# PRE-ALGEBRA and ALGEBRA 1 HONORS

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- A1H Unit 2 will likely be zeroed out on the Midterm Exam
Pinellas County Schools  
Double Block P-A and A1H  
2020-2021

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<tr>
<th>Semester 1</th>
<th>P-A Unit 1: Real Numbers</th>
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### Standards/Learning Goals:

| **MAFS.8.NS.1.1** | Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. | - All irrational numbers may be used, excluding e.  
- Only rational numbers with repeating decimal expansions up to thousandths may be used.  

**Calculator:** NO  
**Context:** NO CONTEXT |

| **MAFS.8.NS.1.2** | Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., \(\pi^2\)). For example, by truncating the decimal expansion of \(\sqrt{2}\) is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations. | - All irrational numbers may be used, excluding e.  
- Irrational expressions should only use one operation.  

**Calculator:** NO  
**Context:** NO CONTEXT |

| **MAFS.8.EE.1.1** | Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, \(3^2 \times 3^{-5} = 3^{-3} = 1/3^2 = 1/27\). | - Exponents must be integers.  
- Bases must be whole numbers  
- Variables may not be used.  

**Calculator:** NO  
**Context:** NO CONTEXT |

| **MAFS.8.EE.1.2** | Use square root and cube root symbols to represent solutions to equations of the form \(x^2 = p\) and \(x^3 = p\), where \(p\) is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that \(\sqrt{2}\) is irrational. | - Square roots and cube roots may be used to represent solutions to equations.  
- Radicands may not include variables.  

**Calculator:** NEUTRAL  
**Context:** ALLOWABLE |

| **MAFS.8.EE.1.3** | Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 times \(10^8\) and the population of the world as 7 times \(10^9\), and determine that the world population is more than 20 times larger. | - N/A  

**Calculator:** NO  
**Context:** ALLOWABLE |

| **MAFS.8.EE.1.4** | Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. | - N/A  

**Calculator:** NO  
**Context:** ALLOWABLE |

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### Open Up Resources Lessons

Grade 8, Unit 7: Exponents and Scientific Notation

- Lesson 1: Exponent Review
- Lesson 2: Multiplying Powers of Ten
- Lesson 3: Powers of Powers of 10
- Lesson 4: Dividing Powers of 10
- Lesson 5: Negative Exponents with Powers of 10
- Lesson 6: What about Other Bases?
- Lesson 7: Practice with Rational Bases
- Lesson 8: Combining Bases
Lesson 9: Describing Large and Small Numbers Using Powers of 10
Lesson 10: Representing Large Numbers on the Number Line
Lesson 11: Representing Small Numbers on the Number Line
Lesson 12: Applications of Arithmetic with Powers of 10
Lesson 13: Definition of Scientific Notation
Lesson 14: Multiplying, Dividing, and Estimating with Scientific Notation
Lesson 15: Adding and Subtracting with Scientific Notation

Grade 8, Unit 8: Pythagorean Theorem and Irrational Numbers
Lesson 14: Decimal Representations of Rational Numbers
Lesson 15: Infinite Decimal Expansions

Decoded Standard

MAFS.8.NS.1.1
Students expand their knowledge of the Real Number System to include irrational numbers. A diagram shows the relationship of the subsets:

see image on page 71 of the Common Core Mathematics Companion

An irrational number is a decimal whose expansion does not terminate or repeat. Irrational numbers cannot be written in fraction form. Using decimal expressions, students compare rational numbers and irrational numbers to show that rational number expansion repeat and irrational numbers expansions do not. The notation “… means “continues indefinitely without repeating.” For example, 0.3 is a rational number that repeats but π = 3.1415 … does not repeat.

To convert a decimal expansion into a fraction:
Change 0.5 to a fraction
1. Let \( x = 0.555 \ldots \)
2. Multiply both sides so that the repeating digits will be in front of the decimal. In this case, one digit repeats so both sides are multiplied by 10, giving \( 10x = 5.555 \ldots \)
3. Subtract the original equation from the new equation.
   \[
   10x = 5.555 \ldots \\
   -x = 0.555 \ldots \\
   \]
   \[
   9x = 5
   \]
4. Solve the equation by dividing both sides of the equation by 9.
   \[
   x = \frac{5}{9}
   \]
(Common Core Mathematics Companion, Pg. 71)

Instructional Resources

Formative Tasks
Mathematics Formative Assessments (MFAS)
- **Rational Numbers** Identify rational numbers from a list of real numbers.
- **Fraction to Decimal Conversion** Given a fraction to convert to a decimal; determine if the decimal repeats.
- **Decimal to Fraction Conversion** Given several terminating and repeating decimals to convert to fractions.

Illustrative Mathematics
- **Converting Decimal Representations of Rational Numbers to Fraction Representations** Convert repeating decimals into fractions
- **Repeating or Terminating?** Understand why terminating decimal numbers can also be written as repeating decimals where the repeating part is all 9’s.

Engage NY
- **Grade 8, Module 7, Topic B, Lesson 8** Decimal expansion

McGraw-Hill
Course 3, Chapter 1
Lesson 1
Decoded Standard

MAFS.8.NS.1.2
Students compare irrational numbers and locate them on a number line by finding their rational approximations. Find rational approximations by creating lists of numbers by answering the following question: Between which two numbers will you find \( \sqrt{2} \)? Since \( 1^2 = 1 \) and \( 2^2 = 4 \), it is between 1 and 2. To be more precise, is it closer to 1 or 2? Systematically square 1.1, 1.2, 1.3, 1.4...... 1.9. Between which two numbers do you find 2? Repeat the process until the degree of precision you are seeking.

