Seventh Grade Pacing Guide

Vision Statement

Imagine a classroom, a school, or a school district where all students have access to high-quality, engaging mathematics instruction. There are ambitious expectations for all, with accommodation for those who need it. Knowledgeable teachers have adequate resources to support their work and are continually growing as professionals. The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding. Technology is an essential component of the environment. Students confidently engage in complex mathematical tasks chosen carefully by teachers. They draw on knowledge from a wide variety of mathematical topics, sometimes approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress. Teachers help students make, refine, and explore conjectures on the basis of evidence and use a variety of reasoning and proof techniques to confirm or disprove those conjectures. Students are flexible and resourceful problem solvers. Alone or in groups and with access to technology, they work productively and reflectively, with the skilled guidance of their teachers. Orally and in writing, students communicate their ideas and results effectively. They value mathematics and engage actively in learning it.

National Council of Teachers of Mathematics

Process Standards

Mathematical Problem Solving

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

Mathematical Communication

Students will use the language of mathematics, including specialized vocabulary and symbols, to express mathematical ideas precisely. Representing, discussing, reading, writing, and listening to mathematics will help students to clarify their thinking and deepen their understanding of the mathematics being studied.

Mathematical Reasoning

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

Mathematical Connections

Students will relate concepts and procedures from different topics in mathematics to one another and see mathematics as an integrated field of study. Through the application of content and process skills, students will make connections between different areas of mathematics and between mathematics and other disciplines, especially science. Science and mathematics teachers and curriculum writers are encouraged to develop mathematics and science curricula that reinforce each other.

Mathematical Representations

Students will represent and describe mathematical ideas, generalizations, and relationships with a variety of methods. Students will understand that representations of mathematical ideas are an essential part of learning, doing, and communicating mathematics. Students should move easily among different representations—graphical, numerical, algebraic, verbal, and physical—and recognize that representation is both a process and a product.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

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

- Students extend their knowledge of patterns developed in the elementary grades and through life experiences by investigating and describing functional relationships.
- Students learn to use algebraic concepts and terms appropriately. These concepts and terms include *variable, term, coefficient, exponent, expression, equation, inequality, domain,* and *range*. Developing a beginning knowledge of algebra is a major focus of mathematics learning in the middle grades.
- Students learn to solve equations by using concrete materials. They expand their skills from one-step to two-step equations and inequalities.
- Students learn to represent relations by using ordered pairs, tables, rules, and graphs. Graphing in the coordinate plane linear equations in two variables is a focus of the study of functions.

7th Grade
Quarterly Overview Sheet

1st Quarter

Unit: Number and Number Sense
Focus: Proportional Reasoning

7.1 The student will
- a) **investigate** and **describe** the concept of negative exponents for powers of ten; (C2)
- c)*** **compare** and **order** fractions, decimals, percents, and numbers written in scientific notation; (B2)
- b)*** **determine** scientific notation for numbers greater than zero; (C3)
- d) ***determine** square roots; and (C3)
- e) **identify** and **describe** absolute value for rational numbers. (B1)

Unit: Computation and Estimation
Focus: Integer Operations and Proportional Reasoning

7.4 The student will **solve** single-step and multi-step practical problems, using proportional reasoning. (C3)

2nd Quarter

Unit: Patterns, Functions, and Algebra
Focus: Linear Equations

7.16 The student will **apply** the following properties of operations with real numbers: (C3)
- a) the commutative and associative properties for addition and multiplication;
- b) the distributive property;
- c) the additive and multiplicative identity properties;
- d) the additive and multiplicative inverse properties; and
- e) the multiplicative property of zero.

Unit: Computation and Estimation
Focus: Integer Operations and Proportional Reasoning

7.3 The student will
- a) **model** addition, subtraction, multiplication, and division of integers; and (C4)
- b)*** **add, subtract, multiply, and divide** integers. (C3)

Unit: Patterns, Functions, and Algebra
Focus: Linear Equations

7.13 The student will
- a) **write** verbal expressions as algebraic expressions and sentences as equations and vice versa; and (B2)
- b) **evaluate** algebraic expressions for given replacement values of the variables. (C3)

7.14 The student will
- a) **solve** one- and two-step linear equations in one variable; and (C3)
- b) **solve** practical problems requiring the solution of one – and two-step equations. (C4)

7.15 The student will
- a) **solve** one-step inequalities in one variable; and (C3)
- b) **graph** solutions to inequalities on the number line. (C3)

3rd Quarter

Unit: Number and Number Sense
Focus: Proportional Reasoning

7.2 The student will **describe** and **represent** arithmetic and geometric sequences, using variable expressions. (B2- C4)

7.12 The student will **represent** relationships with tables, graphs, rules, and words. (C6)

Unit: Geometry
Focus: Relationships between Figures

7.8 The student, given a polygon in the coordinate plane, will **represent** transformations (reflections, dilations, rotations, and translations) by **graphing** in the coordinate plane. (C6)

7.7 The student will **compare and contrast** the following quadrilaterals based on properties: parallelogram, rectangle, square, rhombus, and trapezoid. (B2)

Unit: Measurement
Focus: Proportional Reasoning

7.6 The student will **determine** whether plane figures – quadrilaterals and triangles – are similar and **write** proportions to express the relationships between corresponding sides of similar figures. (C4)

7.5 The student will
- a) **describe** volume and surface area of cylinders; (B2)
- b) **solve** practical problems involving volume and surface area of rectangular prisms and cylinders; and (C3)
- c) **describe** how changing one measured attribute of a rectangular prism affects its volume and surface area. (C5)

4th Quarter

Unit: Probability and Statistics
Focus: Applications of Statistics and Probability

7.9 The student will **investigate** and **describe** the difference between the experimental probability and theoretical probability of an event. (C4)

7.10 The student will **determine** the probability of compound events, using the Fundamental (Basic) Counting Principle. (C3)

7.11 The student, given data for a practical situation, will
- a) **construct and analyze** histograms; and (C6)
- b) **compare and contrast** histograms with other types of graphs presenting information from the same data set. (C4)

***** WITHOUT CALCULATOR**

Unit: **Number and Number Sense**

Focus: **Proportional Reasoning**

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.1 The student will

c) compare and order fractions, decimals, percents and numbers written in scientific notation:
b) determine scientific notation for numbers greater than zero;
a) investigate and describe the concept of negative exponents for powers of ten;
d) determine square roots; and
e) identify and describe absolute value for rational numbers.

Understanding the Standard

Background information of teachers

- Negative exponents for powers of 10 are used to represent numbers between 0 and 1.
  (e.g., $10^{-3} = \frac{1}{10^3} = 0.001$).
- Negative exponents for powers of 10 can be investigated through patterns such as:

$$10^2 = 100$$

$$10^1 = 10$$

$$10^0 = 1$$

$$10^{-1} = \frac{1}{10^1} = \frac{1}{10} = 0.1$$

- A number followed by a percent symbol (%) is equivalent to that number with a denominator of 100
  (e.g., $\frac{3}{5} = \frac{60}{100} = 0.60 = 60\%$).

- 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 1 but less than 10, and a power of 10 (e.g., $3.1 \times 10^5 = 310{,}000$ and $2.85 \times 10^{-4} = 0.000285$).
- Equivalent relationships among fractions, decimals, and percents can be determined by using manipulatives (e.g., fraction bars, Base-10 blocks, fraction circles, graph paper, number lines and calculators).
- A square root of a number is a number which, when multiplied by itself, produces the given number (e.g., $\sqrt{121}$ is 11 since 11 x 11 = 121).
- The square root of a number can be represented geometrically as the length of a side of the square.

  The absolute value of a number is the distance from 0 on the number line regardless of direction. (e.g., $\left|\frac{-1}{2}\right| = \frac{1}{2}$).

