear function;
  - graph a linear function given the equation in  $y = mx + b$  form; and
  - make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.

## Understanding the Standard



- A table of values can be used in conjunction with using slope triangles to verify the graph of a linear function. The  $y$ -intercept is located on the  $y$ -axis which is where the  $x$ -coordinate is 0. The change in each  $y$ -value compared to the corresponding  $x$ -value can be verified by the patterns in the table of values.

	$x$	$y$	
+1	-1	-6	+5
+1	0	-1	+5
+1	1	4	+5
+1	2	9	+5

## Essential Knowledge and Skills

## 8.16 The student will

- a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
- b) identify the slope and  $y$ -intercept of a linear function given a table of values, a graph, or an equation in  $y = mx + b$  form;
- c) determine the independent and dependent variable, given a practical situation modeled by a linear function;
- d) graph a linear function given the equation in  $y = mx + b$  form; and
- e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.

Understanding the Standard	Essential Knowledge and Skills										
<ul style="list-style-type: none"> <li>• The axes of a coordinate plane are generally labeled <math>x</math> and <math>y</math>; however, any letters may be used that are appropriate for the function.</li> <li>• A function has values that represent the input (<math>x</math>) and values that represent the output (<math>y</math>). The independent variable is the input value.</li> <li>• The dependent variable depends on the independent variable and is the output value.</li> <li>• Below is a table of values for finding the approximate circumference of circles, <math>C = \pi d</math>, where the value of <math>\pi</math> is approximated as 3.14. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Diameter</th> <th style="text-align: center;">Circumference</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1 in.</td> <td style="text-align: center;">3.14 in.</td> </tr> <tr> <td style="text-align: center;">2 in.</td> <td style="text-align: center;">6.28 in.</td> </tr> <tr> <td style="text-align: center;">3 in.</td> <td style="text-align: center;">9.42 in.</td> </tr> <tr> <td style="text-align: center;">4 in.</td> <td style="text-align: center;">12.56 in.</td> </tr> </tbody> </table> </li> </ul> <ul style="list-style-type: none"> <li>– The independent variable, or input, is the diameter of the circle. The values for the diameter make up the domain.</li> <li>– The dependent variable, or output, is the circumference of the circle. The set of values for the circumference makes up the range.</li> </ul> <ul style="list-style-type: none"> <li>• In a graph of a continuous function every point in the domain can be interpreted. Therefore, it is possible to connect the points on the graph with a continuous line because every point on the line answers the original question being asked.</li> <li>• The context of a problem may determine whether it is appropriate for ordered pairs representing a linear relationship to be connected by a straight line. If the independent variable (<math>x</math>) represents a discrete quantity (e.g., number of people, number of tickets, etc.) then it is not appropriate to connect the ordered pairs with a straight line when graphing. If the independent variable (<math>x</math>)</li> </ul>	Diameter	Circumference	1 in.	3.14 in.	2 in.	6.28 in.	3 in.	9.42 in.	4 in.	12.56 in.	
Diameter	Circumference										
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- 8.16 The student will**
- recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;**
  - identify the slope and  $y$ -intercept of a linear function given a table of values, a graph, or an equation in  $y = mx + b$  form;**
  - determine the independent and dependent variable, given a practical situation modeled by a linear function;**
  - graph a linear function given the equation in  $y = mx + b$  form; and**
  - make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.**

