Westmoreland County Public Schools
Pacing Guide and Checklist 2018-2019
Math 8

1st Quarter

Integer Review (2 days) (SOL 6.6)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
integer positive negative opposite set whole number sum difference product quotient division bar	**Big ideas:** Integers not only show a direct relationship to some starting point, but they also give description and meaning to the numbers that occur in everyday situations. Integers used in banking, sports, weather. Playing a video game, reviewing deposits or withdrawals in a checking account and even looking at weight. **6.6a** • How does the knowledge of zero pairs help when modeling operations with integers? • Under what circumstances will the sum or difference of integers result in a negative solution? • Under what circumstances will the product or quotient result in a negative solution? • What strategies are most useful in helping develop algorithms for adding, subtracting, multiplying, and dividing positive and negative numbers? • Will addition of integers ever result in a sum smaller than one or smaller than both of its addends? • Will subtraction of integers ever yield a difference greater than the minuend and/or subtrahend? • When will the sum of two integers be positive? Negative? Or zero? **6.6b** • What is a real world situation in which you have to add, subtract, multiply or divide both positive and negative integers? • How do you use integer operations to balance a checkbook or budget?	**2**	• Model addition, subtraction, multiplication, and division of integers using pictorial representations or concrete manipulatives. **(No calculator)** • Add, subtract, multiply, and divide integers. **(No calculator)** • Solve practical problems involving addition, subtraction, multiplication, and division with integers. **(Calculator allowed)**

Perfect Squares/Square Roots (SOL 8.3) (4 Days)

		# of	

Vocabulary	Big Ideas/VDOE Lesson Plans	Days	Essential Knowledge & Skills
perfect square square root opposite consecutive between integer whole estimation area length	**Big ideas:** Being able to calculate a square root is helpful when computing distances, finding the length of a side of a square room, creating a rectangular object, web design, electrical work, carpentry, and so much more. **8.3a** • How is estimating square roots used in the real world? • What is the difference between the meaning of "between two integers" and "between two consecutive integers"? **8.3b** • How is a square root different from the square of a number? **VDOE Lesson Plans**	**4**	• Identify the perfect squares from 0 to 400. **(Review) (SOL 7.1)** • 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. • Determine the positive or negative square root of a given perfect square from 1 to 400.

Understanding the Standard

- A perfect square is a whole number whose square root is an integer.
- The square root of a given number is any number which, when multiplied times itself, equals the given number.
- 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.
- The positive and negative square root of any whole number other than a perfect square lies between two consecutive integers (e.g.,$\sqrt{57}$ lies between 7 and 8 since $7^2 = 49$ and $8^2 = 64$; $-\sqrt{11}$ lies between -4 and -3 since $(-4)^2 = 16$ and $(-3)^2 = 9$).
- The symbol $\sqrt{}$ may be used to represent a positive (principal) root and $-\sqrt{}$ may be used to represent a negative root.
- The square root of a whole number that is not a perfect square is an irrational number (e.g., $\sqrt{2}$ is an irrational number). An irrational number cannot be expressed exactly as a fraction $\frac{a}{b}$ where b does not equal 0.
- Square root symbols may be used to represent solutions to equations of the form $x^2 = p$. Examples may include:
  - If $x^2 = 36$, then x is $\sqrt{36} = 6$ or $-\sqrt{36} = -6$.
  - If $x^2 = 5$, then x is $\sqrt{5}$ or $-\sqrt{5}$.
- 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.

Real Number System (SOL 8.2) (5 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
real numbers rational irrational	**Big ideas:** The set of real numbers is infinite, and each real number can be associated with a unique point on the number line. Real numbers are used in everyday life to be specific about a quantity.	**5**	• 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.

integers whole natural subset(s) opposites terminating non-terminating repeating non-repeating decimals fractions	• What does it mean for one thing to be a subset of another? • What do you know about the sum and /or product of two rational numbers? • What do you know about the sum and/or product of a rational and an irrational number? • What are examples of subsets in the real world? • How can a number not have an exact value? • How do numbers in the real number system relate to one another? • How are real numbers classified? **VDOE Lesson Plans**		• Classify a given number as a member of a particular subset or subsets of the real number system, and explain why. • Describe each subset of the set of real numbers and include examples and non-examples. • 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.

Understanding the Standard

- The subsets of real numbers include natural numbers (counting numbers), whole numbers, integers, rational and irrational numbers.
- 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.
- The set of natural numbers is the set of counting numbers {1, 2, 3, 4...}.
- The set of whole numbers includes the set of all the natural numbers and zero {0, 1, 2, 3…}.
- 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.
- The set of rational numbers includes the set of all numbers that can be expressed as fractions in the form $\frac{a}{b}$ where *a* and *b* are integers and *b* 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 $\sqrt{25}, \frac{1}{4}$, −2.3, 75%, and $4.\overline{59}$.
- The set of irrational numbers is the set of all nonrepeating, nonterminating decimals. An irrational number cannot be written in fraction form (e.g., π, $\sqrt{2}$, 1.232332333…).
- The real number system is comprised of all rational and irrational numbers.

Compare/Order Real Numbers (SOL 8.1) (5 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
compare order real numbers fractions proper improper mixed numbers	**Big ideas:** Any number can be represented in multiple ways (fractions, decimals, percents, powers). You can make everyday activities easier by knowing which representation works best. Knowing the relative size of a number is useful when estimating and figuring out problems in the real world. • What are some real world examples where there is a need to	**5**	• 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 π. Radicals may include both positive and negative square roots of values from 0 to 400. Ordering may be in ascending or descending order. • Use rational approximations (to the nearest hundredth) of irrational

scientific notation square roots radicals percent ascending descending rational irrational terminating and repeating decimals power of 10 exponent undefined	compare and/or order rational numbers? • How can different forms of rational numbers represent the same value? • How would life be different if we were not able to convert rational numbers to other types of rational numbers? • How can one determine whether a rational number is greater than, less than, or equal to another number? • How do decimals and percents relate to fractions? • How can I use a number line to compare and order irrational numbers? • How do you estimate the location of an irrational number on a number line? **VDOE Lesson Plans**		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.

Understanding the Standard

- Real numbers can be represented as integers, fractions (proper or improper), decimals, percents, numbers written in scientific notation, radicals, and π. It is often useful to convert numbers to be compared and/or ordered to one representation (e.g., fractions, decimals or percents).
- 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., $3\frac{5}{8}$). Fractions can have a positive or negative value.
- 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 *density property* but the concept allows for a deeper understanding of the set of real numbers.
- Scientific notation is used to represent very large or very small numbers.
- 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., $3.1 \times 10^5 = 310{,}000$ and $3.1 \times 10^{-5} = 0.000031$).
- 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.

Simplify/Evaluate Expressions (SOL 8.14) (5 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
orders of operations expressions evaluate algebraic expressions exponents	**Big ideas:** **8.14a** Algebraic expressions are used in everyday to make quick calculations in a variety of situations. Meteorologists have to convert between Fahrenheit and Celsius when communicating throughout the world. Banks must determine the amount of interest to charge on home loans. There are a variety of ways to evaluate an algebraic expression using properties of real numbers.	**5**	• 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. • Represent algebraic expressions using concrete materials and pictorial representations. Concrete materials may include colored chips or

replacement values variables grouping symbols parentheses brackets absolute value operation bases square root perfect square like terms coefficient quantity	**8.14b** Simplifying algebraic expressions are used to combine items that are the same thing. When ordering from a fast food restaurant, it is more efficient to order 3 chicken sandwiches, 4 burgers, 5 fries, 2 onion rings and 7 drinks vs. 1 chicken sandwich, 1 fry, 1 drink, 1 chicken sandwich, 1 onion ring, 1 drink, etc. **8.14a** • How is an algebraic expression different from a numerical expression? • Why do we need to follow the order of operations when simplifying expressions? **8.14b** • How can combining like terms help when simplifying an expression? • What are like terms? • How can understanding properties help when simplifying expressions? **VDOE Lesson plans**		algebra tiles. • 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.