Formative Tasks

Mathematics Formative Assessments (MFAS)
- **Approximating Irrational Numbers** Plot the square root of eight on three number lines, scaled to progressively more precision.
- **Locating Irrational Numbers** Graph three different irrational numbers on number lines.
- **Comparing Irrational Numbers** Estimate the value of several irrational numbers using a calculator and order them on a number line.
- **The Irrational Beauty of the Golden Ratio** Find and interpret lower and upper bounds of an irrational expression using a calculator.

Illustrative Mathematics
- **Comparing Rational and Irrational Numbers** Compare rational and irrational numbers without a calculator.
- **Irrational Numbers on the Number Line** Label irrational numbers on a number line.

Engaging Tasks
- **Decimal Approximations of Roots** - Open Middle
- **Rational and Irrational Roots** - Open Middle
- **Number 18** - Which One Doesn’t Belong

Decoded Standard

MAFS.8.EE.1.1
Students learn how to compute using integer exponents building on their earlier experiences with adding and subtracting integers. For any non-zero real numbers \( a \) and \( b \) and integers \( n \) and \( m \), the properties of integer exponents are as follows:

1. \( a^m a^n = a^{m+n} \)
2. \( (a^n)^m = a^{nm} \)
3. \( a^n b^n = (ab)^n \)
4. \( a^0 = 1 \)
5. \( a^{-n} = \frac{1}{a^n} \)

\( \frac{a^n}{a^m} = a^{n-m} \)

(Common Core Mathematics Companion, Pg. 118)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)
- **Exponents Tabled** Complete a table of powers of three and provide an explanation of zero powers.
- **Multiplying and Dividing Integer Exponents** Apply the properties of integer exponents to generate equivalent numerical expressions.

Engage NY
- **Grade 8, Module 1, Topic A, Lesson 1** Understanding exponential notation
- **Grade 8, Module 1, Topic A, Lesson 2** Simplifying exponential expressions
- **Grade 8, Module 1, Topic A, Lesson 3** Powers of powers

Lesson Resources

Engage NY
- **Grade 8, Module 7, Topic B, Lesson 11** Decimal expansion of roots
- **Grade 8, Module 7, Topic B, Lesson 12** Decimal expansions of fractions
- **Grade 8, Module 7, Topic B, Lesson 13** Compare and order rational approximations

MARS/Shell
- **Rational and Irrational Numbers 2** Understand the properties of rational and irrational number.

McGraw-Hill
Course 3, Chapter 1
Lesson 9; Lesson 10
### Illustrated Mathematics
- **Raising to the zero and negative powers**: Use the quotient rule of exponents to help explain how to define the expression \( c^0 \)

### Engaging Tasks
- **How Can We Make Stronger Passwords**: Determine how long it will take to crack your password.

### MARS/Shell
- **Applying Properties of Exponents**: Apply the properties of exponents by a matching activity.

### McGraw-Hill
- **Course 3, Chapter 1**
  - **Lesson 3, 4 and 5**: Decoded Standard
    - **MAFS.8.EE.1.2**
      Students learn that squaring and cubing numbers are the inverse operations to finding square and cube roots. This standard works with perfect squares and perfect cubes, and students will begin to recognize those numbers. Equations should include rational numbers such as \( x^2 = \frac{1}{4} \) and \( x^3 = \frac{1}{64} \) and fractions where both the numerator and denominator are perfect squares or cubes: \( x^2 = \frac{1}{4} \)
      \[
      \sqrt{x^2} = \pm \sqrt{\frac{1}{4}} \\
      x = \pm \frac{1}{2}
      \]
      Square roots can be positive or negative because \( 2 \times 2 = 4 \) and \( -2 \times -2 = 4 \).
      *(Common Core Mathematics Companion, Pg. 119)*

### Instructional Resources

#### Formative Tasks
**Mathematics Formative Assessments (MFAS)**
- **The Root of the Problem**: Evaluate perfect square roots and perfect cube roots.
- **Dimension Needed**: Solve problems involving square roots and cube roots.
- **Roots and Radicals**: Use square root and cube root symbols to represent the real solutions of each equation. Then evaluate any square roots of perfect squares and cube roots of perfect cubes. Indicate if any of your solutions are irrational.

#### Lesson Resources
**Engage NY**
- **Grade 8, Module 7, Topic A, Lesson 2**: Square and cube roots

**McGraw-Hill**
- **Course 3, Chapter 1**
  - **Lesson 8**: Decoded Standard
    - **MAFS.8.EE.1.3**
      This standard emphasizes scientific notation. Students write very large and very small numbers in scientific notation using positive and negative exponents. For example 123,000 written in scientific notation is \( 1.23 \times 10^5 \), and 0.008 written in scientific notation is \( 8 \times 10^{-4} \). When mastered, students use the skill to determine how many times larger (or smaller) one number written in scientific notation is than another. To compare, if the exponent increases by 1, the value increases 10 times. In the example of the U.S. and world populations, the exponent increased by 1, and the 7 is a little more than 2 times 3. So 2 \( \times \) 10 makes for 20 times larger.
      *(Common Core Mathematics Companion, Pg. 120)*

### Instructional Resources

#### Formative Tasks
**Mathematics Formative Assessments (MFAS)**
- **Estimating Extreme Values**: Estimate each value described below by writing it in the form \( a \times 10^n \) where \( a \) is a single digit number and \( n \) is an integer.