Unit: **Number and Number Sense**

Focus: **Proportional Reasoning**

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.1 The student will

c) compare and order fractions, decimals, percents and numbers written in scientific notation:
b) determine scientific notation for numbers greater than zero;
a) investigate and describe the concept of negative exponents for powers of ten;
d) determine square roots; and
e) identify and describe absolute value for rational numbers.

Essential Knowledge and Skills *Essential Vocabulary: absolute value, exponent, percent, perfect square, rational number, scientific notation, square root.*	**Essential Questions** **Essential Understandings All Students should…**
• Recognize powers of 10 with negative exponents by examining patterns. • Write a power of 10 with negative exponent in fraction and decimal form. • Write a number greater than 0 in scientific notation. • Recognize a number greater than 0 in scientific notation. • Compare and determine equivalent relationships between numbers larger than 0 written in scientific notation. • Represent a number in fraction, decimal, and percent forms. • Compare, order, and determine equivalent relationships among fractions, decimals, and percents. Decimals are limited to the thousandths place, and percents are limited to the tenths place. Ordering is limited to no more than 4 numbers. • Order no more than 3 numbers greater than 0 written in scientific notation. • Determine the square root of a perfect square less than or equal to 400. • Demonstrate absolute value using a number line. • Determine the absolute value of a rational number.	• When should scientific notation be used? Scientific notation should be used whenever the situation calls for use of very large or very small numbers. • How are fractions, decimals and percents related? Any rational number can be represented in fraction, decimal and percent form. • What does a negative exponent mean when the base is 10? A base of 10 raised to a negative exponent represents a number between 0 and 1. • How is taking a square root different from squaring a number? Squaring a number and taking a square root are inverse operations. • Why is the absolute value of a number positive? The absolute value of a number represents distance from zero on a number line regardless of direction. Distance is positive.

• Show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle to solve practical problems.	

Instructional Resources next page

Instructional Strategies

- Students, working in pairs, take turns giving each other a percent, a decimal, and a fraction to order from the least to the greatest.
- The students will work in pairs using grid paper and colored pencils, to practice converting fractions to decimals and percents. Each pair will design a color pattern on the grid paper. Have pairs exchange patterns. Then have the group members determine the fraction of the total grid covered by each color. They should then express the part as a decimal and a percent.
- Use manipulatives such as tiles, base ten blocks, counters, grid paper, geoboards, and calculators to demonstrate relationships among fractions, decimals, and percents and identify fractional parts of sets.
- Use play money to have students show relationships of fractional and decimal value of pennies, nickels, dimes, quarters $\frac{70}{100} = \frac{7}{10}$ = ___dimes = $___.
- On a number line mark 0, $\frac{1}{2}$, and 1. Give each student a copy of the number line and a chip. Name a fraction, decimal, or percent and have students place their chip on the number line approximately where the fraction would be located. Check answers and discuss differences. Repeat as many times as needed with different fractions.
- Explore percents as numerical displays in graphs, newspapers, and periodicals to understand real-life applications.

VDOE Lessons

Scientific Notation (VDOE)

Ordering Fractions, Decimals, and Percents (VDOE)

Square Roots (VDOE)

Absolute Value (VDOE)

Powers of Ten (VDOE)

Other Resources

Smart Lesson TEI's

Unit: **Computation and Estimation**

Focus: Integer Operations and Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.4 The student will solve single-step and multistep practical problems, using proportional reasoning.

Understanding the Standard

Background information of teachers

- 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.
- A proportion can be solved by finding 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 situation, both quantities increase or decrease together.
- In a proportional situation, two quantities increase multiplicatively. Both are multiplied by the same factor.
- A proportion can be solved by finding equivalent fractions.
- 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, and monetary conversions.
- Proportions can be used to convert between measurement systems. For example: if 2 inches is about 5 cm, how many inches are in 16 cm?
  - $\frac{2inches}{x} = \frac{5cm}{16cm}$
- A percent is a special ratio in which the denominator is 100.
- Proportions can be used to represent percent problems as follows:
  - $\frac{percent}{100} = \frac{part}{whole}$

Unit: **Computation and Estimation**

Focus: Integer Operations and Proportional Reasoning

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Essential Knowledge and Skills *Essential Vocabulary: discount (amount of discount) equivalent, extremes, means, percent, proportion, rate (discount rate, tax rate, unit rate) ratio, sale price (discount price) scale factor, tax, tip*	**Essential Questions** **Essential Understandings All Students should…**
• Write proportions that represent equivalent relationships between two sets. • Solve a proportion to find a missing term. • Apply proportions to convert units of measurement between U.S. Customary System and the metric system. Calculators may be used. • Apply proportions to solve practical problems, including scale drawings. Scale factors shall have denominators no greater than 12 and decimals no less than tenths. Calculators may be used. • Using 10% as a benchmark, mentally compute 5%, 10%, 15%, or 20% in a practical situation such as tips, tax and discounts. • Solve problems involving tips, tax, and discounts. Limit problems to only one percent computation per problem.	• What makes two quantities proportional? Two quantities are proportional, when one quantity is a constant multiple of the other.

Instructional Strategies

- Create a scale model of a classroom.
- By setting up a proportion of height to shadow length, students will find the height of a tree, building, etc. The students will measure their height, the length of their shadow, and the length of the shadow of a tree or building. For example:

$$\frac{\text{student height}}{\text{student shadow}} = \frac{\text{tree height}}{\text{tree shadow}}$$

- Each student makes a drawing, to scale, of his/her bedroom.
- Using string and following actual highways on a map, students will measure the distance between two given cities. After measuring the length of the string in inches or centimeters, the students will use the scale on the map to determine the actual distance in miles. Using predetermined values for miles per gallon and cost of gas per gallon, students will compute the cost of the trip.
- Have students bring in newspaper ads and use them to determine discounts when the original price and percent of discount are given.
- Students obtain menus from their cafeteria or their favorite restaurants. In groups of two, students record what they would like to order and the cost of each item. Afterwards, they are to determine the tax, 15% tip that they should leave, and the total cost of their meal.
- Students think of something they would like to buy for their room (i.e. clock radio, computer, etc.). They find at least three newspapers and/or catalog advertisements for the item. Students are to write why each is a good choice or why it is not a good choice. Next, they tell which item they would choose to buy and why.
- Students collect and bring to class sales circulars from local papers that express the discounts on sale items in a variety of ways, including percent off, fraction off, and dollar amount off. For items chosen from the circular, the students discuss which form is the easiest form of expression of the discount, which is most understandable to the consumer, and which makes the sale seem the biggest bargain.
- Outback project for tax, tip, and discounts.
- Scale Drawings

VDOE Lesson Plans

Proportions (VDOE)

Sales Tax and Tip (VDOE)

Other Resources

Smart Lesson TEI

2nd Quarter

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.16 The student will apply the following properties of operations with real numbers:

a) The commutative and associative properties of addition and multiplication;
b) The distributive property;
c) The additive and multiplicative identity properties;
d) The additive and multiplicative inverse properties; and
e) The multiplicative property of zero.

Understanding the Standard

Background information of teachers

- The commutative property for addition states that changing the order of the addends does not change the sum (e.g., $5 + 4 = 4 + 5$).
- The commutative property for multiplication states that changing the order of the factors does not change the product (e.g., $5 \cdot 4 = 4 \cdot 5$).
- The associative property of addition states that regrouping the addends does not change the sum
  [e.g., $5 + (4 + 3) = (5 + 4) + 3$].
- The associative property of multiplication states that regrouping the factors does not change the product
  [e.g., $5 \cdot (4 \cdot 3) = (5 \cdot 4) \cdot 3$].
- Subtraction and division are neither commutative nor associative.
- The distributive property states that the product of a number and the sum (or difference) of two other numbers equals the sum (or difference) of the products of the number and each other number
  [e.g., $5 \cdot (3 + 7) = (5 \cdot 3) + (5 \cdot 7)$, or
  $5 \cdot (3 – 7) = (5 \cdot 3) – (5 \cdot 7)$].
- Identity elements are numbers that combine with other numbers without changing the other numbers. The additive identity is zero (0). The multiplicative identity is one (1). There are no identity elements for subtraction and division.
- The additive identity property states that the sum of any real number and zero is equal to the given real number (e.g., $5 + 0 = 5$).
- The multiplicative identity property states that the product of any real number and one is equal to the given real number (e.g., $8 \cdot 1 = 8$).