Understanding the Standard

- 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., $\frac{3}{4}$, 5x, 140 - 38.2, -18 · 21, (5 + 2x) · 4). An expression cannot be solved.
- A numerical expression contains only numbers, the operations symbols, and grouping symbols.
- Expressions are simplified using the order of operations.
- Simplifying an algebraic expression means to write the expression as a more compact and equivalent expression. This usually involves combining like terms.
- Like terms are terms that have the same variables and exponents. The coefficients do not need to match (e.g., $12x$ and $-5x$; 45 and $-5\frac{2}{3}$; $9y$, $-51y$ and $\frac{4}{9}y$.)
- Like terms may be added or subtracted using the distributive and other properties. For example,
  - $2(x - \frac{1}{2}) + 5x = 2x - 1 + 5x = 2x + 5x - 1 = 7x - 1$
  - $w + w - 2w = (1 + 1)\,w - 2w = 2w - 2w = (2 - 2)\,w = 0$
    $w = 0$
- The order of operations is as follows:
  - First, complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols, do the innermost operation first.
  - Second, evaluate all exponential expressions.
  - Third, multiply and/or divide in order from left to right.
  - Fourth, add and/or subtract in order from left to right.

  * Parentheses ( ), brackets [ ], braces {}, absolute value | |

(i.e., $|3(-5+2)|-7$), and the division bar (i.e., $\frac{3+4}{5+6}$) should be treated as grouping symbols.

- 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 a, b, or c in this standard):

  - Commutative property of addition: $a+b=b+a$.
  - Commutative property of multiplication: $a \cdot b = b \cdot a$.
  - Associative property of addition: $(a+b)+c=a+(b+c)$.
  - Associative property of multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$.
  - Subtraction and division are neither commutative nor associative.
  - Distributive property (over addition/subtraction): $a \cdot (b+c) = a \cdot b + a \cdot c$ *and* $a \cdot (b-c) = a \cdot b - a \cdot c$.
  - 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.
  - Identity property of addition (additive identity property): $a+0=a$ *and* $0+a=a$.
  - Identity property of multiplication (multiplicative identity property): $a \cdot 1 = a$ *and* $1 \cdot a = a$.
  - Inverses are numbers that combine with other numbers and result in identity elements [e.g., 5 + (–5) = 0; $\frac{1}{5} \cdot 5 = 1$].
  - Inverse property of addition (additive inverse property): $a+(-a)=0$ *and* $(-a)+a=0$.
  - Inverse property of multiplication (multiplicative inverse property): $a \cdot \frac{1}{a} = 1$ *and* $\frac{1}{a} \cdot a = 1$.
  - Zero has no multiplicative inverse.
  - Multiplicative property of zero: $a \cdot 0 = 0$ *and* $0 \cdot a = 0$.
  - Division by zero is not a possible mathematical operation. It is undefined.
  - Substitution property: If $a=b$, then b can be substituted for a in any expression, equation, or inequality.

- A power of a number represents repeated multiplication of the number. For example, $(-5)^4$ means (–5) · (–5) · (–5) · (–5). 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, (–5) 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, -5^4 means 5 · 5 · 5 · 5 negated which results in a product of −625. The expression $-(5)^4$ means to take the opposite of 5 · 5 · 5 · 5 which is −625. Students should be exposed to all three representations.
- An algebraic expression is an expression that contains variables and numbers.
- Algebraic expressions are evaluated by substituting numbers for variables and applying the order of operations to simplify the resulting numeric expression.

Properties (Review) (SOL 8.17) (2 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills

<u>Properties of Real Numbers</u> commutative associative distributive identity inverse mult. of zero substitution **<u>Properties of Equality/Inequality</u>** addition subtraction multiplication division	**Big ideas:** 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 *a*, *b*, or *c* in this standard): – Commutative property of addition: $a + b = b + a$. – Commutative property of multiplication: $a \cdot b = b \cdot a$. – Associative property of addition: $(a + b) + c = a + (b + c)$. – Associative property of multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$. – Subtraction and division are neither commutative nor associative. – Distributive property (over addition/subtraction): $a \cdot (b + c) = a \cdot b + a \cdot c \; and$ $a \cdot (b - c) = a \cdot b - a \cdot c$. – 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. – Identity property of addition (additive identity property): $a + 0 = a \; and \; 0 + a = a$. – Identity property of multiplication (multiplicative identity property): $a \cdot 1 = a \; and \; 1 \cdot a = a$. – Inverses are numbers that combine with other numbers and result in identity elements (e.g., 5 + (–5) = 0; $\frac{1}{5} \cdot 5 = 1$). – Inverse property of addition (additive inverse property): $a + (-a) = 0 \; and \; (-a) + a = 0$. – Inverse property of multiplication (multiplicative inverse property): $a \cdot \frac{1}{a} = 1 \; and \; \frac{1}{a} \cdot a = 1$. – Zero has no multiplicative inverse. – Multiplicative property of zero: $a \cdot 0 = 0 \; and \; 0 \cdot a = 0$. – Division by zero is not a possible mathematical operation. It	**2**	• This is a review of the properties that will help assist you in the application of properties and the justification of each step used in solving equations/inequalities. • Emphasis is placed on the application of properties of real numbers and the properties if equality/inequality.

	is undefined. – Substitution property: If $a = b$, then b can be substituted for a in any expression, equation, or inequality. – Addition property of equality: If $a = b$, then $a + c = b + c$. – Subtraction property of equality: If $a = b$, then $a - c = b - c$. – Multiplication property of equality: If $a = b$, then $a \cdot c = b \cdot c$. – Division property of equality: If $a = b \; and \; c \neq 0$, – then $\frac{a}{c} = \frac{b}{c}$.		

Combining Like-Terms (Review) (SOL 8.17) (2 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
like terms equations expressions coefficients distributive	**Big ideas:** • Like terms are terms that have the same variables and exponents. The coefficients do not need to match (e.g., 12*x* and –5*x*; 45 and $-5\frac{2}{3}$; 9*y*, –51*y* and $\frac{4}{9}y$.) • Like terms may be added or subtracted using the distributive and other properties. For example, – 4.6*y* – 5*y* = (–4.6 – 5)*y* = –9.6*y* – *w* + *w* – 2*w* = (1 + 1)*w* – 2*w* = 2*w* – 2*w* = (2 – 2)*w* = 0·*w* = 0	**2**	• This is a mini-lesson on combining like terms that will assist with the simplification process while solving equations in the next unit. • Combining like terms is helpful when solving equations.

Multi-Step Equations (SOL 8.17) (11 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
equation variable coefficient numeric terms like terms solution expression multi-step linear **<u>Properties of Real Numbers</u>** commutative associative	**Big ideas:** Equations give us a precise way to represent many situations that arise in the world. As such, solving equations allows us to answer questions about those situations and sometimes even determine that there is no solution. These fundamental solving skills are built upon in all future mathematics courses to address an even wider variety of practical situations. There are a variety of ways to compute the value of a numerical expression and evaluate an algebraic expression. Often, a practical situation requires the input of various amounts in order to predict an outcome. • How can a model be used to represent an equation? • How can a model be used to solve an equation? • How can you check to see if your solution is correct?	**11**	• 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. • 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. • Solve practical problems that require the solution of a multistep linear equation. • Confirm algebraic solutions to linear equations in one variable.

distributive identity inverse mult. of zero substitution **<u>Properties of</u>** **<u>Equality/Inequality</u>** addition subtraction multiplication division	• How can a practical situation be represented by a multi-step equation? • How can understanding properties help when solving an equation? **VDOE Lesson Plans**		

Understanding the Standard

- A multistep equation may include, but not be limited to equations such as the following:
  $2x + 1 = \frac{-x}{4}$; $-3(2x + 7) = \frac{1}{2}x$; $2x + 7 - 5x = 27$; $-5x - (x + 3) = -12$.
- 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., $\frac{3}{4}$, $5x$, $140 - 38.2$, $18 \cdot 21$, $5 + x$.)
- 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.
- 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 "$n \cdot 5$" or "$5n$".
- An algebraic expression is a variable expression that contains at least one variable (e.g., $2x - 3$).
- A verbal sentence is a complete word statement (e.g., "The sum of two consecutive integers is thirty-five." could be represented by "$n + (n + 1) = 35$").
- An algebraic equation is a mathematical statement that says that two expressions are equal
  (e.g., $2x + 3 = -4x + 1$).
- 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.
- Like terms are terms that have the same variables and exponents. The coefficients do not need to match (e.g., $12x$ and $-5x$; 45 and $-5\frac{2}{3}$; $9y$, $-51y$ and $\frac{4}{9}y$.)
- Like terms may be added or subtracted using the distributive and other properties. For example,
  - $4.6y - 5y = (-4.6 - 5)y = -9.6y$
  - $w + w - 2w = (1 + 1)w - 2w = 2w - 2w = (2 - 2)w = 0 \cdot w = 0$
- Real-world problems can be interpreted, represented, and solved using linear equations in one variable.
- 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 a, b, or c in this standard):