#### Lesson Resources
**Engage NY**
- **Grade 8, Module 1, Topic B, Lesson 1**: Powers of 10
- **Grade 8, Module 1, Topic B, Lesson 2**: Translating scientific notation and standard form
• **How Many Times** Given pairs of numbers written in exponential form to compare them multiplicatively.

• **Compare Numbers** Given pairs of numbers written in scientific notation compare them multiplicatively.

• **Order Matters** Given pairs of numbers written in the form of an integer times a power of 10. Then compare the numbers in each pair using the inequality symbols.

**Illustrated Mathematics**

• **Ant and Elephant** Compare very small and very large quantities using metric system

**Grade 8, Module 1, Topic B, Lesson 13** Comparing numbers in scientific notation

**MARS/Shell**

• **Applying Properties of Exponents** Estimating length using scientific notation.

**McGraw-Hill**

Course 3, Chapter 1
Lesson 6 (supplement to express how many times larger)

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### Decoded Standard

MAFS.8.EE.1.4

This standard builds on previous standards as now students use what they know about scientific notation and properties of integer exponents to solve problems. Quantities in the problems can be expressed in scientific notation and decimal form. Students focus on the size of the measurement to determine which units are appropriate for the context such as millimeters for very small quantities. This standard also calls for students to use technology and be able to interpret the scientific notation used. The teacher needs to check the class calculators to be familiar with the notation used by those particular calculators as the notation used by calculators to express scientific notation is not standard.

(Common Core Mathematics Companion, Pg. 121)

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**

• **Mixed Form Operations** Given word problems with numbers in both standard and scientific notation to solve problems using various operations.

• **Sums and Differences in Scientific Notation** Add and subtract numbers given in scientific notation in real-world contexts.

• **Scientific Multiplication and Division** Multiply and divide numbers given in scientific notation in real-world contexts.

• **Scientific Calculator Display** Given examples of calculator displays and asked to convert the notation in the display to both scientific notation and standard form.

**Engaging Tasks**

• **Scientific Notation** Math Mistakes

#### Engage NY

• **Grade 8, Module 1, Topic B, Lesson 9** Operations with numbers in scientific notation

• **Grade 8, Module 1, Topic B, Lesson 10** Operations with numbers in scientific notation

• **Grade 8, Module 1, Topic B, Lesson 11** Operations with numbers in scientific notation

• **Grade 8, Module 1, Topic B, Lesson 12** Measurement

**McGraw-Hill**

Course 3, Chapter 1
Lesson 7
Standards/Learning Goals:

MAFS.8.EE.3.7 Solve linear equations in one variable.

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form \( x = a, a = a, \) or \( a = b \) results (where \( a \) and \( b \) are different numbers).

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Open Up Resources Lessons

Grade 8, Unit 2: Dilations, Similarity, and Introducing Slope

- Lesson 10: Meet Slope
- Lesson 11: Writing Equations for Lines
- Lesson 12: Using Equations for Lines

Grade 8, Unit 3: Linear Relationships

- Lesson 1: Understanding Proportional Relationships
- Lesson 2: Graphs of Proportional Relationships
- Lesson 3: Representing Proportional Relationships
- Lesson 4: Comparing Proportional Relationships
- Lesson 5: Introduction to Linear Relationships
- Lesson 6: More Linear Relationships
- Lesson 7: Representations of Linear Relationships
- Lesson 8: Translating to \( y = mx + b \)
- Lesson 9: Slopes Don’t Have to be Positive
- Lesson 10: Calculating Slope
- Lesson 11: Equations of All Kinds of Lines

Decoded Standard

MAFS.8.EE.3.7

This standard has students solving linear equations. It is explained by 8.EE.3.7a and b. It is best to teach a and b together so that they are not considered isolated skills.

These standards provide the foundation for all future work with linear equations. Students solve equations that have one, zero, or infinitely many solutions and relate those solutions to the context. If the solution is in the form \( x = a \), there is only one solution. If \( a = a \), there are infinitely many solutions. If \( a = b \) results (where \( a \) and \( b \) are different numbers), there are no solutions.

Linear equations can have fractions and decimals as coefficients and can be solved by expanding expressions with the distributive property and/or collecting like terms. (Common Core Mathematics Companion, Pg. 128)

Instructional Resources

Formative Tasks

- **Counting Solutions**, Worksheet includes three equations where students identify whether there is one solution, no solution, or infinitely many solutions.