- Inverses are numbers that combine with other numbers and result in identity elements [e.g., $5 + (-5) = 0$; $\frac{1}{5} \cdot 5 = 1$].
- The additive inverse property states that the sum of a number and its additive inverse always equals zero [e.g., $5 + (-5) = 0$].
- The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one (e.g., $4 \cdot \frac{1}{4} = 1$).
- Zero has no multiplicative inverse.
- The multiplicative property of zero states that the product of any real number and zero is zero.
- Division by zero is not a possible arithmetic operation. Division by zero is undefined.

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.16 The student will apply the following properties of operations with real numbers:

f) The commutative and associative properties of addition and multiplication;
g) The distributive property;
h) The additive and multiplicative identity properties;
i) The additive and multiplicative inverse properties; and
j) The multiplicative property of zero.

Essential Knowledge and Skills	**Essential Questions** **Essential Understandings All Students should…**
Essential Vocabulary: additive identify property, additive inverse property, associative property of addition and multiplication, commutative property of addition and multiplication, distributive property, identify elements, inverses, multiplicative identify property, and property of zero, reciprocal.	
• Identify properties of operations used in simplifying expressions. • Apply the properties of operations to simplify expressions.	Why is it important to apply properties of operations when simplifying expressions? • Using the properties of operations with real numbers helps with understanding mathematical relationships.

Instructional Strategies

- Use game pieces to have students represent the properties.
- Students work in pairs. They will select an index card containing an expression and its simplified form, missing the operations, and grouping symbols. In order to arrive at the given value, the students will arrange the operations in correct order. For example:

  Expression: 5 3 2 When simplified is equal to 25

  Answer: 5(3 + 2)

  Justification: Distributive property

VDOE Lesson Plans

Properties (VDOE)

Other Resources

Examples such as the following should be using in instruction to identify and apply properties of operations.

Example 1:

Step 1:	$-25\,(7)(-4)$	
Step 2:	$7(-25)(-4)$	Between step 1 and step 2 the Commutative property of multiplication was applied.
Step 3:	$7[(-25)(-4)]$	Between step 2 and step 3 the Associative property of multiplication was applied.
Step 4:	$7(100)$	
Step 5:	700	

Example 2:

Step 1: $\frac{2}{3}+\left(-\frac{2}{3}\right)+7$

Step 2: $0 + 7$ Between step 1 and step 2 the Additive inverse property was applied.

Step 3: 7 Between step 2 and step 3 the Additive identity property was applied.

Example 3:

$3(4+6)=12+18$ The Distributive property is shown in this equation.

Unit: **Computation and Estimation**

Focus: Integer Operations and Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.3 The student will

a) Model addition, subtraction, multiplication and division of integers; and

b) Add, subtract, multiply, and divide integers.

Understanding the Standard

Background information of teachers

- The set of integers is the set of whole numbers and their opposites (e.g., … –3, –2, –1, 0, 1, 2, 3, …).
- Integers are used in practical situations, such as temperature changes (above/below zero), balance in a checking account (deposits/withdrawals), and changes in altitude (above/below sea level).
- Concrete experiences in formulating rules for adding and subtracting integers should be explored by examining patterns using calculators, along a number line and using manipulatives, such as two-color counters, or by using algebra tiles.
- Concrete experiences in formulating rules for multiplying and dividing integers should be explored by examining patterns with calculators, along a number line and using manipulatives, such as two-color counters, or by using algebra tiles.

Unit: **Computation and Estimation**

Focus: Integer Operations and Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.3 The student will

c) Model addition, subtraction, multiplication and division of integers; and

d) Add, subtract, multiply, and divide integers.

Essential Knowledge and Skills *Essential Vocabulary: absolute value, integers, opposites*	**Essential Questions** **Essential Understandings All Students should…**
• Model addition, subtraction, multiplication and division of integers using pictorial representations of concrete manipulatives. • Add, subtract, multiply, and divide integers. • Simplify numerical expressions involving addition, subtraction, multiplication and division of integers using order of operations. • Solve practical problems involving addition, subtraction, multiplication, and division with integers.	• The sums, differences, products and quotients of integers are either positive, zero, or negative. How can this be demonstrated?

Instructional Strategies

- Use real-life examples such as weather maps to demonstrate positive and negative temperatures, stock market to illustrate gains and losses, banking examples involving credits and debits, and problems involving sea level to understand ways in which positives and negatives are used.
- Students think about how they would figure their bank balance, if they wrote a check for an amount larger than their balance (i.e. $100 – $125 = –$25). Discuss how subtracting an integer produces the same answer as adding the opposite.
- Have the students work in groups of four to investigate integers. Give each group a number line showing –20 to +20 and a deck of cards with the face cards removed. Each student starts at zero. As a student is dealt a card face up, the student moves that number of places: red is negative, black is positive. The first student to reach negative 20 or positive 20 wins.
- Integer War

VDOE Lesson Plans

Integers Multiplication and Division (VDOE)

Integers Addition and Subtractions (VDOE)

Other Resources

Smart Lesson TEI

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.13 The student will

a) Write verbal expressions as algebraic expressions and sentences as equations and vice versa; and

b) Evaluate algebraic expressions for given replacement values of the variables.

Understanding the Standard

Background information of teachers

- An expression is a name for a number.
- An expression that contains a variable is a variable expression.
- An expression that contains only numbers is a numerical expression.
- A verbal expression is a word phrase (e.g., "the sum of two consecutive integers").
- A verbal sentence is a complete word statement (e.g., "The sum of two consecutive integers is five.").
- An algebraic expression is a variable expression that contains at least one variable (e.g., $2x - 5$).
- An algebraic equation is a mathematical statement that says that two expressions are equal (e.g., $2x + 1 = 5$).
- To evaluate an algebraic expression, substitute a given replacement value for a variable and apply the order of operations. For example, if a = 3 and b = -2 then 5a + b can be evaluated as:
  5(3) + (-2) = 15 + (-2) = 13.

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

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c) Write verbal expressions as algebraic expressions and sentences as equations and vice versa; and

d) Evaluate algebraic expressions for given replacement values of the variables.

Essential Knowledge and Skills	**Essential Questions** **Essential Understandings All Students should…**
Essential Vocabulary: algebraic equation, algebraic expression, coefficient, constant, expression, grouping symbols, order of operations, substitution, term, variable, variable expression, verbal expression, verbal sentence	
• Write verbal expressions as algebraic expressions. Expressions will be limited to no more than 2 operations. • Write verbal sentences as algebraic equations. Equations will contain no more than 1 variable term. • Translate algebraic expressions and equations to verbal expressions and sentences. Expressions will be limited to no more than 2 operations. • Identify examples of expressions and equations. • Apply the order of operations to evaluate expressions for given replacement values of the variables. Limit the number of replacements to no more than 3 per expression.	How can algebraic expression and equations be written? • Word phrases and sentences can be used to represent algebraic expressions and equations.

Instructional Strategies

- Use algebra tiles to model algebraic expressions.
- Use counters and cups to represent algebraic expressions. Each counter may represent one unit and each cup represents the unknown value. Students should model expressions such as:

  "the sum of four and a number" with four counters and a cup.

  "twice a number" with two cups.

- Students, working in pairs, construct a cross-number puzzle whose answers are the solutions to equations. Clues will be given as word expressions. Student pairs will exchange their puzzles with other pairs and, then try to solve the puzzles.
- The students, working in pairs using index cards and pencils, convert word phrases into algebraic expressions. Each student will write a phrase for his or her age on the index card, for example, "I am 14 years younger than three times my sister's age." Next, the students will exchange cards and write each phrase as an expression in algebraic form.