- Commutative property of addition: $a + b = b + a$.
- Commutative property of multiplication: $a \cdot b = b \cdot a$.
- Associative property of addition: $(a + b) + c = a + (b + c)$.
- Associative property of multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$.
- Subtraction and division are neither commutative nor associative.
- Distributive property (over addition/subtraction): $a \cdot (b + c) = a \cdot b + a \cdot c \ and$ $a \cdot (b - c) = a \cdot b - a \cdot c$.
- 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.
- Identity property of addition (additive identity property): $a + 0 = a \ and \ 0 + a = a$.
- Identity property of multiplication (multiplicative identity property): $a \cdot 1 = a \ and \ 1 \cdot a = a$.
- Inverses are numbers that combine with other numbers and result in identity elements (e.g., 5 + (–5) = 0; $\frac{1}{5} \cdot 5 = 1$).
- Inverse property of addition (additive inverse property): $a + (-a) = 0 \ and \ (-a) + a = 0$.
- Inverse property of multiplication (multiplicative inverse property): $a \cdot \frac{1}{a} = 1 \ and \ \frac{1}{a} \cdot a = 1$.
- Zero has no multiplicative inverse.
- Multiplicative property of zero: $a \cdot 0 = 0 \ and \ 0 \cdot a = 0$.
- Division by zero is not a possible mathematical operation. It is undefined.
- Substitution property: If $a = b$, then *b* can be substituted for *a* in any expression, equation, or inequality.
- Addition property of equality: If $a = b$, then $a + c = b + c$.
- Subtraction property of equality: If $a = b$, then $a - c = b - c$.
- Multiplication property of equality: If $a = b$, then $a \cdot c = b \cdot c$.
- Division property of equality: If $a = b \ and \ c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$.

Verbal Statements (SOL 8.17, SOL 8.18) (2 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
verbal expression equation sentence	**Big ideas:** There are various practical problems in everyday life that require solving for an unknown. In this skill, students will write verbal expressions and sentences as algebraic expressions and sentences, and vice versa.	**2**	• Write verbal expressions and sentences as algebraic expressions and equations. • Write algebraic expressions and equations as verbal expressions and sentences.

algebraic numeric product quotient square root square absolute value sum difference less than less	**VDOE Lesson Plans**		• Write verbal expressions and sentences as algebraic expressions and inequalities. • Write algebraic expressions and inequalities as verbal expressions and sentences.

Understanding the Standard

- 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 "$n \cdot 5$" or "$5n$".
- An algebraic expression is a variable expression that contains at least one variable (e.g., $2x – 3$).
- A verbal sentence is a complete word statement (e.g., "The sum of two consecutive integers is thirty-five." could be represented by "$n+ (n + 1) = 35$").
- An algebraic equation is a mathematical statement that says that two expressions are equal (e.g., $2x + 3 = -4x +1$).

Inequalities (SOL 8.18) (5 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
inequality greater than > greater than or equal to ≥ less than < less than or equal to ≤ solution set linear numerical values multi-step coefficients numeric terms **Properties of Real Numbers** commutative associative distributive identity	**Big ideas:** Inequalities can be used to express a range of values that can be acceptable in a given situation and graphing allows us to visualize these values. When budgeting, you are only able to spend so much without going into debt. At an amusement park, roller coasters have height restrictions based on safety regulations. Inequalities, like equations, give us a precise way to represent many situations that arise in the world and solving inequalities allows us to answer questions about those situations. • How can graphing the solution to an inequality on a number line increase understanding of inequalities? • Why does the inequality need to be flipped when multiplying or dividing by a negative number? • How is the solution to an inequality different from the solution to an equation? • Why is it important to identify the solutions to an inequality? • How can understanding the properties of inequalities help when solving an inequality? • How can a practical situation be represented by a multi-step inequality?	**5**	• 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. • Graph solutions to multistep linear inequalities on a number line. • Solve practical problems that require the solution of a multistep linear inequality in one variable. • Identify a numerical value(s) that is part of the solution set of a given inequality.

inverse mult. of zero substitution **Properties of Equality/Inequality** addition subtraction multiplication division	**VDOE Lesson Plans**		

Understanding the Standard

- A multistep inequality may include, but not be limited to inequalities such as the following: $2x + 1 > \frac{-x}{4}$; $-3(2x + 7) \leq \frac{1}{2}x$; $2x + 7 - 5x < 27$; $-5x - (x + 3) > -12$.
- When both expressions of an inequality are multiplied or divided by a negative number, the inequality sign reverses.
- A solution to an inequality is the value or set of values that can be substituted to make the inequality true.
- 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., $x + 4 > -3$ then the solutions is $x > -7$. This means that x can be any number greater than −7. A few solutions might be −6.5, −3, 0, 4, 25, etc.)
- Real-world problems can be modeled and solved using linear inequalities.
- 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 *a*, *b*, or *c* in this standard).
- Commutative property of addition: $a + b = b + a$.
- Commutative property of multiplication: $a \cdot b = b \cdot a$.
- Associative property of addition: $(a + b) + c = a + (b + c)$.
- Associative property of multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$.
- Subtraction and division are neither commutative nor associative.
- Distributive property (over addition/subtraction): $a \cdot (b + c) = a \cdot b + a \cdot c$ *and* $a \cdot (b - c) = a \cdot b - a \cdot c$.
- 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.
- Identity property of addition (additive identity property): $a + 0 = a$ *and* $0 + a = a$.
- Identity property of multiplication (multiplicative identity property): $a \cdot 1 = a$ *and* $1 \cdot a = a$.
- Inverses are numbers that combine with other numbers and result in identity elements (e.g., 5 + (–5) = 0; $\frac{1}{5} \cdot 5 = 1$).
- Inverse property of addition (additive inverse property): $a + (-a) = 0$ *and* $(-a) + a = 0$.

- Inverse property of multiplication (multiplicative inverse property): $a \cdot \frac{1}{a} = 1 \text{ and } \frac{1}{a} \cdot a = 1$.
- Zero has no multiplicative inverse.
- Multiplicative property of zero: $a \cdot 0 = 0 \text{ and } 0 \cdot a = 0$.
- Division by zero is not a possible mathematical operation. It is undefined.
- Substitution property: If $a = b$, then b can be substituted for a in any expression, equation, or inequality.
- Addition property of inequality: If $a < b$, then $a + c < b + c$.
- Subtraction property of inequality: If $a < b$, then $a - c < b - c$.
- Multiplication property of inequality: If $a < b$, then $a \cdot c < b \cdot c$.
- Division property of inequality: If $a < b \text{ and } c \neq 0$, then $\frac{a}{c} < \frac{b}{c}$.

Quarter 1: (43 Instructional Days)

2nd Quarter

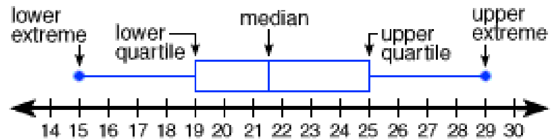
Box Plots (SOL 8.12) (6 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
box-and-whisker boxplots median lower extreme upper extreme lower quartile upper quartile range interquartile range data spread of data inference	**Big ideas:** Representing data and having an overview of the four quarters is helpful when comparing two sets of data such as comparing two classes of test scores. It is useful to be able to determine what type of data is best seen in a boxplot. **8.12a** • How is a box-and-whisker plot useful in analyzing data? **8.12b** • What observations/inferences/conclusions can be drawn from analyzing data displayed using a boxplot? **8.12c** • What information can be compared when two box-plots are graphed on the same number-line? **VDOE Lesson Plans**	6	• Collect and display a numeric data set of no more than 20 items, using boxplots. (a) • Make observations and inferences about data represented in a boxplot. (b) • 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) • Compare and analyze two data sets represented in boxplots. (c)

Understanding the Standard

- A boxplot (box-and-whisker plot) is a convenient and informative way to represent single-variable (univariate) data.
- 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.
- 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.