Lesson Resources

- **Engage NY**
  - Grade 8, Module 4, Topic A, Lesson 3: Solving equations with variables on both sides
  - Grade 8, Module 4, Topic A, Lesson 4: Solving equations with rational coefficients and variables on both sides
- **Equation Prototypes** Worksheet includes three questions where students are to create equations with one solution, no solution, and infinitely many solutions.
- **Linear Equations I** Students are to solve one linear equation with only one variable that involves rational numbers (fractions): \( \frac{2}{3}x - 4 \frac{1}{2} = -8 \)
- **Linear Equations II** Students are to solve one linear equation with only one variable that involves rational coefficients (decimals) and distributive property: \(-3.5(10x - 2) = -176.75\)
- **Linear Equations III** Students are to solve a linear equation in one variable with rational coefficients and variables on both sides of the equation: \(-4(2x + 9) + 3x = 6 - 4(x - 3)\)

**Engaging Tasks**
- **Linear Equations with One Solutions** Create a linear equation with one solution — Open Middle
- **One Solution, No Solutions, Infinite Solutions** — Open Middle
- **Solving Equations** — Math Mistakes
- **Solving Systems Algebraically** — Math Mistakes
- **Number 17** — Which One Doesn’t Belong

- **Grade 8, Module 4, Topic A, Lesson 6** Solving equations with rational coefficients, distributive property and variables on both sides
- **Grade 8, Module 4, Topic A, Lesson 7** Understanding the conditions for \(a=a\), \(a=b\) and \(x=a\)

**MARS/Shell**
- **Solving Linear Equations in One Variable** Tasks require students to use rational coefficients, collect like terms, expand using distributive property, and categorize equations as one, none, or infinitely many solutions. Whole class instruction, small group and assessment tasks are available.)
- **Classifying Solutions to Systems of Equations** Tasks require students to classify solutions that are represented graphically and use substitution to complete a table of values for linear equations.

**McGraw-Hill**
- **Course 3, Chapter 2**
  - Inquiry Lab: Equations with Variables on Each Side; Lesson 4 and 5
**Semester 1**

**P-A Unit 3: Linear Equations in Two Variables**

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<tr>
<th>Standards/Learning Goals</th>
<th>Content Limits, Assessment Types, Calculator</th>
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| **MAFS.8.EE.2.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.* | • Numbers in items must be rational numbers  
Calculators: YES  
Context: ALLOWABLE |
| **MAFS.8.EE.2.6** Use similar triangles to explain why the slope \(m\) is the same distance between two distinct points on a non-vertical line in the coordinate plane; derive the equation \(y = mx\) for a line through the origin and the equation \(y = mx + b\) for a line intercepting the vertical axis at \(b\). | • All triangles must be right triangles and on a coordinate grid.  
• Numbers in items must be rational numbers.  
• Functions must be linear.  
Calculators: YES  
Context: ALLOWABLE |
| **MAFS.8.EE.3.8** Analyze and solve pairs of simultaneous linear equations.  
\(\text{a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.}\)  
\(\text{b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.*}\)  
\(\text{c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*}\) | • Numbers in items must be rational numbers.  
• Coefficients of equations in standard form must be integers.  
• Items written for MAFS.8.EE.3.8a must include the graph or the equations.  
• Equations in items written for MAFS.8.EE.3.8a must be given in slope-intercept form.  
Calculators: YES  
Context: ALLOWABLE |

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**Open Up Resources Lessons**

**Grade 8, Unit 3: Linear Relationships**
- Lesson 12: Solutions to Linear Equations
- Lesson 13: More Solutions to Linear Equations

**Grade 8, Unit 4: Linear Equations and Linear Systems**
- Lesson 1: Number Puzzles
- Lesson 2: Keeping the Equation Balanced
- Lesson 3: Balanced Moves
- Lesson 4: More Balanced Moves
- Lesson 5: Solving Any Linear Equation
- Lesson 6: Strategic Solving
- Lesson 7: All, Some, or No Solutions
- Lesson 8: How Many Solutions?
- Lesson 9: When Are They the Same
- Lesson 10: On or Off the Line?
- Lesson 11: On Both of the Lines
- Lesson 12: Systems of Equations
- Lesson 13: Solving Systems of Equations
Double Block P-A and A1H

- Lesson 14: Solving More Systems
- Lesson 15: Writing Systems of Equations
- Lesson 16: Solving Problems with Systems of Equations

Decoded Standard

MAFS.8.EE.2.5
Students build on their work from Grade 6 with unit rates and their work with proportional relationships in Grade 7 to compare graphs, tables, and equations of linear (proportional) relationships. Students identify the unit rate as slope in graphs, tables, and equations to compare proportional relationships presented using different representations. For example, compare the unit rate in a problem about a phone bill presented in graphic form on a Cartesian plane to a phone bill from a different company where the unit rate can be found represented in an equation or table. (Common Core Mathematics Companion, Pg. 123)

Instructional Resources

Formative Tasks
- **Interpreting Slope** Using a worksheet, graph a proportionate relationship (from a table of values), find and interpret slope.
- **Proportional Paint** Interpret a graph through a worksheet including three questions (identify unit rate, find slope, and describe how they are related).
- **Compare Slopes** Identify, describe, and compare the slopes of two proportional relationships given the graph of one and the equation of the other.

Illustrative Mathematics
- **Who has the best job?** Compare the rate of change of two functions displayed as a table and an equation.
- **Peaches and Plums** Reason about the relative costs per pound of the two fruits without actually knowing what the costs are.