VDOE Lesson Plans

Translate and Evaluate (VDOE)

Other Resources

Smart Lesson TEI

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.14 The student will

a) Solve one- and two-step linear equations in one variable; and

b) Solve practical problems requiring the solution of one- and two-step linear equations.

Understanding the Standard

Background information of teachers

- An equation is a mathematical sentence that states that two expressions are equal.
- A one-step equation is defined as an equation that requires the use of one operation to solve (e.g., $x + 3 = -4$).
- The inverse operation for addition is subtraction, and the inverse operation for multiplication is division.
- A two-step equation is defined as an equation that requires the use of two operations to solve (e.g., $2x + 1 = -5$; $-5 = 2x + 1$; $\frac{x-7}{3} = 4$).

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.14 The student will

c) Solve one- and two-step linear equations in one variable; and

d) Solve practical problems requiring the solution of one- and two-step linear equations.

Essential Knowledge and Skills *Essential Vocabulary: inverse operations*	**Essential Questions** **Essential Understandings All Students should…**
• Represent and demonstrate steps for solving one- and two-step equations in one variable using concrete materials, pictorial representations and algebraic sentences. • Solve one- and two-step linear equations in on variable. • Solve practical problems that require the solution of a one- or two-step linear equation.	When solving an equation, why is it important to perform identical operations on each side of the equation? • An operation that is performed on one side of an equation must be performed on the other side to maintain equality.

Instructional Strategies

- Hands-on-Equations

VDOE Lesson Plans

Equations (VDOE)

Other Resources

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.15 The student will

a) Solve one-step inequalities in one variable; and

b) Graph solutions to inequalities on the number line.

Understanding the Standard

Background information of teachers

A one-step inequality is defined as an inequality that requires the use of one operation to solve (e.g., $x - 4 > 9$).

- The inverse operation for addition is subtraction, and the inverse operation for multiplication is division.
- When both expressions of an inequality are multiplied or divided by a negative number, the inequality symbol reverses (e.g., $-3x < 15$ is equivalent to $x > -5$).
- Solutions to inequalities can be represented using a number line.

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.15 The student will

c) Solve one-step inequalities in one variable; and

d) Graph solutions to inequalities on the number line.

Essential Knowledge and Skills *Essential Vocabulary: inequality and inverse operations*	**Essential Questions** **Essential Understandings All Students should…**
• Represent and demonstrate steps in solving inequalities in one variable, using concrete materials, pictorial representations, and algebraic sentences. • Graph solutions to inequalities on the number line. • Identify a numerical value that satisfies the inequality.	• How are the procedures for solving equations and inequalities the same? The procedures are the same except for the case when an inequality is multiplied or divided on both sides by a negative number. Then the inequality sign is changed from less than to greater than, or greater than to less than. • How is the solution to an inequality different from that of a linear equation? In an inequality, there can be more than one value for the variable that makes the inequality true.

Instructional Strategies

- Hands-On-Equations
- Use 2-color counters and cups to model inequalities.
- Students will write one-step inequalities on index cards. They will switch cards with a partner and try to solve the one-step inequalities.
- Students use Algeblocks or algebra tiles to solve one-step inequalities.

VDOE Lesson Plans

Inequalities (VDOE)

Other Resources

3rd Quarter

Unit: **Number and Number Sense**

Focus: Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.2 The student will describe and represent arithmetic and geometric sequences using variable expressions.

Understanding the Standard

Background information of teachers

- In the numeric pattern of an arithmetic sequence, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number.
- In geometric sequences, students must determine what each number is multiplied by in order to obtain the next number in the geometric sequence. This multiplier is called the *common ratio*. Sample geometric sequences include
  - 2, 4, 8, 16, 32, …; 1, 5, 25, 125, 625, …; and 80, 20, 5, 1.25, ….
- A variable expression can be written to express the relationship between two consecutive terms of a sequence
  - If n represents a number in the sequence 3, 6, 9, 12…, the next term in the sequence can be determined using the variable expression $n + 3$.
  - If n represents a number in the sequence 1, 5, 25, 125…, the next term in the sequence can be determined by using the variable expression $5n$.

Unit: **Number and Number Sense**

Focus: Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.2 The student will describe and represent arithmetic and geometric sequences using variable expressions.

Essential Knowledge and Skills *Essential Vocabulary: arithmetic sequence, common difference, common ratio, consecutive terms, geometric sequence, variable expression.*	**Essential Questions** **Essential Understandings All Students should…**
• Analyze arithmetic and geometric sequences to discover a variety of patterns. • Identify the common difference in an arithmetic sequence. • Identify the common ratio in a geometric sequence. • Given an arithmetic or geometric sequence, write a variable expression to describe the relationship between two consecutive terms in the sequence.	• What are arithmetic sequences? In an arithmetic sequence, the numbers are found by using a common difference. • What are geometric sequences? In a geometric sequence, the numbers are found by using a common ratio. • When are variable expressions used? Variable expressions can express the relationship between two consecutive terms in a sequence.

Instructional Strategies
VDOE Lesson Plans
Arithmetic and Geometric Sequences (VDOE)
Other Resources

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.12 The student will represent relationships with tables, graphs, rules, and words.

Understanding the Standard

Background information of teachers

- Rules that relate elements in two sets can be represented by word sentences, equations, tables of values, graphs, or illustrated pictorially.
- A relation is any set of ordered pairs. For each first member, there may be many second members.
- A function is a relation in which there is one and only one second member for each first member.
- As a table of values, a function has a unique value assigned to the second variable for each value of the first variable.
- As a graph, a function is any curve (including straight lines) such that any vertical line would pass through the curve only once.
- Some relations are functions; all functions are relations.

Unit: **Patterns, Functions, and Algebra**

Focus: Linear Equations

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.12 The student will represent relationships with tables, graphs, rules, and words.

Essential Knowledge and Skills *Essential Vocabulary: function, relation, table of values*	**Essential Questions** **Essential Understandings All Students should…**
• Describe and represent relations and functions, using tables, graphs, rules, and words. Given one representation, students will be able to represent the relation in another form.	• What are the different ways to represent the relationship between two sets of numbers? Rules that relate elements in two sets can be represented by word sentences, equations, tables of values, graphs or illustrated pictorially.

Instructional Strategies

- A student can text 150 letters in one minute.
  Create a table to illustrate this relationship.

  Write a function rule to represent the relationship between the number of letters and the time in which they are typed.

  Use your rule to determine the number of letters typed in 15 minutes.

  How long will it take the student to type 2,850 letters?

VDOE Lesson Plans

Relationships Round Robin (VDOE)

Other Resources

Tables, graphs, rules, and words are used to illustrate and describe patterns and functional relationships.

A *relation* is any set of ordered pairs. For each first member, there may be many second members.

A *function* is a relation in which there is one and only one second member for each first member.

For example: The function that relates earnings to time worked is

earnings = rate of pay × hours worked.

Some examples of functions are:

- The function that relates distance traveled to the rate of travel and the time is distance = rate × time; for example, a student traveling at 30 miles per hour on a motor bike, would produce the following table:

TIME (t)	1 hour	2 hours	3 hours	4 hours
DISTANCE (d)	30 miles	60 miles	90 miles	120 miles

The equation that represents this function is $d = 30t$.

- A person makes $30 an hour. A function representing this is $e = 30h$ where e represents the earnings and h is the number of hours worked. The following represents a table of values for this function.