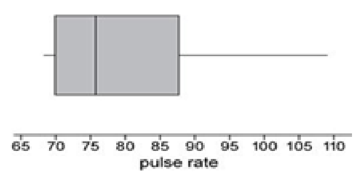
- A boxplot uses a rectangle to represent the middle half of a set of data and lines (whiskers) at both ends to represent the remainder of the data. The median is marked by a vertical line inside the rectangle.
- The five critical points in a boxplot, commonly referred to as the five-number summary, 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.



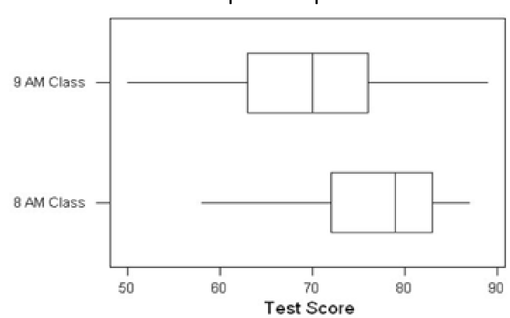
- The range is the difference between the upper extreme and the lower extreme. The interquartile range (IQR) is the difference between the upper quartile and the lower quartile. Using the example above, the range is 14 or 29−15. The interquartile range is 6 or 25–19.
- When there are an odd number of data values in a set of data, the median will not be considered when calculating the lower and upper quartiles.
  - 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
- 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.



- 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.



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.

Coordinate Plane (Review) (SOL 6.8) (2 Days)			
Vocabulary	**Big Ideas/VDOE Lesson Plans**	**# of Days**	**Essential Knowledge & Skills**

coordinate plane first coordinate x-axis horizontal second coordinate y-axis vertical origin quadrants coordinates ordered pair Roman numerals I, II, III, IV polygons vertices distance	**Big ideas:** Graphing on a coordinate plane is useful for reading maps. Like the coordinates of an ordered pair, giving directions requires attention to direction of movement and magnitude of that movement. Air traffic control, satellites, and the military all use concepts of a coordinate plane to identify precise locations. **6.8a** • How are the axes of a coordinate plane related to a number line? **6.8b** • How is the concept of the coordinate plane applied in practical situations? (i.e. maps) • On a coordinate plane, how are points on a horizontal line related to each other? • On a coordinate plane, how are points on a vertical line related to each other? • How do you determine the distance a point is from an axis? **VDOE Lesson Plans**	**2**	• Identify and label the axes, origin, and quadrants of a coordinate plane. • Identify the quadrant or the axis on which a point is positioned by examining the coordinates (ordered pairs) of the point. Ordered pairs will be limited to coordinates expressed as integers. • Graph ordered pairs in the four quadrants and on the axes of a coordinate plane. Ordered pairs will be limited to coordinates expressed as integers. • Identify ordered pairs represented by points in the four quadrants and on the axes of the coordinate plane. Ordered pairs will be limited to coordinates expressed as integers. • Relate the coordinates of a point to the distance from each axis and relate the coordinates of a single point to another point on the same horizontal or vertical line. Ordered pairs will be limited to coordinates expressed as integers. • Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to determine the length of a side joining points with the same first coordinate or the same second coordinate. Ordered pairs will be limited to coordinates expressed as integers. Apply these techniques in the context of solving practical and mathematical problems.

Understanding the Standard

- In a coordinate plane, the coordinates of a point are typically represented by the ordered pair (x, y), where x is the first coordinate and y is the second coordinate.
- Any given point is defined by only one ordered pair in the coordinate plane.
- The grid lines on a coordinate plane are perpendicular.
- The axes of the coordinate plane are the two intersecting perpendicular lines that divide it into its four quadrants. The x-axis is the horizontal axis and the y-axis is the vertical axis.
- The quadrants of a coordinate plane are the four regions created by the two intersecting perpendicular lines (x- and y-axes). Quadrants are named in counterclockwise order. The signs on the ordered pairs for quadrant I are (+,+); for quadrant II, (–,+); for quadrant III, (–, –); and for quadrant IV, (+,–).
- In a coordinate plane, the origin is the point at the intersection of the x-axis and y-axis; the coordinates of this point are (0, 0).
- For all points on the x-axis, the y-coordinate is 0. For all points on the y-axis, the x-coordinate is 0.
- The coordinates may be used to name the point. (e.g., the point (2, 7)). It is not necessary to say "the point whose coordinates are (2, 7)." The first coordinate tells the location or distance of the point to the left or right of the y-axis and the second coordinate tells the location or distance of the point above or below the x-axis. For example, (2, 7) is two units to the right of the y-axis and seven units above the x-axis.
- Coordinates of points having the same x-coordinate are located on the same vertical line. For example, (2, 4) and (2, -3) are both two units to the right of the y-axis and are vertically seven units from each other.
- Coordinates of points having the same y-coordinate are located on the same horizontal line. For example, (-4, -2) and (2, -2) are both two units below the x-axis and are

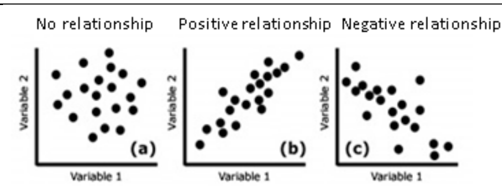
horizontally six units from each other.

Scatterplots (SOL 8.13) (4 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
scatterplot relationship correlation positive negative none line of best fit slope trend independent variable dependent variable	**Big ideas:** Scatterplots allow students to follow trends or find relationships between two sets of data. One example of a relationship is the value of a car and its age. Another one would be the amount of time that a student studied for a test and the score on the test. **8.13a** • What does each point in a scatterplot represent? • When should a scatterplot be used to represent data? **8.13b** • How can a scatterplot be used to make predictions about data? • Why do some scatterplots not have any relationship? **8.13c** • How is the shape of the graph related to the slope of the line of best fit? • How can a line of best fit help to explain data presented in a scatterplot? **VDOE Lesson Plans**	4	• Collect, organize, and represent a data set of no more than 20 items using scatterplots. (a) • 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) • Estimate the line of best fit with a drawing for data represented in a scatterplot. (c)

Understanding the Standard

- 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.
- 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.
- Scatterplots can be used to predict linear trends and estimate a line of best fit.
- 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.
- 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.
  - For example: The following scatterplots illustrate how patterns in data values may indicate linear relationships.



- 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).
- 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.

Functions/Relations (SOL 8.15) (5 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
function relation discrete ordered pairs domain range table continuous vertical line test input output coordinate plane	**Big ideas:** Functions are a unifying idea in mathematics because they represent many input-output situations that arise in practical situations, especially with technological advances. Functions are a powerful tool to simplify complex situations and predict outcomes. **8.15a** • What are the differences and/or similarities of relations and functions? • How can a function be represented? • How is a discrete function different from a continuous function? • How is the vertical line test used to determine if a relation is a function? **8.15b** • How can I represent domain/range of a relation or function? • What are the differences and/or similarities of domain and range? **VDOE Lesson Plans**	5	• 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. • Identify the domain and range of a function represented as a set of ordered pairs, a table, or a graph of discrete points.