Engage NY
- **Grade 8, Module 4, Topic B, Lesson 11** Constant rate problems displayed in a graph and a table

MARS/Shell
- **Buying cars** Students will create, compare, and evaluate different representations of functions.
- **Defining Lines by Points, Slopes and Equations** Find slopes and equations using graphs and use slopes and y intercepts to derive equations

McGraw-Hill
- **Course 3, Chapter 3**
  - Lesson 1

Decoded Standard

MAFS.8.EE.2.6
Students gain additional knowledge about slope in this standard as they use similar triangles to explain why the slope \( m \) of a line is the same between any two points on a given non-vertical line. Students understand positive/negative slopes, 0 slope, and undefined slopes. Through the use of similar triangles, teachers lead students to derive the general equation \( y = mx + b \) of a line and discover that \( m \) is the slope and \( b \) is the y-intercept. (Common Core Mathematics Companion, Pg. 124)

**The similarity portion of this standard will be addressed in Unit 6.**

Instructional Resources

Formative Tasks
- **Slope Triangles** Use similar triangles to explain why the slope is the same regardless of the points used to calculate it (worksheet uses proportionality of line segments to help students visualize concept).
- **Deriving Lines II** Students are asked to derive one general equation of a line (using the slope formula) with a y-intercept of \((0,b)\).

Illustrative Mathematics
- **Slopes between points on a line** Help students understand why the calculated slope will be the same for any two points on a given line.

Engage NY
- **Grade 8, Module 4, Topic C, Lesson 15** Interpret slope as rate of change on a graph
- **Grade 8, Module 4, Topic C, Lesson 16** Use triangles to explain slope; slope formula to find slope
- **Grade 8, Module 4, Topic C, Lesson 17** Find slope of a line; Transform standard form to slope intercept form
- **Grade 8, Module 4, Topic C, Lesson 19** Proof that any point on a line is a point on the graph of the equation of that line.
- **Grade 8, Module 4, Topic C, Lesson 20** Any line is the graph of a linear equations
- **Grade 8, Module 4, Topic C, Lesson 23** Solving systems with equations in different forms
### Decoded Standard

**MAFS.8.EE.3.8**

This standard has students solving simultaneous linear equations. It is explained by 8.EE.3.8a-c. It is best to consider a, b, and c together as they are not isolated skills.

Students will understand that points of intersection are the solutions to pairs of simultaneous linear equations (also known as systems of linear equations). Students will solve systems graphically, algebraically, and by inspection. Examples in this standard are in real-world contexts and mathematical problems. *(Common Core Mathematics Companion, Pg. 129)*

### Formative Tasks

**Mathematics Formative Assessments (MFAS)**

- **Identify the Solution** Two graphs are given; students are to identify the solutions of the system and justify their answer.
- **Solving Systems of Linear Equations** Three problems are given; students are asked to solve each algebraically (equations are written in both standard form and slope-intercept form).
- **Solving Systems of Linear Equations by Graphing** Solve one system of equation problem graphically (written in slope-intercept form), write the solution as an ordered pair and explain why it is the solution.
- **How Many Solutions?** Determine the number of solutions for each of the four systems of linear equations without solving (standard form and slope-intercept form) and justify the answer.
- **Writing System Equations** Two word problems are given. Students are asked to write a system of linear equations that could be used to solve them.
- **System Solutions** One word problem (real-world context) with both equations provided. Students are to solve the system of linear equations (elimination or substitution).

**Engaging Tasks**

- **Candy and Chips** Solve the system to determine the cost of a new order of chips and candy.
- **Solutions of Two Linear Equations** Given a graphic, provide 4 points that represent 2 distinct lines.
- **Create a System of Equations, Given 1 Equation and the Solution** Write linear equations so that the solution of the system of that line and equation is a particular point.
- **System of Equations, Special Case Infinitely Many Solutions** Fill in the boxes so that there are infinitely many solutions to the system.
- **Systems of Equations, Special Case No Solution** Fill in the boxes so that there is no solution to the system.
- **Solve Linear Equations with Special Cases** Complete each equation with the given number of solutions.

### Instructional Resources

**Engage NY**

- **Grade 8, Module 4, Topic D, Lesson 24** Intro to Systems of Equations
- **Grade 8, Module 4, Topic D, Lesson 25** Solving systems by graphing
- **Grade 8, Module 4, Topic D, Lesson 26** Solving systems with parallel lines
- **Grade 8, Module 4, Topic D, Lesson 27** Solving systems with no solution
- **Grade 8, Module 4, Topic D, Lesson 28** Solving systems by elimination and substitution

**MARS/Shell**

- **Solving Real Life Problems: Baseball Jerseys** Tasks require students to select appropriate mathematical methods to interpret and evaluate data generated and identify a break-even point.

**McGraw-Hill**

- **Course 3, Chapter 3** Lesson 7
### Standards/Learning Goals:

<table>
<thead>
<tr>
<th>MAFS.8.F.1.1</th>
<th>Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAFS.8.F.1.2</td>
<td>Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.</td>
</tr>
<tr>
<td>MAFS.8.F.1.3</td>
<td>Interpret the equation ( y = mx + b ) as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function ( A = s^2 ) giving the area of a square as a function of its side length is not linear because its graph contains the points ((1, 1), (2, 4)) and ((3, 9)), which are not on a straight line.</td>
</tr>
<tr>
<td>MAFS.8.F.2.4</td>
<td>Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two ((x, y)) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
</tr>
<tr>
<td>MAFS.8.F.2.5</td>
<td>Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</td>
</tr>
</tbody>
</table>