TIME (t)	1 hour	2 hours	3 hours	4 hours
EARNINGS (e)	$30	$60	$90	$120

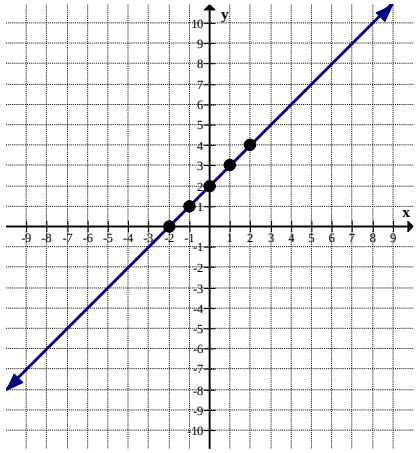
A table of values is the data used to make a graph in the coordinate system. The values are used to graph points.

Graphs may be constructed from ordered pairs represented in a table.

The ordered pairs in the following table are $(-2,0),\ (-1,1),\ (0,2),\ (1,3),\ (2,4)$.

The equation represented in this table and graph is $y = x + 2$.

$x + 2$	
−2	0
−1	1
0	2
1	3
2	4



Rules that relate elements in two sets can be represented by word sentences, equations, tables of values, graphs, or illustrated pictorially.

As a *table of values*, a function has a unique value assigned to the second variable for each value of the first variable. As a graph, a function is any curve (including straight lines) such that any vertical line would pass through the curve only once (vertical line test).

Some relations are functions; all functions are relations.

Unit: **Geometry**

Focus: Relationships between Figures

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.8 The student, given a polygon in the coordinate plane, will represent transformations (reflections, dilations, rotations, and translations) by graphing in the coordinate plane.

Understanding the Standard

Background information of teachers

- A rotation of a geometric figure is a turn of the figure around a fixed point. The point may or may not be on the figure. The fixed point is called the *center of rotation*.
- A translation of a geometric figure is a slide of the figure in which all the points on the figure move the same distance in the same direction.
- A reflection is a transformation that reflects a figure across a line in the plane.
- A dilation of a geometric figure is a transformation that changes the size of a figure by scale factor to create a similar figure.
- The image of a polygon is the resulting polygon after the transformation. The preimage is the polygon before the transformation.
- A transformation of preimage point A can be denoted as the image A' (read as "A prime").

Unit: **Geometry**

Focus: Relationships between Figures

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.8 The student, given a polygon in the coordinate plane, will represent transformations (reflections, dilations, rotations, and translations) by graphing in the coordinate plane.

Essential Knowledge and Skills *Essential Vocabulary: center of rotation, coordinate plane, coordinates (ordered pair), dilation, horizontal axis (x-axis), image, origin, preimage, quadrant, reflection, rotation, scale factor, transformation, translation, vertical axis (y-axis)*	**Essential Questions** **Essential Understandings All Students should…**
• Identify the coordinates of the image of a right triangle or rectangle that has been translated either vertically, horizontally, or a combination of a vertical and horizontal translation. • Identify the coordinates of the image of a right triangle or rectangle that has been rotated 90° or 180° about the origin. • Identify the coordinates of the image of a right triangle or a rectangle that has been reflected over the x- or y-axis. • Identify the coordinates of a right triangle or rectangle that has been dilated. The center of the dilation will be the origin. • Sketch the image of a right triangle or rectangle translated vertically or horizontally. • Sketch the image of a right triangle or rectangle that has been rotated 90° or 180° about the origin. • Sketch the image of a right triangle or rectangle that has been reflected over the x- and y-axis. • Sketch the image of a dilation of a right triangle or rectangle limited to a scale factor of 1/4, 1/2, 2, 3 or 4.	• Translations, rotations and reflections do not change the size or shape of a figure. A dilation of a figure and the original figure are similar. Reflections, translations and rotations usually change the position of the figure.

Instructional Strategies

- Tessellation Project
- Use patty paper to trace figures to determine the type of transformation.
- Bring in advertisements from flyers, newspapers, and coupon mailers. Have students identify different types of transformations found in the ads. Wallpaper samples can be used to illustrate different transformations.

VDOE Lesson Plans

Rotations (VDOE)

Dilations (VDOE)

Translation and Reflection (VDOE)

Other Resources

Unit: **Geometry**

Focus: Relationships between Figures

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.7 The student will compare and contrast the following quadrilaterals based on properties: parallelogram, rectangle, square, rhombus, and trapezoid.

Understanding the Standard

Background information of teachers

- A quadrilateral is a closed plane (two-dimensional) figure with four sides that are line segments.
- A parallelogram is a quadrilateral whose opposite sides are parallel and opposite angles are congruent.
- A rectangle is a parallelogram with four right angles. The diagonals of a rectangle are the same length and bisect each other.
- A square is a rectangle with four congruent sides whose diagonals are perpendicular. A square is a rhombus with four right angles.
- A rhombus is a parallelogram with four congruent sides whose diagonals bisect each other and intersect at right angles.
- A trapezoid is a quadrilateral with exactly one pair of parallel sides.
- A trapezoid with congruent, nonparallel sides is called an *isosceles trapezoid*.
- Quadrilaterals can be sorted according to common attributes, using a variety of materials.
- A chart, graphic organizer, or Venn diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles.

Unit: **Geometry**

Focus: Relationships between Figures

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.7 The student will compare and contrast the following quadrilaterals based on properties: parallelogram, rectangle, square, rhombus, and trapezoid.

Essential Knowledge and Skills	**Essential Questions** **Essential Understandings All Students should…**
Essential Vocabulary: congruent, decagon, diagonal, hatch marks, heptagon, hexagon, isosceles, trapezoid, kite, nonagon, octagon, parallel, parallelogram, pentagon, plane figure	
• Compare and contrast attributes of the following quadrilaterals: parallelogram, rectangle, square, rhombus, and trapezoid. • Identify the classification(s) to which a quadrilateral belongs, using deductive reasoning and inference.	• Why can some quadrilaterals be classified in more than one category? Every quadrilateral in a subset has all of the defining attributes of the subset. For example, if a quadrilateral is a rhombus, it has all the attributes of a rhombus. However, if that rhombus also has the additional property of 4 right angles, then that rhombus is also a square. • What is a polygon?** A polygon is a simple closed plane figure whose sides are line segments that intersect only at their endpoints. • How do the prefixes in the names relate to the attributes of the polygon?** The prefixes in the names name the number of sides of a polygon

Instructional Strategies

- Quadrilateral Family Project
- Have students locate and make lists of where different geometric shapes are found.
- Students search for parallelograms, rectangles, squares, rhombi, and trapezoids. Students will describe the characteristics of each quadrilateral and how the shapes are alike and different.
- Prepare a bulletin board with shapes and the appropriate name of each shape. Each day, a student will go to the bulletin board and place the correct name under the appropriate shape.
- Make a flow chart demonstrating the relationships among all quadrilaterals.
- Make models of angles and triangles using geostrips or rays made out of paper and connected with paper fasteners.**
- Students draw various polygons, not to exceed ten sides, on grid paper. Next, the students will trade papers with a classmate and name the polygons drawn on the paper.**

VDOE Lesson Plans

Quadrilateral Sort (VDOE)

Other Resources

A *polygon* is a simple closed plane figure whose sides are line segments that intersect only at their endpoints. A *quadrilateral* is a closed *plane figure* (two-dimensional) with four sides that are line segments.

Two lines in the same plane are *parallel* if they do not intersect. They are everywhere the same distance from each other. Two geometric figures that are the same shape and size are *congruent*. Two angles are congruent if they have the same measure. Two line segments are congruent if they are the same length.

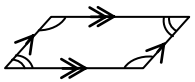
A *diagonal* is a line segment that connects two non-consecutive vertices. A *vertex* is a common point to two sides of an angle or a polygon.

Denote which angles are congruent with the same number of curved lines. Congruent sides are denoted with the same number of *hatch marks* on each congruent side.

Arrows are used in diagrams to indicate that lines are parallel.

Parallelogram

A *parallelogram* is a quadrilateral whose opposite sides are parallel and congruent. Opposite angles are congruent.
A diagonal divides the parallelogram into two congruent



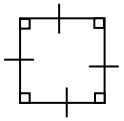
triangles. The diagonals of a parallelogram bisect each other.