Understanding the Standard	Essential Knowledge and Skills
<p>represents a continuous quantity (e.g., amount of time, temperature, etc.), then it is appropriate to connect the ordered pairs with a straight line when graphing.</p> <ul style="list-style-type: none"> <li>– Example: The function <math>y = 7x</math> represents the cost in dollars (<math>y</math>) for <math>x</math> tickets to an event. The domain of this function would be discrete and would be represented by discrete points on a graph. Not all values for <math>x</math> could be represented and connecting the points would not be appropriate.</li> <li>– Example: The function <math>y = -2.5x + 20</math> represents the number of gallons of water (<math>y</math>) remaining in a 20-gallon tank being drained for <math>x</math> number of minutes. The domain in this function would be continuous. There would be an <math>x</math>-value representing any point in time until the tank is drained so connecting the points to form a straight line would be appropriate (Note: the context of the problem limits the values that <math>x</math> can represent to positive values, since time cannot be negative.).</li> </ul> <ul style="list-style-type: none"> <li>• Functions can be represented as ordered pairs, tables, graphs, equations, physical models, or in words. Any given relationship can be represented using multiple representations.</li> <li>• The equation <math>y = mx + b</math> defines a linear function whose graph (solution) is a straight line. The equation of a linear function can be determined given the slope, <math>m</math>, and the <math>y</math>-intercept, <math>b</math>. Verbal descriptions of practical situations that can be modeled by a linear function can also be represented using an equation. <ul style="list-style-type: none"> <li>– Example: Write the equation of a linear function whose slope is <math>\frac{3}{4}</math> and <math>y</math>-intercept is <math>-4</math>, or located at the point <math>(0, -4)</math>.</li> </ul> <p>The equation of this line can be found by substituting the values for the slope, <math>m = \frac{3}{4}</math>, and the <math>y</math>-intercept, <math>b = -4</math>, into the general form of a linear function <math>y = mx + b</math>. Thus, the equation would be <math>y = \frac{3}{4}x - 4</math>.</p> </li> </ul>	

## 8.16 The student will

- a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
- b) identify the slope and  $y$ -intercept of a linear function given a table of values, a graph, or an equation in  $y = mx + b$  form;
- c) determine the independent and dependent variable, given a practical situation modeled by a linear function;
- d) graph a linear function given the equation in  $y = mx + b$  form; and
- e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.

Understanding the Standard	Essential Knowledge and Skills
<p>– Example: John charges a \$30 flat fee to trouble shoot a personal watercraft that is not working properly and \$50 per hour needed for any repairs. Write a linear function that represents the total cost, <math>y</math> of a personal watercraft repair, based on the number of hours, <math>x</math>, needed to repair it. Assume that there is no additional charge for parts.</p> <p>In this practical situation, the <math>y</math>-intercept, <math>b</math>, would be \$30, to represent the initial flat fee to trouble shoot the watercraft. The slope, <math>m</math>, would be \$50, since that would represent the rate per hour. The equation to represent this situation would be <math>y = 50x + 30</math>.</p> <ul style="list-style-type: none"> <li>• A proportional relationship between two variables can be represented by a linear function <math>y = mx</math> that passes through the point <math>(0, 0)</math> and thus has a <math>y</math>-intercept of 0. The variable <math>y</math> results from <math>x</math> being multiplied by <math>m</math>, the rate of change or slope.</li> <li>• The linear function <math>y = x + b</math> represents a linear function that is a non-proportional additive relationship. The variable <math>y</math> results from the value <math>b</math> being added to <math>x</math>. In this linear relationship, there is a <math>y</math>-intercept of <math>b</math>, and the constant rate of change or slope would be 1. In a linear function with a slope other than 1, there is a coefficient in front of the <math>x</math> term, which represents the constant rate of change, or slope.</li> <li>• Proportional relationships and additive relationships between two quantities are special cases of linear functions that are discussed in grade seven mathematics.</li> </ul>	