Understanding the Standard

- A relation is any set of ordered pairs. For each first member, there may be many second members.
- 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.
- 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 −3, assigned to it, so the example is not a function.

function

x	*y*
2	3
1	5
0	3
-1	-3

not a function

x	*y*
2	3
1	5
0	4
1	-3

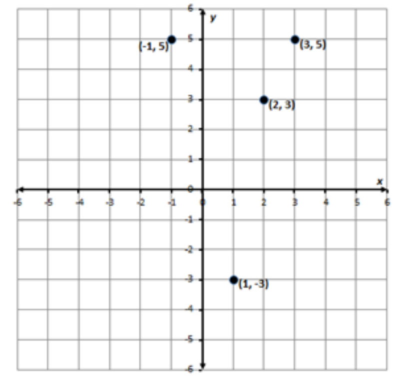
- As a set of ordered pairs, a function has a unique or different *y*-value assigned to each *x*-value. For example, the set of ordered pairs, {(1, 2), (2, 4), (3, 2), (4, 8)} is a function. This set of ordered pairs, {(1, 2), (2, 4), (3, 2), (2, 3)}, is not a function because the *x*-value of “2” has two different *y*-values.
- As a graph of discrete points, a relation is a function when, for any value of *x*, a vertical line passes through no more than one point on the graph.
- Some relations are functions; all functions are relations.
- Graphs of functions can be discrete or continuous.
- 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.
- Functions may be represented as ordered pairs, tables, graphs, equations, physical models, or in words. Any given relationship can be represented using multiple representations.
- 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.

$$\text{domain} \rightarrow \boxed{\text{function}} \rightarrow \text{range}$$

- The domain is the set of all the input values for the independent variable or *x*-values (first number in an ordered pair).
- The range is the set of all the output values for the dependent variable or *y*-values (second number in an ordered pair
- If a function is comprised of a discrete set of ordered pairs, then the domain is the set of all the *x*-coordinates, and the range is the set of all the *y*-coordinates. These sets of values can be determined given different representations of the function.
  - Example: The domain of a function is {−1, 1, 2, 3} and the range is {−3, 3, 5}. The following are representations of this function:
    - The function represented as a table of values:

x	*y*
-1	5
1	-3
2	3
3	5

- The function represented as a set of ordered pairs: {(-1, 5), (1, -3), (2, 3), (3, 5)}
- The function represented as a graph on a coordinate plane:



Functions (SOL 8.16) (10 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
slope (m) positive negative zero linear function y-intercept y = mx + b coordinates independent variable dependent variable representations verbal descriptions tables graphs equations vertical change horizontal change change in y rate of change coefficient	**Big ideas:** Functions are all around us. For example, a functional relationship is at play when we are paying for gasoline by the gallon or fruit by the pound. We need functions for calculating such things as income and interest. Functions are important as well when looking at local and world demographics and population growth. Functions are even found in such settings as baseball statistics and measurement conversions. The slope of a line represents a constant rate of change. Many practical situations including science, construction, and business all represent various situations in terms of rate of change. In addition, rate of change is the foundation of calculus where interpretation is also essential with correct units of measure. Lines are all around us in everything we see every day. Buildings have lines; paintings and drawings have lines; just about anything you can think of has lines. A line can be represented by its graph or by an equation. Different forms of linear equations lend themselves to different situations. Practical applications using parallel and perpendicular lines include road construction (most American towns are laid out with parallel and perpendicular lines), architectural design, railroad tracks, building frameworks, window panes and blinds, power lines, and the goal posts on a football field.	**10**	• Recognize and describe a line with a slope that is positive, negative, or zero (0). (a) • Given a table of values for a linear function, identify the slope and *y*-intercept. The table will include the coordinate of the *y*-intercept. (b) • Given a linear function in the form *y* = *mx* + *b*, identify the slope and *y*-intercept. (b) • Given the graph of a linear function, identify the slope and *y*-intercept. The value of the *y*-intercept will be limited to integers. The coordinates of the ordered pairs shown in the graph will be limited to integers. (b) • Identify the dependent and independent variable, given a practical situation modeled by a linear function. (c) • Given the equation of a linear function in the form *y* = *mx* + *b*, graph the function. The value of the *y*-intercept will be limited to integers. (d) • Write the equation of a linear function in the form *y* = *mx* + *b* given values for the slope, *m,* and the *y*-intercept or given a practical situation in which the slope, *m*, and *y*-intercept are described verbally.(e)

constant	**8.16a** • How can the slope of a line be used to describe the shape of the line? • What is the slope of a line? What does it represent? **8.16b** • How can the slope of a line be found using a graph? • How can the y-intercept of a line be found using a graph? • How can the equation of a line be used to find the slope of the line? • How can the equation of a line be used to find the y-intercept of a line? • How can a table be used to find the slope of a line? • How can a table be used to find the y-intercept of a line? **8.16c** • How does an independent variable differ from a dependent variable? • Why is the independent variable the input of a function? • How can you identify the independent and dependent variables of a function on a graph? • Given a practical situation, how do you identify the dependent and independent variables? **8.16d** • What are some methods that can be used to graph a linear function? • Why will the graph of a linear function always be in a straight line? • How can the equation of a line be used to graph the line? • How can the slope and y-intercept of a line be used to graph the line? **8.16e** • What are some ways that a linear function can be represented? • How can the slope and y-intercept of a line be used to write the equation of the line? • How can a linear function be used to represent a practical situation? **VDOE Lesson Plans**		• Make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs. (e).

Understanding the Standard

- A linear function can be written in the form $y = mx + b$, where m represents the slope or rate of change in y compared to x, and b represents the y-intercept of the graph of the linear function. The y-intercept is the point at which the graph of the function intersects the y-axis and may be given as a single value, b, or as the location of a point (0, *b*).

– Example: Given the equation of the linear function $y = -3x + 2$, the slope is -3 or $\frac{-3}{1}$ and the *y*-intercept is 2 or (0, 2).

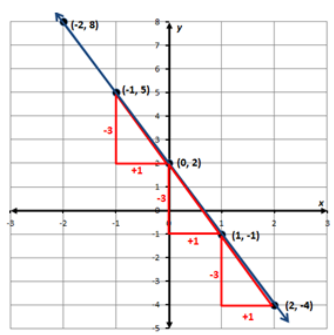
– Example: The table of values represents a linear function.
In the table, the point (0, 2) represents the *y*-intercept. The slope is determined by observing the change in each *y*-value compared to the corresponding change in the *x*-value.

x	y
-2	8
-1	5
0	2
1	-1
2	-4

slope = $m = \frac{change\ in\ y-value}{change\ in\ x-value} = \frac{-3}{+1} = -3$

– The slope, *m*, and *y*-intercept of a linear function can be determined given the graph of the function.

– Example: Given the graph of the linear function, determine the slope and *y*-intercept.



Given the graph of a linear function, the *y*-intercept is found by determining where the line intersects the *y*-axis. The *y*-intercept would be 2 or located at the point (0, 2). The slope can be found by determining the change in each *y*-value compared to the change in each *x*-value. Here, we could use slope triangles to help visualize this:

slope = $m = \frac{change\ in\ y-value}{change\ in\ x-value} = \frac{-3}{+1} = -3$

- 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 determine points on the line.
  – Example: Graph the linear function whose equation is $y = 5x - 1$.

  In order to graph the linear function, we can create a table of values by substituting arbitrary values for *x* to determining coordinating values for *y*:

x	$5x - 1$	y
-1	5(-1) - 1	-6
0	5(0) - 1	-1
1	5(1) - 1	4
2	5(2) - 1	9

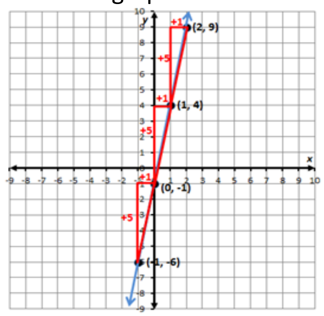
The values can then be plotted as points on a graph.

Knowing the equation of a linear function written in $y = mx + b$ provides information about the slope and y-intercept of the function. If the equation is $y = 5x - 1$, then the slope, m, of the line is 5 or $\frac{5}{1}$ and the y-intercept is −1 and can be located at the point (0, −1). We can graph the line by first plotting the y-intercept. We also know,

slope = $m = \frac{change\ in\ y-value}{change\ in\ x-value} = \frac{+5}{+1}$

Other points can be plotted on the graph using the relationship between the y and x values.

Slope triangles can be used to help locate the other points as shown in the graph below:



- 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	-6	
+1			+5
	0	-1	
+1			+5
	1	4	
+1			+5
	2	9	

- The axes of a coordinate plane are generally labeled x and y; however, any letters may be used that are appropriate for the function.
- A function has values that represent the input (x) and values that represent the output (y). The independent variable is the input value.
- The dependent variable depends on the independent variable and is the output value.
- Below is a table of values for finding the approximate circumference of circles, $C = \pi d$, where the value of π is approximated as 3.14.