Rectangle

A *rectangle* is a parallelogram with four right angles. The diagonals of a rectangle are the same length (congruent) and bisect each other. Since a rectangle is a parallelogram, a rectangle has the same properties as those of a parallelogram.

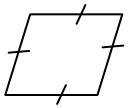
Square

A *square* is a rectangle with four congruent sides and a rhombus with four right angles. Squares have special characteristics that are true for all squares, such as diagonals are perpendicular bisectors and diagonals bisect opposite angles. Since a square is a rectangle, a square has all the properties of a rectangle and of a parallelogram.



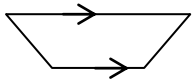
Rhombus

A *rhombus* is a parallelogram with four congruent sides whose diagonals bisect each other and intersect at right angles. Opposite angles are congruent.



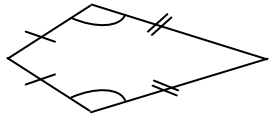
Trapezoid

A *trapezoid* is a quadrilateral with exactly one pair of parallel sides. A trapezoid may have none or two right angles. A trapezoid with congruent, non-parallel sides is called an *isosceles trapezoid.*

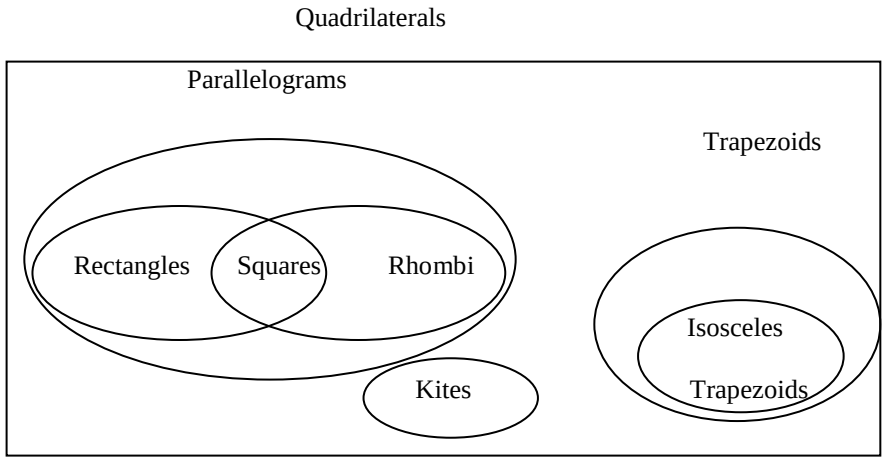


Kite

A kite is a quadrilateral with two pairs of adjacent congruent sides. One pair of opposite angles is congruent.



Quadrilaterals can be sorted according to common attributes, using a variety of materials. A chart, graphic organizer, or a Venn diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles.



The number of sides determines the name of the polygon. A *pentagon* has 5 sides; a *hexagon*, 6 sides; a *heptagon*, 7 sides; an *octagon*, 8 sides; a *nonagon*, 9 sides; and a *decagon*, 10 sides.**

Prefixes in the names of polygons tell the number of sides: penta = 5, hexa = 6, hepta = 7, octa = 8, nona = 9, and deca = 10.**

In *regular polygons* all angles are congruent and all sides are congruent.**

Unit: **Measurement**

Focus: Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.6 The student will determine whether plane figures – quadrilaterals and triangles – are similar and write proportions to express the relationships between corresponding sides of similar figures.

Understanding the Standard

Background information of teachers

- Two polygons are similar if corresponding (matching) angles are congruent and the lengths of corresponding sides are proportional.
- Congruent polygons have the same size and shape.
- Congruent polygons are similar polygons for which the ratio of the corresponding sides is 1:1.
- Similarity statements can be used to determine corresponding parts of similar figures such as:

$\Delta ABC \sim \Delta DEF$

$\angle A$ corresponds to $\angle D$

$\overline{AB}$ corresponds to $\overline{DE}$

- The traditional notation for marking congruent angles is to use a curve on each angle. Denote which angles are congruent with the same number of curved lines. For example, if $\angle$A congruent to $\angle$B, then both angles will be marked with the same number of curved lines.
- Congruent sides are denoted with the same number of hatch marks on each congruent side. For example, a side on a polygon with 2 hatch marks is congruent to the side with 2 hatch marks on a congruent polygon.

Unit: **Measurement**

Focus: Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.6 The student will determine whether plane figures – quadrilaterals and triangles – are similar and write proportions to express the relationships between corresponding sides of similar figures.

Essential Knowledge and Skills *Essential Vocabulary: corresponding parts, congruent, hatch marks, polygon, proportion, ratio, similar figures*	**Essential Questions** **Essential Understandings All Students should…**
• Identify corresponding sides and corresponding and congruent angles of similar figures using the traditional notation of curved lines for angles. • Write proportions to express the relationships between the lengths of corresponding sides of similar figures. • Determine if quadrilaterals or triangles are similar by examining congruence of corresponding angles and proportionality of corresponding sides. • Given two similar figures, write similarity statements using symbols such as $\Delta ABC \sim \Delta DEF$, $\angle A$ corresponds to $\angle D$, and AB corresponds to DE.	• How do polygons that are similar compare to polygons that are congruent? Congruent polygons have the same size and shape. Similar polygons have the same shape, and corresponding angles between the similar figures are congruent. However, the lengths of the corresponding sides are proportional. All congruent polygons are considered similar with the ratio of the corresponding sides being 1:1.

Instructional Strategies

- Each student is given two rectangular cards to see if they are similar. The students measure the cards in inches and compare the two ratios to see if they are equal. If they are not similar, one of the cards is cut so they are similar.
- Students are given several quadrilaterals and asked to identify which are similar. Students must identify congruency and proportionality to support their decisions.
-

VDOE Lesson Plans

Similar Figures (VDOE)

Other Resources

Smart Lesson TEI

Unit: **Measurement**

Focus: Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.5 The student will

a) Describe volume and surface area of cylinders;
b) Solve practical problems involving the volume and surface area of rectangular prisms and cylinders; and
c) Describe how changing one measured attribute of a rectangular prism affects its volume and surface area.

Understanding the Standard
Background information of teachers

- The area of a rectangle is computed by multiplying the lengths of two adjacent sides.
- The area of a circle is computed by squaring the radius and multiplying that product by π ($A = \pi r^2$, where $\pi \approx 3.14$ or $\frac{22}{7}$).
- A rectangular prism can be represented on a flat surface as a net that contains six rectangles — two that have measures of the length and width of the base, two others that have measures of the length and height, and two others that have measures of the width and height. The surface area of a rectangular prism is the sum of the areas of all six faces ($SA = 2lw + 2lh + 2wh$).
- A cylinder can be represented on a flat surface as a net that contains two circles (bases for the cylinder) and one rectangular region whose length is the circumference of the circular base and whose width is the height of the cylinder. The surface area of the cylinder is the area of the two circles and the rectangle ($SA = 2\pi r^2 + 2\pi rh$).
- The volume of a rectangular prism is computed by multiplying the area of the base, B, (length times width) by the height of the prism ($V = lwh = Bh$).
- The volume of a cylinder is computed by multiplying the area of the base, B, (πr^2) by the height of the cylinder ($V = \pi r^2 h = Bh$).
- There is a direct relationship between changing one measured attribute of a rectangular prism by a scale factor and its volume. For example, doubling the length of a prism will double its volume. This direct relationship does not hold true for surface area.

Unit: **Measurement**

Focus: Proportional Reasoning

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.5 The student will

a) Describe volume and surface area of cylinders;

b) Solve practical problems involving the volume and surface area of rectangular prisms and cylinders; and

c) Describe how changing one measured attribute of a rectangular prism affects its volume and surface area.