- 8.17 The student will solve multistep linear equations in one variable with the variable on one or both sides of the equation, including practical problems that require the solution of a multistep linear equation in one variable.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• A multistep equation may include, but not be limited to equations such as the following:  <math>2x + 1 = \frac{-x}{4}</math>; <math>-3(2x + 7) = \frac{1}{2}x</math>; <math>2x + 7 - 5x = 27</math>; <math>-5x - (x + 3) = -12</math>.</li> <li>• An expression is a representation of quantity. It may contain numbers, variables, and/or operation symbols. It does not have an “equal sign (=)” (e.g., <math>\frac{3}{4}</math>, <math>5x</math>, <math>140 - 38.2</math>, <math>18 \cdot 21</math>, <math>5 + x</math>.)</li> <li>• An expression that contains a variable is a variable expression. A variable expression is like a phrase: as a phrase does not have a verb, so an expression does not have an “equal sign (=)”. An expression cannot be solved.</li> <li>• A verbal expression can be represented by a variable expression. Numbers are used when they are known; variables are used when the numbers are unknown. For example, the verbal expression “a number multiplied by five” could be represented by the variable expression “<math>n \cdot 5</math>” or “<math>5n</math>”.</li> <li>• An algebraic expression is a variable expression that contains at least one variable (e.g., <math>2x - 3</math>).</li> <li>• A verbal sentence is a complete word statement (e.g., “The sum of two consecutive integers is thirty-five.” could be represented by “<math>n + (n + 1) = 35</math>”).</li> <li>• An algebraic equation is a mathematical statement that says that two expressions are equal (e.g., <math>2x + 3 = -4x + 1</math>).</li> <li>• In an equation, the “equal sign (=)” indicates that the value of the expression on the left is equivalent to the value of the expression on the right.</li> <li>• Like terms are terms that have the same variables and exponents. The coefficients do not need to match (e.g., <math>12x</math> and <math>-5x</math>; <math>45</math> and <math>-5\frac{2}{3}</math>; <math>9y</math>, <math>-51y</math> and <math>\frac{4}{9}y</math>.)</li> <li>• Like terms may be added or subtracted using the distributive and other properties. For example, <ul style="list-style-type: none"> <li>– <math>4.6y - 5y = (-4.6 - 5)y = -9.6y</math></li> <li>– <math>w + w - 2w = (1 + 1)w - 2w = 2w - 2w = (2 - 2)w = 0 \cdot w = 0</math></li> </ul> </li> <li>• Real-world problems can be interpreted, represented, and solved using linear equations in one variable.</li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Represent and solve multistep linear equations in one variable with the variable on one or both sides of the equation (up to four steps) using a variety of concrete materials and pictorial representations.</li> <li>• Apply properties of real numbers and properties of equality to solve multistep linear equations in one variable (up to four steps). Coefficients and numeric terms will be rational. Equations may contain expressions that need to be expanded (using the distributive property) or require collecting like terms to solve.</li> <li>• Write verbal expressions and sentences as algebraic expressions and equations.</li> <li>• Write algebraic expressions and equations as verbal expressions and sentences.</li> <li>• Solve practical problems that require the solution of a multistep linear equation.</li> <li>• Confirm algebraic solutions to linear equations in one variable.</li> </ul>

- 8.17 The student will solve multistep linear equations in one variable with the variable on one or both sides of the equation, including practical problems that require the solution of a multistep linear equation in one variable.**

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• Properties of real numbers and properties of equality can be used to solve equations, justify solutions and express simplification. Students should use the following properties, where appropriate, to further develop flexibility and fluency in problem solving (limitations may exist for the values of <math>a</math>, <math>b</math>, or <math>c</math> in this standard):               <ul style="list-style-type: none"> <li>– Commutative property of addition: <math>a + b = b + a</math>.</li> <li>– Commutative property of multiplication: <math>a \cdot b = b \cdot a</math>.</li> <li>– Associative property of addition: <math>(a + b) + c = a + (b + c)</math>.</li> <li>– Associative property of multiplication: <math>(a \cdot b) \cdot c = a \cdot (b \cdot c)</math>.</li> <li>– Subtraction and division are neither commutative nor associative.</li> <li>– Distributive property (over addition/subtraction): <math>a \cdot (b + c) = a \cdot b + a \cdot c</math> and <math>a \cdot (b - c) = a \cdot b - a \cdot c</math>.</li> <li>– The additive identity is zero (0) because any number added to zero is the number. The multiplicative identity is one (1) because any number multiplied by one is the number. There are no identity elements for subtraction and division.</li> <li>– Identity property of addition (additive identity property): <math>a + 0 = a</math> and <math>0 + a = a</math>.</li> <li>– Identity property of multiplication (multiplicative identity property): <math>a \cdot 1 = a</math> and <math>1 \cdot a = a</math>.</li> <li>– Inverses are numbers that combine with other numbers and result in identity elements (e.g., <math>5 + (-5) = 0</math>; <math>\frac{1}{5} \cdot 5 = 1</math>).</li> <li>– Inverse property of addition (additive inverse property): <math>a + (-a) = 0</math> and <math>(-a) + a = 0</math>.</li> <li>– Inverse property of multiplication (multiplicative inverse property): <math>a \cdot \frac{1}{a} = 1</math> and <math>\frac{1}{a} \cdot a = 1</math>.</li> <li>– Zero has no multiplicative inverse.</li> <li>– Multiplicative property of zero: <math>a \cdot 0 = 0</math> and <math>0 \cdot a = 0</math>.</li> <li>– Division by zero is not a possible mathematical operation. It is undefined.</li> </ul> </li> </ul>	