Diameter	Circumference
1 in.	3.14 in.
2 in.	6.28 in.
3 in.	9.42 in.
4 in.	12.56 in.

- The independent variable, or input, is the diameter of the circle. The values for the diameter make up the domain.
- The dependent variable, or output, is the circumference of the circle. The set of values for the circumference makes up the range.

- 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.
- 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 (x) 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 (x) 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.
  - Example: The function $y = 7x$ represents the cost in dollars (y) for x 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 x could be represented and connecting the points would not be appropriate.
  - Example: The function $y = -2.5x + 20$ represents the number of gallons of water (y) remaining in a 20-gallon tank being drained for x number of minutes. The domain in this function would be continuous. There would be an x-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 x can represent to positive values, since time cannot be negative.).
- Functions can be represented as ordered pairs, tables, graphs, equations, physical models, or in words. Any given relationship can be represented using multiple representations.
- The equation $y = mx + b$ defines a linear function whose graph (solution) is a straight line. The equation of a linear function can be determined given the slope, m, and the y-intercept, b. Verbal descriptions of practical situations that can be modeled by a linear function can also be represented using an equation.
  - Example: Write the equation of a linear function whose slope is $\frac{3}{4}$ and y-intercept is −4, or located at the point (0, −4).
  - The equation of this line can be found by substituting the values for the slope, $m = \frac{3}{4}$, and the y-intercept, $b = -4$, into the general form of a linear function $y = mx + b$. Thus, the equation would be $y = \frac{3}{4}x - 4$.
  - 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, y of a personal watercraft repair, based on the number of hours, x, needed to repair it. Assume that there is no additional charge for parts.

    In this practical situation, the y-intercept, b, would be $30, to represent the initial flat fee to trouble shoot the watercraft. The slope, m, would be $50, since that would represent the rate per hour. The equation to represent this situation would be $y = 50x + 30$.
- A proportional relationship between two variables can be represented by a linear function $y = mx$ that passes through the point (0, 0) and thus has a y-intercept of 0. The variable y results from x being multiplied by m, the rate of change or slope.
- The linear function $y = x + b$ represents a linear function that is a non-proportional additive relationship. The variable y results from the value b being added to x. In this linear relationship, there is a y-intercept of b, 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 *x* term, which represents the constant rate of change, or slope.

- Proportional relationships and additive relationships between two quantities are special cases of linear functions that are discussed in grade seven mathematics.

Probability (SOL 8.11) (10 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
probability event independent dependent likelihood simple compound theoretical experimental outcomes sample space	**Big ideas:** We make countless decisions every day based on prior experience and what we believe will happen. Meteorologists use trends in weather data to predict hurricanes. Coaches use batting averages to create the starting line-up for big games. Rolling doubles in Monopoly gets you an extra turn, but why? The likelihood of these events occurring helps make life fun and interesting. **8.11a** • How do you distinguish between independent and dependent events? **8.11b** • Why would it be useful to make a prediction? When is it appropriate to make a prediction? • What are some examples of how probability is used in the real world? • Explain the difference(s) between calculating independent probability, as opposed to dependent probability. • How does the value of the outcome change depending on what type of event occurred? **VDOE Lesson Plans**	**10**	• Determine whether two events are independent or dependent. (a) • Compare and contrast the probability of independent and dependent events. (a) • Determine the probability of two independent events. (b) • Determine the probability of two dependent events. (b)

Understanding the Standard

- A simple event is one event (e.g., pulling one sock out of a drawer and examining the probability of getting one color).

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.

The probability of an event occurring can be represented as a ratio or the equivalent fraction, decimal, or percent.

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.

- Two events are either dependent or independent.
  - 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.

The probability of two independent events is found by using the following formula:

P(A and B) = P(A)·P(B)

- 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?
  P(3 and heads) = $\frac{1}{6} \cdot \frac{1}{2} = \frac{1}{12}$

- 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 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.

The probability of two dependent events is found by using the following formula: *P(A and B) = P(A)·P(B after A)*

- 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 *without* replacing the blue ball in the bag, picking a red ball on the second pick?

P(blue *and* red) = *P*(blue)·*P*(red *after* blue) = $\frac{1}{3} \cdot \frac{1}{2} = \frac{1}{6}$

Proportions (SOL 7.3) (5 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
proportion US customary metric scale drawings quantities ratio table product of means product of extremes convert conversion factor	**Big ideas:** Proportional reasoning involves thinking about relationships and making comparisons of quantities or values. People use proportional reasoning to calculate best buys, taxes and investments, to work with drawings and maps, to measure or exchange money, to adjust recipes, or to create various concentrations of mixtures and solutions. • How do we know if the relationship between any two numbers is proportional? • Is there more than one way to solve a proportion? Explain. • In what type of scenarios do we use proportions to solve problems? • How do you use proportions to convert between the U.S. Customary and the metric systems? • How do you use proportions to find scale factor and create a scale drawing? **VDOE Lesson Plans:**	**5**	• Given a proportional relationship between two quantities, create and use a ratio table to determine missing values. • Write and solve a proportion that represents a proportional relationship between two quantities to find a missing value. • Apply proportional reasoning to convert units of measurement within and between the U.S. Customary System and the metric system when given the conversion factor. • Apply proportional reasoning to solve practical problems, including scale drawings. Scale factors shall have denominators no greater than 12 and decimals no less than tenths.

Understanding the Standard

- A proportion is a statement of equality between two ratios. A proportion can be written as $\frac{a}{b} = \frac{c}{d}$, *a*:*b* = *c*:*d*, or *a* is to *b* as *c* is to *d*.
- Equivalent ratios arise by multiplying each value in a ratio by the same constant value. For example, the ratio of 3:2 would be equivalent to the ratio 6:4 because each of the values in 3:2 can be multiplied by 2 to get 6:4.
- A ratio table is a table of values representing a proportional relationship that includes pairs of values that represent equivalent rates or ratios.
- A proportion can be solved by determining the product of the means and the product of the extremes. For example, in the proportion *a*:*b* = *c*:*d*, *a* and *d* are the extremes and *b* and *c* are the means. If values are substituted for *a*, *b*, *c*, and *d* such as 5:12 = 10:24, then the product of extremes (5 · 24) is equal to the product of the means (12 · 10).
- In a proportional relationship, two quantities increase multiplicatively. One quantity is a constant multiple of the other.
- A proportion is an equation which states that two ratios are equal. When solving a proportion, the ratios may first be written as fractions.
  - Example: A recipe for oatmeal cookies calls for 2 cups of flour for every 3 cups of oatmeal. How much flour is needed for a larger batch of cookies that uses 9 cups of oatmeal? To solve this problem, the ratio of flour to oatmeal could be written as a fraction in the proportion used to determine the amount of flour needed when 9 cups of oatmeal is used. To use a proportion to solve for the unknown cups of flour needed, solve the proportion: $\frac{2}{3} = \frac{x}{9}$.
    To use a table of equivalent ratios to find the unknown amount, create the table:

flour (cups)	2	4	?
oatmeal (cups)	3	6	9

    To complete the table, we must create an equivalent ratio to 2:3; just as 4:6 is equivalent to 2:3, then 6 cups of flour to 9 cups of oatmeal would create an equivalent ratio.
- A proportion can be solved by determining equivalent ratios.
- A rate is a ratio that compares two quantities measured in different units. A unit rate is a rate with a denominator of 1. Examples of rates include miles/hour and revolutions/minute.
- Proportions are used in everyday contexts, such as speed, recipe conversions, scale drawings, map reading, reducing and enlarging, comparison shopping, tips, tax, and discounts, and monetary conversions.
- A multistep problem is a problem that requires two or more steps to solve.
- Proportions can be used to convert length, weight (mass), and volume (capacity) within and between measurement systems. For example, if 1 inch is about 2.54 cm, how many inches are in 16 cm?