Essential Knowledge and Skills *Essential Vocabulary: base, cylinder, diameter, face, formula, height, length, net, pi (π), radius, rectangular prism, scale factor, surface area, volume, width*	**Essential Questions** **Essential Understandings All Students should…**
• Determine if a practical problem involving a rectangular prism or cylinder represents the application of volume or surface area. • Find the surface area of a rectangular prism. • Solve practical problems that require finding the surface area of a rectangular prism. • Find the surface area of a cylinder. • Solve practical problems that require finding the surface area of a cylinder. • Find the volume of a rectangular prism. • Solve practical problems that require finding the volume of a rectangular prism. • Find the volume of a cylinder. • Solve practical problems that require finding the volume of a cylinder. • Describe how the volume of a rectangular prism is affected when one measured attribute is multiplied by a scale factor. Problems will be limited to changing attributes by scale factors only. • Describe how the surface area of a rectangular prism is affected when one measured attribute is multiplied by a scale factor. Problems will be limited to changing attributes by scale factors only.	• How are volume and surface area related? Volume is a measure of the amount a container holds while surface area is the sum of the areas of the surfaces on the container. • How does the volume of a rectangular prism change when one of the attributes is increased? There is a direct relationship between the volume of a rectangular prism increasing when the length of one of the attributes of the prism is changed by a scale factor.

Instructional Strategies

- Students bring in cereal and oatmeal boxes from home and cut them apart to determine the surface area.
- Students stack unit cubes in various ways and find the surface areas of the structures they have built. They sketch their figures and discuss which figure has the largest surface area and which has the smallest surface area.
- The students will work in groups of three or four using 1" cubes and 1" by 1" grid paper. Have the students design the cubes on the grid paper in a 3 x 5 rectangle. The students will then figure the area of the rectangle by counting the cubes. Next have the students add a second layer of cubes to the rectangle and give the area. Add the areas in order to determine the volume. Continue adding layers until the students arrive at the formula V= (area of base) h.
- Three-dimensional models may be built from pictures showing the top, side and/or bottom views. Pictures may be line drawings or drawings on dot paper. Volume can then be determined by counting the cubes. Surface area can be determined by counting all outside faces.

VDOE Lesson Plans

Surface Area and Volume of cylinders (VDOE)

Volume of a Rectangular Prism (VDOE)

Surface Area of a Rectangular Prism (VDOE)

Attributes of a Rectangular Prism (VDOE)

Other Resources

Smart Lesson TEI

Example given on next page

Example: Given a rectangular prism with the following dimensions: $l = 5$ meters, $w = 4$ meters and $h = 3$ meters. Students should describe how the volume and surface area of a rectangular prism is affected when one attribute is multiplied by a scale factor.

	Length	Width	Height	Volume	Surface Area
Original Figure	5	4	3	60 m^3	94 m^2
Using the original figure:					
Multiply length by 2	10	4	3	120 m^3	164 m^2
Multiply width by 2	5	8	3	120 m^3	158 m^2
Multiply height by 2	5	4	6	120 m^3	148 m^2
Multiply length by $\frac{1}{2}$	$2\frac{1}{2}$	4	3	30 m^3	59 m^2
Multiply width by $\frac{1}{2}$	5	2	3	30 m^3	62 m^2
Multiply height by $\frac{1}{2}$	5	4	$1\frac{1}{2}$	30 m^3	67 m^2

4th Quarter

Unit: **Probability and Statistics**

Focus: Applications of Statistics and Probability

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.9 The student will investigate and describe the difference between the experimental probability and theoretical probability of an event.

Understanding the Standard
Background information of teachers

- Theoretical probability of an event is the expected probability and can be found with a formula.
- Theoretical probability of an event =

$$\frac{\text{number of possible favorable outcomes}}{\text{total number of possible outcomes}}$$

- The experimental probability of an event is determined by carrying out a simulation or an experiment.
- The experimental probability =

$$\frac{\text{number of times desired outcomes occur}}{\text{number of trials in the experiment}}$$

In experimental probability, as the number of trials increases, the experimental probability gets closer to the theoretical probability (Law of Large Numbers).

Unit: **Probability and Statistics**

Focus: Applications of Statistics and Probability

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.9 The student will investigate and describe the difference between the experimental probability and theoretical probability of an event.

Essential Knowledge and Skills *Essential Vocabulary: event, experimental probability, Law of Large Numbers, outcome, probability, sample space, sampling simulation, theoretical probability*	**Essential Questions** **Essential Understandings All Students should…**
• Determine the theoretical probability of an event. • Determine the experimental probability of an event. • Describe changes in the experimental probability as the number of trials increases. • Investigate and describe the difference between the probability of an event found through experiment or simulation versus the theoretical probability of that same event.	• What is the difference between the theoretical and experimental probability of an event? Theoretical probability of an event is the expected probability and can be found with a formula. The experimental probability of an event is determined by carrying out a simulation or an experiment. In experimental probability, as the number of trials increases, the experimental probability gets closer to the theoretical probability.

Instructional Strategies

- Flipping Coin Activity to compare theoretical versus experimental.
- Plan and carry out experiments that use concrete materials (e.g., coins, spinners, number cubes, etc.) to determine an experimental probability of an event.
- Students form large groups and, then, break into pairs of students. Each pair of students is given one number cube with faces labeled 1-6 and a score sheet. One student in each pair tosses the number cube 20 times, while the other student tallies the results on the score sheet. Students then reverse roles. Upon completion students should return to their larger group to compare and discuss their results. In particular, they should decide whether the chance of tossing a 1, 2, or 3 is the same as the chance of tossing a 4, 5, or a 6 and why? Compile the results from all classes. Describe how these results approach the theoretical probability of the events.
- Using two number cubes, work with the class to list all the possible outcomes of rolling both cubes. Students work in pairs with two number cubes. Rolling the number cubes 10 times students list their outcomes. The two students compare their results with the results from the list (table) of all possible outcomes. Discuss with students how close their results were to the original results. Have students do the experiment 10 more times adding these results to the first 10 and again compare results with the original results. Ask, "Are your results any closer to the original results?" Do the experiment 10 more times and compare results.

VDOE Lesson Plans

What are the Chances (VDOE)

Other Resources

Unit: **Probability and Statistics**

Focus: Applications of Statistics and Probability

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.10 The student will determine the probability of compound events, using the Fundamental (Basic) Counting Principle.

Understanding the Standard

Background information of teachers

- The Fundamental (Basic) Counting Principle is a computational procedure to determine the number of possible outcomes of several events. It is the product of the number of outcomes for each event that can be chosen individually (e.g., the possible outcomes or outfits of four shirts, two pants, and three shoes is $4 \cdot 2 \cdot 3$ or 24).
- Tree diagrams are used to illustrate possible outcomes of events. They can be used to support the Fundamental (Basic) Counting Principle.
- A compound event combines two or more simple events. For example, a bag contains 4 red, 3 green and 2 blue marbles. What is the probability of selecting a green and then a blue marble?

Unit: **Probability and Statistics**

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Standard: 7.10 The student will determine the probability of compound events, using the Fundamental (Basic) Counting Principle.

Essential Knowledge and Skills	**Essential Questions** **Essential Understandings All Students should…**
Essential Vocabulary: compound event, dependent event, Fundamental Counting Principle, independent event, outcomes, probability, sample space, tree diagram	
• Compute the number of possible outcomes by using the Fundamental (Basic) Counting Principle. • Determine the probability of a compound event containing no more than 2 events.	• What is the Fundamental (Basic) Counting Principle? The Fundamental (Basic) Counting Principle is a computational procedure used to determine the number of possible outcomes of several events. • What is the role of the Fundamental (Basic) Counting Principle in determining the probability of compound events? The Fundamental (Basic) Counting Principle is used to determine the number of outcomes of several events. It is the product of the number of outcomes for each event that can be chosen individually.