- 8.17** The student will solve multistep linear equations in one variable with the variable on one or both sides of the equation, including practical problems that require the solution of a multistep linear equation in one variable.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"><li>- Substitution property: If <math>a = b</math>, then <math>b</math> can be substituted for <math>a</math> in any expression, equation, or inequality.</li><li>- Addition property of equality: If <math>a = b</math>, then <math>a + c = b + c</math>.</li><li>- Subtraction property of equality: If <math>a = b</math>, then <math>a - c = b - c</math>.</li><li>- Multiplication property of equality: If <math>a = b</math>, then <math>a \cdot c = b \cdot c</math>.</li><li>- Division property of equality: If <math>a = b</math> and <math>c \neq 0</math>, then <math>\frac{a}{c} = \frac{b}{c}</math>.</li></ul>	

- 8.18** The student will solve multistep linear inequalities in one variable with the variable on one or both sides of the inequality symbol, including practical problems, and graph the solution on a number line.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>• A multistep inequality may include, but not be limited to inequalities such as the following:  <math>2x + 1 &gt; \frac{-x}{4}</math>; <math>-3(2x + 7) \leq \frac{1}{2}x</math>; <math>2x + 7 - 5x &lt; 27</math>; <math>-5x - (x + 3) &gt; -12</math>.</li> <li>• When both expressions of an inequality are multiplied or divided by a negative number, the inequality sign reverses.</li> <li>• A solution to an inequality is the value or set of values that can be substituted to make the inequality true.</li> <li>• In an inequality, there can be more than one value for the variable that makes the inequality true. There can be many solutions. (i.e., <math>x + 4 &gt; -3</math> then the solutions is <math>x &gt; -7</math>. This means that <math>x</math> can be any number greater than <math>-7</math>. A few solutions might be <math>-6.5, -3, 0, 4, 25</math>, etc.)</li> <li>• Real-world problems can be modeled and solved using linear inequalities.</li> <li>• The properties of real numbers and properties of inequality can be used to solve inequalities, justify solutions, and express simplification. Students should use the following properties, where appropriate, to further develop flexibility and fluency in problem solving (limitations may exist for the values of <math>a, b</math>, or <math>c</math> in this standard). <ul style="list-style-type: none"> <li>– Commutative property of addition: <math>a + b = b + a</math>.</li> <li>– Commutative property of multiplication: <math>a \cdot b = b \cdot a</math>.</li> <li>– Associative property of addition: <math>(a + b) + c = a + (b + c)</math>.</li> <li>– Associative property of multiplication: <math>(a \cdot b) \cdot c = a \cdot (b \cdot c)</math>.</li> <li>– Subtraction and division are neither commutative nor associative.</li> <li>– Distributive property (over addition/subtraction): <math>a \cdot (b + c) = a \cdot b + a \cdot c</math> and <math>a \cdot (b - c) = a \cdot b - a \cdot c</math>.</li> <li>– The additive identity is zero (0) because any number added to zero is the number. The multiplicative identity is one (1) because any number multiplied by one is the number. There are no identity elements for subtraction and division.</li> <li>– Identity property of addition (additive identity property): <math>a + 0 = a</math> and <math>0 + a = a</math>.</li> </ul> </li> </ul>	<p><b>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</b></p> <ul style="list-style-type: none"> <li>• Apply properties of real numbers and properties of inequality to solve multistep linear inequalities (up to four steps) in one variable with the variable on one or both sides of the inequality. Coefficients and numeric terms will be rational. Inequalities may contain expressions that need to be expanded (using the distributive property) or require collecting like terms to solve.</li> <li>• Graph solutions to multistep linear inequalities on a number line.</li> <li>• Write verbal expressions and sentences as algebraic expressions and inequalities.</li> <li>• Write algebraic expressions and inequalities as verbal expressions and sentences.</li> <li>• Solve practical problems that require the solution of a multistep linear inequality in one variable.</li> <li>• Identify a numerical value(s) that is part of the solution set of a given inequality.</li> </ul>