### Open Up Resources Lessons

**Grade 8, Unit 5: Functions and Volume**

- Lesson 1: Inputs and Outputs
- Lesson 2: Introduction to Functions
- Lesson 3: Equations for Functions
- Lesson 4: Tables, Equations, and Graphs of Functions
- Lesson 5: More Graphs of Functions
- Lesson 6: Even More Graphs of Functions
- Lesson 7: Connecting Representations of Functions
- Lesson 8: Linear Functions
- Lesson 9: Linear Models
- Lesson 10: Piecewise Linear Functions

### Decoded Standard

MAFS.8.F.1.1

This standard is the students’ introduction to functions and involves the definition of function as a rule that assigns to each input exactly one output. Students are not required to use or recognize function notation at this grade but will be able to
identify functions using tables, graphs, and equations. A relationship is not a function when there is more than one y-value associated with any x-value. Using the definition, an example of a table that does not represent a function is as follows:

See tables on page 139 of the Common Core Mathematics Companion

(Common Core Mathematics Companion, Pg. 139)

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**
- **What is a Function?** Definition including important properties.
- **Identifying Algebraic Functions** Determine if each of three equations represents a function.
- **Recognizing Functions** Determine whether or not each of two graphs represent functions.
- **Tabulating Functions** Determine whether or not tables of ordered pairs represent functions.

#### Illustrative Mathematics Assessment Tasks

- **Foxes and Rabbits** Illustrates examples of functions as well as relationships that are not functions.
- **US Garbage, Version 1** Describing a linear function.
- **Introduction to Linear Functions** Explore the differences between linear and non-linear functions.

#### Engaging Tasks

- **Figure This! Double or Not** Would you rather work 7 days at $20 per day or be paid $2 for the first day and have your salary double every day for a week?
- **25 Billion Apps** When should you start bombarding the App Store with purchases if you want to win?
- **Tables of Values: Not a Function** Create a table of values that is not a function
- **Tables of Values: Function** Create a table of values that is a function

### Lesson Resources

#### Engage NY

- **Grade 8, Module 5, Topic A, Lesson 2** Expressing functions by rule, and when input is used with the formula, the outcome is the output.
- **Grade 8, Module 5, Topic A, Lesson 6** Determine if a function is linear and interpret the equation y=mx+b as a linear function

#### McGraw-Hill

Course 3, Chapter 4
- Lesson 2

### Decoded Standard

MAFS.8.F.1.2

For this standard students will compare the properties of functions. One property of functions is slope. When students are given two different functions, each represented in a different form (algebraically, graphically, in a table, or by a verbal description), students should be able to determine which function has the greater slope. An example follows:

Ruth starts with a $50 gift card for Walmart. She spends $5.50 per week to buy cat food. Let y be the amount left on the card and x represent the number of weeks.

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>1</td>
<td>44.5</td>
</tr>
<tr>
<td>2</td>
<td>39.00</td>
</tr>
<tr>
<td>3</td>
<td>33.50</td>
</tr>
<tr>
<td>4</td>
<td>28.00</td>
</tr>
</tbody>
</table>

Boyce rents bikes for $5 an hour. He also collects a non-refundable fee of $10.00 for a rental to cover wear and tear. Write the rule for the total cost (c) of renting a bike as a function of the number of hours (h) rented.
Solution: Ruth’s story is an example of a function with a negative slope. The amount of money left on the card decreases each week. The graph has a negative slope of -5.5, which is the amount the card balance decreases every time Ruth buys cat food.

Boyce’s bike rental is an example of a function with a positive slope. This function has a positive slope of 5, which is the amount to rent a bike for an hour. An equation for Boyce’s bikes could be $c = 5h + 10$.  
*(Common Core Mathematics Companion, Pg. 140)*

### Instructional Resources

<table>
<thead>
<tr>
<th><strong>Formative Tasks</strong></th>
<th><strong>Lesson Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
<td><strong>Engage NY</strong></td>
</tr>
<tr>
<td>- <strong>Innovative Functions</strong> Compare the rates of change of two functions presented in different forms (an expression and a table) within a real-world context.</td>
<td>- <strong>Grade 8, Module 5, Topic A, Lesson 7</strong> Compare 2 functions in different way</td>
</tr>
<tr>
<td>- <strong>Speed Reading</strong> Compare the rates of change of two functions presented in different forms (an expression and a table) within a real-world context.</td>
<td></td>
</tr>
<tr>
<td>- <strong>Competing Functions</strong> Recognize and compare the initial values of two functions represented in different ways.</td>
<td></td>
</tr>
<tr>
<td>- <strong>This House is Mine!</strong> Compare a specific value of two functions given in different forms (a graph and a verbal description) within a real-world context.</td>
<td></td>
</tr>
</tbody>
</table>

### Illustrative Mathematics Assessment Tasks

- **Battery Charging** Verbal and numerical descriptions of battery life as a function of time.

### Engaging Tasks

- **Comparing Functions** Generate five ordered pairs that represent a linear function that has a greater rate of change than the graph.