Instructional Strategies

- The standard Virginia state license plate has three letters followed by four digits. How many different license plates are possible if the digits and letters can be repeated? (175,760,000) How many are possible if they cannot be repeated? (78,624,000)
- Students will list several items of clothing and then determine the different outfits that they could create with these items.
- Obtain three chips; one with sides marked A and B, one with B and C, and one with A and C. All chips will be flipped at the same time. Make a tree diagram to show all possible results. Determine probability that none of the chips matches or that at least two will match. Similar experiments may be done with spinners, flipping coins, and number cubes.
- Students study the chances of winning in the Virginia Lottery Pick 3 and Pick 4 daily events using the Basic Counting Principle. They compare the chances of winning with the size of the prize.
- Bring in menus from various restaurants. Have students determine the possible number of meals using various combinations. For example, how many meals with an entrée and a drink are possible?

VDOE Lesson Plans

The Real Meal Deal (VDOE)

Other Resources

Unit: **Probability and Statistics**

Focus: Applications of Statistics and Probability

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

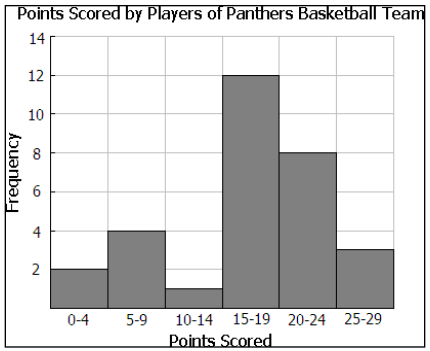
Standard: 7.11 The student, given data in a practical situation, will

a) Construct and analyze histograms; and

b) Compare and contrast histograms with other types of graphs presenting information from the same data set.

Understanding the Standard
Background information of teachers

- All graphs tell a story and include a title and labels that describe the data.
- A histogram is a form of bar graph in which the categories are consecutive and equal intervals. The length or height of each bar is determined by the number of data elements frequency falling into a particular interval.



- A frequency distribution shows how often an item, a number, or range of numbers occurs. It can be used to construct a histogram.

STUDENTS WHO READ GARFIELD			
Age Group	Tally	Frequency	Cumulative Frequency
7-10	𝍸 ||	7	7
11-14	𝍸 ||	7	14 ← 7 + 7
15-18	|||	3	17 ← 14 + 3
19-22	|||	3	20 ← 17 + 3

- Comparisons, predictions and inferences are made by examining characteristics of a data set displayed in a variety of graphical representations to draw conclusions.
- The information displayed in different graphs may be examined to determine how data are or are not related, ascertaining differences between characteristics (comparisons), trends that suggest what new data might be like (predictions), and/or "what could happen if" (inference).

Unit: **Probability and Statistics**

Focus: Applications of Statistics and Probability

Process standards: The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations.

Standard: 7.11 The student, given data in a practical situation, will
a) Construct and analyze histograms; and
b) Compare and contrast histograms with other types of graphs presenting information from the same data set.

Essential Knowledge and Skills	**Essential Questions** **Essential Understandings All Students should…**
Essential Vocabulary: circle graph, conjecture, frequency distribution, histogram, inference, intervals, line plot, prediction, stem-and-leaf-plot, tally, trends	
• Collect, analyze, display, and interpret a data set using histograms. For collection and display of raw data, limit the data to 20 items. • Determine patterns and relationships within data sets (e.g., trends). • Make inferences, conjectures, and predictions based on analysis of a set of data. • Compare and contrast histograms with line plots, circle graphs, and stem-and-leaf plots presenting information from the same data set.	• What type of data are most appropriate to display in a histogram? Numerical data that can be characterized using consecutive intervals are best displayed in a histogram.

Instructional Strategies

- Students research to find the ages of the Presidents when they took office. Construct a histogram displaying this data. What can the students determine about the ages of the Presidents when they took office?
- Students are asked to predict how many metals the United States will win in the next Olympics. They write their prediction on a Post-It-Note and an explanation of their reasoning. The predictions are collected and displayed on line plot, stem-and-leaf plots, circle graphs, or histograms. Discuss which graph will best display this data and why it is the best choice.
- Students collect data on topics that interest them, display their findings using a histogram. Compare this histogram with a line plot, stem-and-leaf plot, or circle graph displaying the same data. Possible topics include the following:
    - number of minutes spent on homework per week;
    - allowances of each student in the class; or
    - number of hours of television watched per week.

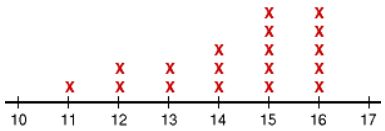
VDOE Lesson Plans

Name and Number (VDOE)

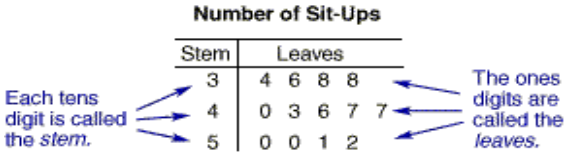
Other Resources

Statistics are generalizations about data that has been gathered, organized and summarized, displayed in tables and graphs, and interpreted. All graphs tell a story and include a title and labels that describe the data.

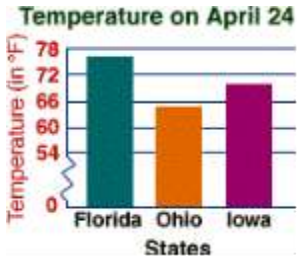
A *line plot* shows the frequency of data on a number line. Line plots are used to show the spread of the data and quickly identify the range, mode, and any outliers.



A *stem-and-leaf plot* displays data from least to greatest using the digits of the greatest place value to group data.



Bar graphs are utilized to compare counts of different categories both categorical or discrete data. A bar graph uses parallel bars; either horizontal or vertical, to represent counts for several categories. One bar is used for each category with the length of the bar representing the count for that category. There is space before, between, and after the bars. The axis displaying the scale representing the count for the categories should extend one increment above the greatest recorded piece of data. The values should represent equal increments. Each axis should be labeled, and the graph should have a title.



Graphs make it easier to observe patterns in data. Some graphs includes two scales, or rulers – the horizontal axis and the vertical axis. An *interval* is the difference between the values on a scale.

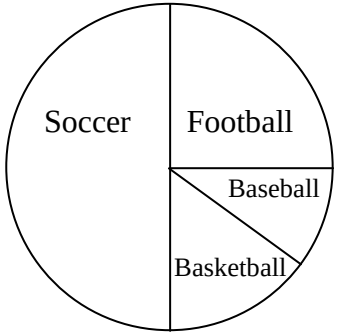
Comparisons, predictions and inferences are made by examining characteristics of a data set displayed in a variety of graphical representations to draw conclusions.

The information displayed in different graphs may be examined to determine how data are or are not related, ascertaining differences between characteristics (comparisons), *trends* (patterns and relationships within data sets) that suggest what new data might be like (*predictions*), and/or "what could happen if" (*inference*).

A *conjecture* is a statement that has not been proved to be true nor shown to be false.

*Circle graph*s are best used for data showing a relationship of the parts to the whole. To construct a circle graph find the fractional part of the whole. Multiply each fractional part by 360 (the number of degrees in a circle). Draw a circle. Make central angles (angles whose vertex is the center of the circle) based on the products of the fractional parts times 360.

Favorite Sports



Sport	Number	Fractional part of circle	Measure of central angle
Football	10	$\frac{10}{40}=\frac{1}{4}$	$\frac{1}{4}\times 360=90°$
Soccer	20	$\frac{20}{40}=\frac{1}{2}$	$\frac{1}{2}\times 360=180°$
Baseball	4	$\frac{4}{40}=\frac{1}{10}$	$\frac{1}{10}\times 360=36°$
Basketball	6	$\frac{6}{40}=\frac{3}{20}$	$\frac{3}{20}\times 360=54°$
Total	40	$\frac{40}{40}=1$	360º