- 8.18** The student will solve multistep linear inequalities in one variable with the variable on one or both sides of the inequality symbol, including practical problems, and graph the solution on a number line.

Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> <li>- Identity property of multiplication (multiplicative identity property): <math>a \cdot 1 = a</math> and <math>1 \cdot a = a</math>.</li> <li>- Inverses are numbers that combine with other numbers and result in identity elements (e.g., <math>5 + (-5) = 0</math>; <math>\frac{1}{5} \cdot 5 = 1</math>).</li> <li>- Inverse property of addition (additive inverse property): <math>a + (-a) = 0</math> and <math>(-a) + a = 0</math>.</li> <li>- Inverse property of multiplication (multiplicative inverse property): <math>a \cdot \frac{1}{a} = 1</math> and <math>\frac{1}{a} \cdot a = 1</math>.</li> <li>- Zero has no multiplicative inverse.</li> <li>- Multiplicative property of zero: <math>a \cdot 0 = 0</math> and <math>0 \cdot a = 0</math>.</li> <li>- Division by zero is not a possible mathematical operation. It is undefined.</li> <li>- Substitution property: If <math>a = b</math>, then <math>b</math> can be substituted for <math>a</math> in any expression, equation, or inequality.</li> <li>- Addition property of inequality: If <math>a &lt; b</math>, then <math>a + c &lt; b + c</math>; if <math>a &gt; b</math>, then <math>a + c &gt; b + c</math>.</li> <li>- Subtraction property of inequality: If <math>a &lt; b</math>, then <math>a - c &lt; b - c</math>; if <math>a &gt; b</math>, then <math>a - c &gt; b - c</math>.</li> <li>- Multiplication property of inequality: If <math>a &lt; b</math> and <math>c &gt; 0</math>, then <math>a \cdot c &lt; b \cdot c</math>; if <math>a &gt; b</math> and <math>c &gt; 0</math>, then <math>a \cdot c &gt; b \cdot c</math>.</li> <li>- Multiplication property of inequality (multiplication by a negative number): If <math>a &lt; b</math> and <math>c &lt; 0</math>, then <math>a \cdot c &gt; b \cdot c</math>; if <math>a &gt; b</math> and <math>c &lt; 0</math>, then <math>a \cdot c &lt; b \cdot c</math>.</li> <li>- Division property of inequality: If <math>a &lt; b</math> and <math>c &gt; 0</math>, then <math>\frac{a}{c} &lt; \frac{b}{c}</math>; if <math>a &gt; b</math> and <math>c &gt; 0</math>, then <math>\frac{a}{c} &gt; \frac{b}{c}</math>.</li> <li>- Division property of inequality (division by a negative number): If <math>a &lt; b</math> and <math>c &lt; 0</math>, then <math>\frac{a}{c} &gt; \frac{b}{c}</math>; if <math>a &gt; b</math> and <math>c &lt; 0</math>, then <math>\frac{a}{c} &lt; \frac{b}{c}</math>.</li> </ul>	