$$\frac{1\ inch}{2.54\ cm} = \frac{x\ inch}{16\ cm}$$

$$2.54x = 1 \cdot 16$$

$$2.54x = 16$$

$$x = \frac{16}{2.54}$$

$x = 6.299$ or about 6.3 inches

- Examples of conversions may include, but are not limited to:
  - Length: between feet and miles; miles and kilometers
  - Weight: between ounces and pounds; pounds and kilograms
  - Volume: between cups and fluid ounces; gallons and liters
- Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes depending on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?").
- When converting measurement units in practical situations, the precision of the conversion factor used will be based on the accuracy required within the context of the problem. For example, when converting from miles to kilometers, we may use a conversion factor of 1 mile ≈ 1.6 km or 1 mile ≈ 1.609 km, depending upon the accuracy needed.
- Estimation may be used prior to calculating conversions to evaluate the reasonableness of a solution.
- A percent is a ratio in which the denominator is 100.
- Proportions can be used to represent percent problems as follows:

$$\frac{percent}{100} = \frac{part}{whole}$$

Quarter 2: (42 Instructional Days)

3rd Quarter

Consumer Math (SOL 8.4) (8 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
proportional balance transactions debit withdraw discount markup resulting sale price sales tax tip resulting total simple interest investment loan new balance principal interest rate	**Big ideas:** Proportional reasoning and consumer applications involve thinking about relationships and making comparisons of quantities or values. People use proportional reasoning and consumer applications to calculate best buys, taxes and investments, to work with drawings and maps, to measure or exchange money, to adjust recipes, or to create various concentrations of mixtures and solutions. • How are discount, markup, sales tax, and tip similar? How are they different? • How do banks make money? What is the purpose of interest? • What are examples from the real world where percent increase and percent decrease are significant? • What is the difference between a percent of increase and a percent of decrease? • What are some practical consumer applications of proportions? • How are concepts of proportions and percents connected?	**8**	• Solve practical problems involving consumer applications by using proportional reasoning and computation procedures for rational numbers. • Reconcile an account balance given a statement with five or fewer transactions. • Compute a discount or markup and the resulting sale price for one discount or markup. • Compute the sales tax or tip and resulting total. • 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. • Compute the percent increase or decrease found in a practical situation.

time (years) % increase % decrease	• Why would someone reconcile an account balance?		

Understanding the Standard

- Rational numbers may be expressed as whole numbers, integers, fractions, percents, and numbers written in scientific notation.
- 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.
- A percent is a ratio with a denominator of 100.
- 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.
- A discount is a percent of the original price. The discount price is the original price minus the discount.
- Simple interest (I) for a number of years is determined by finding the product of the principal (p), the annual rate of interest (r), and the number of years (t) of the loan or investment using the formula $I = prt$.
- The total value of an investment is equal to the sum of the original investment and the interest earned.
- The total cost of a loan is equal to the sum of the original cost and the interest paid.
- Percent increase and percent decrease are both percents of change measuring the percent a quantity increases or decreases.

Angles (SOL 8.5) (7 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
angles vertical adjacent complementary supplementary congruent common vertex common ray intersecting lines	**Big ideas:** Angles are everywhere in the world around us: streets, floorboards, ceilings, buildings, bridges, etc. For example, in architecture, creation of textiles, construction of buildings. • How are angle relationships used to find the measures of missing angles? • How are adjacent and vertical angles both alike and different? • How are complementary and supplementary angles both alike and different? • How do experts (in construction, city planning, architecture, or engineering) use knowledge of angle relationships in their work? **VDOE Lesson Plans**	**7**	• Identify and describe the relationship between pairs of angles that are vertical, adjacent, supplementary, and complementary. • Use the relationships among supplementary, complementary, vertical, and adjacent angles to solve problems, including practical problems, involving the measure of unknown angles.

Understanding the Standard

- Vertical angles are a pair of nonadjacent angles formed by two intersecting lines. Vertical angles are congruent and share a common vertex.

- Complementary angles are any two angles such that the sum of their measures is 90°.
- Supplementary angles are any two angles such that the sum of their measures is 180°.
- Complementary and supplementary angles may or may not be adjacent.
- Adjacent angles are any two non-overlapping angles that share a common ray and a common vertex.

Transformations (SOL 8.7) (8 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
transformation orientation image preimage polygon translate vertically horizontally coordinate plane x-axis y-axis origin center of dilation dilation enlarge reduce scale factor similar reflection line of reflection mirror image corresponding points	**Big ideas:** Many occupations use dilations in the creation of their products; such as using a blueprint in construction and enlarging or reducing the size of photographs. Rigid motions are present in everyday life; such as the rotation of a tire or the rotation of a ceiling fan, the reflection of an image in a mirror, and the translation of moving vehicles and airplanes through space. **8.7a** • How could you determine which transformation has been performed on the preimage? • What does it mean to transform a polygon? • What are ways that performing a transformation could change a polygon? • How do you determine the coordinates of an image after a transformation? • How do you determine the scale factor after a dilation? • What effect does different scale factors have on a polygon? (ie. If the scale factor is a fraction (½ and ¼) Vs. If the scale factor is a natural number (2, 3, or 4). • How dilations are related to similar figures? **8.7b** • What practical applications of transformations can you find in the real world? **VDOE Lesson Plans**	**8**	• 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) • Given a preimage in the coordinate plane, identify the coordinates of the image of a polygon that has been reflected over the *x*- or *y*-axis. (a) • 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 $\frac{1}{4}$, $\frac{1}{2}$, 2, 3, or 4. The center of the dilation will be the origin. (a) • Given a preimage in the coordinate plane, identify the coordinates of the image of a polygon that has been translated and reflected over the *x*-or *y*-axis, or reflected over the *x*- or *y*-axis and then translated. (a) • Sketch the image of a polygon that has been translated vertically, horizontally, or a combination of both. (a) • Sketch the image of a polygon that has been reflected over the *x*- or *y*-axis. (a) • Sketch the image of a dilation of a right triangle or a rectangle limited to a scale factor of $\frac{1}{4}$, $\frac{1}{2}$, 2, 3, or 4. The center of the dilation will be the origin. (a) • Sketch the image of a polygon that has been translated and reflected over the *x*- or *y*-axis, or reflected over the *x*- or *y*-axis and then translated. (a) • Identify the type of translation in a given example. (a, b) • Identify practical applications of transformations including, but not limited to, tiling, fabric, wallpaper designs, art, and scale drawings. (b)

Understanding the Standard

- 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.
- A transformation of a figure, called preimage, changes the size, shape, and/or position of the figure to a new figure, called the image.
- A transformation of preimage point *A* can be denoted as the image *A′* (read as "*A* prime").
- 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.
- 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.
- 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.
- The result of first translating and then reflecting over the *x*- or *y*-axis may not result in the same transformation of reflecting over the *x*- or *y*-axis and then translating.
- Practical applications may include, but are not limited to, the following:
  - 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;
  - A translation of a figure on a wallpaper pattern shows the same figure slid the same distance in the same direction; and
  - A dilation of a model airplane is the production model of the airplane.

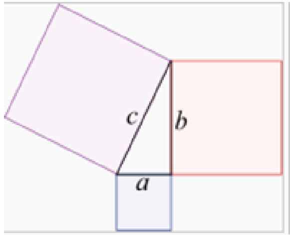
Pythagorean Theorem (SOL 8.9) (8 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
Pythagorean Theorem right triangle right angle sides hypotenuse squaring square root opposite verify	**Big ideas:** Being able to use the Pythagorean theorem can be helpful in many ways in the real world. For example, television and computer screens are measured by their diagonal length. By using the Pythagorean theorem, painters, or people cleaning out gutters, can determine how tall a ladder must be to reach certain heights. Architects can ensure the plans for a new building will form perfect right angles by the using the Pythagorean theorem. **8.9a** • What is the relationship among the lengths of the sides of a right triangle? • How can you determine whether a triangle is a right triangle given the measure of the three sides? • How do you determine the parts of the right triangle? • Given two of the sides of a right triangle, how would you calculate the third side? • How can the Pythagorean Theorem be used to find other parts of a right triangle? (ie. altitude and diagonal) **8.9b** • How would you apply the Pythagorean Theorem to a real-	**8**	• Verify the Pythagorean Theorem, using diagrams, concrete materials, and measurement. (a) • Determine whether a triangle is a right triangle given the measures of its three sides. (b) • Determine the measure of a side of a right triangle, given the measures of the other two sides. (b) • Solve practical problems involving right triangles by using the Pythagorean Theorem. (b)

	world situation?		

Understanding the Standard

- The Pythagorean Theorem is essential for solving problems involving right triangles.
- The relationship between the sides and angles of right triangles are useful in many applied fields.
- 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: $a^2 + b^2 = c^2$.



- 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.
- 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.
- 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.
- The hypotenuse of a right triangle is the side opposite the right angle.
- The hypotenuse of a right triangle is always the longest side of the right triangle.
- The legs of a right triangle form the right angle.

Composite Figures (SOL 8.10) (12 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
composite figure irregular figure polygon plane figure subdivide triangle trapezoid parallelogram rectangle square semicircle area	**Big ideas:** Shapes can come in a variety of sizes and can be combined in a variety of ways. These shapes are utilized when creating things such as floor plans, artwork, sculptures, logos, web design, etc. • What real-life objects are complex/composite figures? • What words/phrases imply area and perimeter? • How would you determine whether you need to add or subtract to find the area of a complex/composite figure? • What connections can you make between a net and a composite figure? • How would you explain the process for subdividing a composite figure?	**12**	• 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. • 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. • Apply perimeter, circumference, and area formulas to solve practical problems involving composite plane figures.

perimeter length width circumference radius diameter pi 2-dimensional attributes	• How can you determine which formulas are used to solve practical problems using composite figures? • How can you determine the missing sides of a composite figure using the attributes? **VDOE Lesson Plans**		

Understanding the Standard

- A plane figure is any two-dimensional shape that can be drawn in a plane.
- A polygon is a closed plane figure composed of at least three line segments that do not cross.
- The perimeter is the path or distance around any plane figure. The perimeter of a circle is called the circumference.
- 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.
- The area of a rectangle is computed by multiplying the lengths of two adjacent sides ($A = lw$).
- 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 $\frac{1}{2}$ ($A = \frac{bh}{2}$ or $A = \frac{1}{2}bh$).
- The area of a parallelogram is computed by multiplying the measure of its base by the measure of its height ($A = bh$).
- 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 ($A = \frac{1}{2}h(b_1 + b_2)$).
- The area of a circle is computed by multiplying pi times the radius squared ($A = \pi r^2$).
- The circumference of a circle is found by multiplying pi by the diameter or multiplying pi by 2 times the radius ($C = \pi d$ or $C = 2\pi r$).
- The area of a semicircle is half the area of a circle with the same diameter or radius.

Quarter 3: (43 Instructional Days)

4th Quarter

Volume/Surface Area (SOL 8.6) (7 Days)

polyhedron volume cubic units surface area square units rect. prisms cones	**Big ideas:** Every day questions and curiosities arise from three dimensional objects. If I choose one drinking glass over another, will I get more or less beverage? If I want to build a rectangular garden bed, how much mulch do I need? If I am going to wrap a present, what shape is it and how much wrapping paper will I need? Being able to apply surface area, lateral area, and volume formulas will help answer these [and so many other] daily questions.	**7**	• Distinguish between situations that are applications of surface area and those that are applications of volume. (a) • Determine the surface area of cones and square-based pyramids by using concrete objects, nets, diagrams and formulas. (a) • Determine the volume of cones and square-based pyramids, using concrete objects, diagrams, and formulas. (a)

pyramids nets formulas attributes factor base face radius diameter length width height slant height apex edges vertices cube pi	**8.6a** • How are volume and surface area different? • When do I need to use volume and when do I need to use surface area in the real world? • What do the shapes of the faces in a three-dimensional figure have to do with its surface area? • Why is knowledge of surface area important in the business of manufacturing? • In which careers would a firm understanding of volume be important? • Why are the volume formulas for rectangular prisms and square-based pyramids similar? • Why are the volume formulas for cylinders and cones similar?\ **8.6b** • What are attributes of a rectangular prism? • How does changing one attribute affect the volume of a rectangular prism? • How does changing one attribute affect the surface area of a rectangular prism? • Why does changing an attribute affect volume? • Why does changing an attribute affect surface area? • Why are attributes changed in the real word (for example, in manufacturing, construction, or design)? **VDOE Lesson Plans**		• Solve practical problems involving volume and surface area of cones and square-based pyramids. (a) • Describe how the volume of a rectangular prism is affected when one measured attribute is multiplied by a factor of $\frac{1}{4}, \frac{1}{3}, \frac{1}{2}$, 2, 3, or 4. (b) • Describe how the surface area of a rectangular prism is affected when one measured attribute is multiplied by a factor of $\frac{1}{2}$ or 2. (b)

Understanding the Standard

- A polyhedron is a solid figure whose faces are all polygons.
- Nets are two-dimensional representations of a three-dimensional figure that can be folded into a model of the three-dimensional figure.
- Surface area of a solid figure is the sum of the areas of the surfaces of the figure.
- Volume is the amount a container holds.
- 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.
- The surface area of a rectangular prism is the sum of the areas of the faces and bases, found by using the formula $S.A. = 2lw + 2lh + 2wh$. All six faces are rectangles.
- The volume of a rectangular prism is calculated by multiplying the length, width and height of the prism or by using the formula $V = lwh$.
- 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.

- 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.
- The surface area of a right circular cone is found by using the formula, $S.A. = \pi r^2 + \pi rl$, where l represents the slant height of the cone. The area of the base of a circular cone is πr^2.
- The volume of a cone is found by using $V = \frac{1}{3}\pi r^2 h$, where h is the height and πr^2 is the area of the base.
- 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.
- The volume of a pyramid is $\frac{1}{3}Bh$, where B is the area of the base and h is the height.
- 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 $S.A. = \frac{1}{2}lp + B$ where l is the slant height, p is the perimeter of the base and B is the area of the base.
- The volume of a pyramid is found by using the formula $V = \frac{1}{3}Bh$, where B is the area of the base and h is the height.
- The volume of prisms can be found by determining the area of the base and multiplying that by the height.
- The formula for determining the volume of cones and cylinders are similar. For cones, you are determining $\frac{1}{3}$ of the volume of the cylinder with the same size base and height. The volume of a cone is found by using $V = \frac{1}{3}\pi r^2 h$. The volume of a cylinder is the area of the base of the cylinder multiplied by the height, found by using the formula, $V = \pi r^2 h$, where h is the height and πr^2 is the area of the base.
- The calculation of determining surface area and volume may vary depending upon the approximation for pi. Common approximations for π include 3.14, $\frac{22}{7}$, or the pi button on the calculator.
- 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 $2 \cdot 3 \cdot 4$, the volume is 24 cubic units. However, if one of the attributes is doubled, the volume doubles. That is, $2 \cdot 3 \cdot 8$, the volume is 48 cubic units or 24 doubled.
- 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 $2(lw) + 2(lh) + 2(wh)$ 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 $2(7 \cdot 4) + 2(7 \cdot 3) + 2(4 \cdot 3)$ or 122 square inches. If the height is doubled to 6 inches then the surface area would be found by $2(7 \cdot 4) + 2(7 \cdot 6) + 2(4 \cdot 6)$ or 188 square inches.

3-Dimensional Views (SOL 8.8) (4 Days)

Vocabulary	Big Ideas/VDOE Lesson Plans	# of Days	Essential Knowledge & Skills
3-Dimensional spatial top view side view front view perspective 2-Dimensional	**Big ideas:** Being able to visualize where you are on a map or finding a perspective in a building requires spatial understanding. • How can you determine which three-dimensional figure would be created from a given two-dimensional model (net)? • What are some practical uses for determining the top/bottom, side, and front views?	**4**	• Construct three-dimensional models, given the top or bottom, side, and front views. • Identify three-dimensional models given a two-dimensional perspective. • Identify the two-dimensional perspective from the top or bottom, side, and front view, given a three-dimensional model.

nets mirror image	**VDOE Lesson Plan**		

Understanding the Standard

- A three-dimensional object can be represented as a two-dimensional model with views of the object from different perspectives.
- Three-dimensional models of geometric solids can be used to understand perspective and provide tactile experiences in determining two-dimensional perspectives.
- Three-dimensional models of geometric solids can be represented on isometric paper.
- The top view is a mirror image of the bottom view.

SOL Review (24 Days)