### Decoded Standard

MAFS.8.F.1.3

In this standard students become familiar with the equation $y = mx + b$ as defining a linear function that will graph as a straight line. Students distinguish between linear (functions that graph into a straight line) and nonlinear functions (functions that do not graph into a straight line such as a curve). Note that standard form and point-slope for are not studied in this grade. *(Common Core Mathematics Companion, Pg. 141)*

### Instructional Resources

<table>
<thead>
<tr>
<th><strong>Formative Tasks</strong></th>
<th><strong>Lesson Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
<td><strong>Engage NY</strong></td>
</tr>
<tr>
<td>- <strong>What Am I?</strong> Describe a linear function, its graph, and the meaning of its parameters.</td>
<td>- <strong>Grade 8, Module 5, Topic A, Lesson 8</strong> Determine whether an equation is linear or non-linear by examining the rate of change</td>
</tr>
<tr>
<td>- <strong>Explaining Linear Functions</strong> Describe defining properties of linear functions.</td>
<td><strong>MARS/Shell</strong></td>
</tr>
<tr>
<td>- <strong>Nonlinear Functions</strong> Provide an example of a nonlinear function and explain why it is nonlinear.</td>
<td>- <strong>Meal Out</strong> Use equations to solve a problem with a restaurant check.</td>
</tr>
<tr>
<td>- <strong>Linear or Nonlinear?</strong> Identify a function as either linear or nonlinear and to justify their decision.</td>
<td>- <strong>Linear Graphs</strong> Match equations with linear graphs.</td>
</tr>
</tbody>
</table>

### Illustrative Mathematics Assessment Tasks

- **Function Rules** Connect a function described by a verbal rule with corresponding values in a table.
### Decoded Standard

#### MAFS.8.F.2.4
Students identify the rate of change (slope) and y-intercept (initial value) from tables, graphs, equations, and verbal descriptions of linear relationships. The y-intercept is the y-value when the x-value is 0. Interpretation of slope and the initial value of the function is accomplished using real-world situations. *(Common Core Mathematics Companion, Pg. 143)*

### Instructional Resources

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
<td><strong>Lesson Resources</strong></td>
</tr>
<tr>
<td>- <strong>Construction Function</strong></td>
<td><strong>Grade 8, Module 6, Topic A, Lesson 1</strong> Describe determine and interpret a linear function from a verbal description.</td>
</tr>
<tr>
<td>- <strong>Profitable Functions</strong></td>
<td><strong>Grade 8, Module 6, Topic A, Lesson 2</strong> Interpret slope and the initial value; describe the graph of the function based on its slope.</td>
</tr>
<tr>
<td>- <strong>Trekking Functions</strong></td>
<td><strong>Grade 8, Module 6, Topic A, Lesson 3</strong> Graph a line based on different characteristics (function, initial value, points.</td>
</tr>
<tr>
<td>- <strong>Smart TV</strong></td>
<td><strong>Lines and Linear Functions</strong> Interpret speed as the slope of a linear graph and translate between the equation of a line and its graphical representation.</td>
</tr>
<tr>
<td>- <strong>Drain the Pool</strong></td>
<td><strong>Interpreting Time-Distance Graphs</strong> Interpret distance–time graphs as if they are pictures of situations rather than abstract representations of them.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Illustrative Mathematics Assessment Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Video Streaming</strong></td>
</tr>
<tr>
<td>- <strong>High School Graduation</strong></td>
</tr>
<tr>
<td>- <strong>Baseball Cards</strong></td>
</tr>
</tbody>
</table>

### Decoded Standard

#### MAFS.8.F.2.5
Given a graph, students will provide a verbal description of the function, including whether the graph is linear or nonlinear or where the function is increasing or decreasing. Given a function’s verbal description, students will be able to sketch the graph displaying qualitative properties of that function. The quantitative features of the graph are not displayed (specific quantities on the axes). *(Common Core Mathematics Companion, Pg. 144)*

### Instructional Resources

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
<td><strong>Lesson Resources</strong></td>
</tr>
<tr>
<td>- <strong>Jet Fuel</strong></td>
<td><strong>Grade 8, Module 6, Topic A, Lesson 4</strong> Describe and sketch qualitatively function relationships.</td>
</tr>
<tr>
<td>- <strong>Population Trend</strong></td>
<td><strong>Grade 8, Module 6, Topic A, Lesson 5</strong> Qualitatively sketch and describe function relationship.</td>
</tr>
<tr>
<td>- <strong>Graph the Ride</strong></td>
<td>** Modeling Situation with Linear Equations** Explore relationships between variables in everyday situations.</td>
</tr>
<tr>
<td>- <strong>Bacterial Growth Graph</strong></td>
<td><strong>McGraw-Hill</strong></td>
</tr>
<tr>
<td>- <strong>Tides</strong></td>
<td><strong>Course 3, Chapter 4 Lesson 9</strong></td>
</tr>
<tr>
<td>- <strong>Distance</strong></td>
<td></td>
</tr>
</tbody>
</table>
Bike Race interpret two distance-time graphs in terms of the context of a bicycle race.

**Engaging Tasks**
- **Joules** Three Acts Math – Do you think Joules will work as advertised?
## Standards/Learning Goals:

<table>
<thead>
<tr>
<th>Standards/Learning Goals</th>
<th>Content Limits, Assessment Types, Calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAFS.8.G.1.5 Use informal arguments to establish facts about the angle sum &amp; exterior</td>
<td>• Items must not include shapes beyond triangles.</td>
</tr>
<tr>
<td>angle of triangles and about the angle created when parallel lines are cut by a</td>
<td>Calculator: NEUTRAL</td>
</tr>
<tr>
<td>transversal. For example, arrange three copies of the same triangle so that the sum of</td>
<td>Context: NO CONTEXT</td>
</tr>
<tr>
<td>the three angles appears to form a line, and give an argument in terms of</td>
<td></td>
</tr>
<tr>
<td>transversals why this is so.</td>
<td></td>
</tr>
<tr>
<td>MAFS.8.G.2.6 Explain a proof of the Pythagorean Theorem and its converse.</td>
<td>• For the converse, only perfect roots should be used.</td>
</tr>
<tr>
<td></td>
<td>Calculator: NEUTRAL</td>
</tr>
<tr>
<td></td>
<td>Context: ALLOWABLE</td>
</tr>
<tr>
<td>MAFS.8.G.2.7 Apply the Pythagorean Theorem to determine unknown side lengths in right</td>
<td>• If the triangles is part of a 3-dimensional figure, a</td>
</tr>
<tr>
<td>triangles in real-world and mathematical problems in two and three dimensions.</td>
<td>graphic of the 3-dimensional figure must be included.</td>
</tr>
<tr>
<td></td>
<td>• Points on the coordinate grid must be where grid lines</td>
</tr>
<tr>
<td></td>
<td>intersect.</td>
</tr>
<tr>
<td></td>
<td>Calculator: YES</td>
</tr>
<tr>
<td></td>
<td>Context: ALLOWABLE</td>
</tr>
<tr>
<td>MAFS.8.G.2.8 Apply the Pythagorean Theorem to find the distance between two points in</td>
<td>• If the triangles is part of a 3-dimensional figure, a</td>
</tr>
<tr>
<td>a coordinate system.</td>
<td>graphic of the 3-dimensional figure must be included.</td>
</tr>
<tr>
<td></td>
<td>• Points on the coordinate grid must be where grid lines</td>
</tr>
<tr>
<td></td>
<td>intersect.</td>
</tr>
<tr>
<td></td>
<td>Calculator: YES</td>
</tr>
<tr>
<td></td>
<td>Context: ALLOWABLE</td>
</tr>
</tbody>
</table>

### Open Up Resources Lessons

**Grade 8, Unit 1: Rigid Transformations and Congruence**
- Lesson 14: Alternate Interior Angles
- Lesson 15: Adding the Angles in a Triangle
- Lesson 16: Parallel Lines and the Angles in a Triangle

**Grade 8, Unit 8: Pythagorean Theorem and Irrational Numbers**
- Lesson 1: The Areas of Squares and Their Side Lengths
- Lesson 2: Side Lengths and Areas
- Lesson 3: Rational and Irrational Numbers
- Lesson 4: Square Roots on the Number Line
- Lesson 5: Reasoning About Square Roots
- Lesson 6: Finding Side Lengths of Triangles
- Lesson 7: A Proof of the Pythagorean Theorem
- Lesson 8: Finding Unknown Side Lengths
- Lesson 9: The Converse
- Lesson 10: Applications of the Pythagorean Theorem
- Lesson 11: Finding Distances in the Coordinate Plane
## Decoded Standard

**MAFS.8.G.1.5**
Students are expected to make informal arguments while exploring facts about the sum of the angles of a triangle, exterior angles of triangles, angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similar triangles. The example demonstrates how these facts are interrelated. Note that formal two-column proofs are not expected at this grade.

*See image on page 184 of the Common Core Mathematics Companion.*

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**
- **Same Side Interior Angles** Given same side interior angles, describe relationship and provide justification when not required to find angle measurement.
- **Justifying Angle Relationships** Describe the relationship between alternate interior angle and provide justification.
- **Justifying the Exterior Angle Theorem** Justify when it is not required to find angle measurement.
- **What is the Triangle Relationship?** Describe the relationship between similar triangles.
- **Justifying the Triangle Sum Theorem** Provide proof using a triangle.

**Illustrative Mathematics**
- **Congruence of Alternate Interior Angles via Rotations** Experiment with rigid motions to help visualize why alternate interior angles (made by a transverse connecting two parallel lines) are congruent.
- **Find the Angle** The task is an example of a direct but non-trivial problem in which students have to reason with angles and angle measurements (and in particular, their knowledge of the sum of the angles in a triangle) to deduce information from a picture.

**Engaging Tasks**
- **Transversals, Tape and Stickies** Place sticky notes in their assigned location based on a description

#### Lesson Resources

**Engage NY**
- **Grade 8, Module 2, Topic C, Lesson 12** Understand equivalent angle relationships when lines are parallel. Understand angle relationships related to translations and rotations. Present informal arguments about angles formed from parallel lines cut by a transversal.
- **Grade 8, Module 2, Topic C, Lesson 13** Informal arguments about Angle Sum Theorem for triangles
- **Grade 8, Module 2, Topic C, Lesson 14** Informal proof of angle sum theorem. Find missing angle measures and prove their answer is correct.
- **Grade 8, Module 3, Topic B, Lesson 10** Informal proof of Angle-Angle criterion and whether or not triangles are similar

**MARS/Shell**
- **Identifying Similar Triangles** Categorize diagrams of pairs of triangles based on their similarity.

**McGraw-Hill**
- **Course 3, Chapter 5** Lesson 3 (review vocabulary pg. 372)

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## Decoded Standard

**MAFS.8.G.2.6**
There are many proofs of the Pythagorean Theorem. Students will work through one to understand the meaning of $a^2 + b^2 = c^2$ and its converse. The converse statement is as follows: If the square of one side of a triangle is equal to the sum of the squares of the other two sides, then the triangle is a right triangle. *(Common Core Mathematics Companion, Pg. 186)*

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**
- **Pythagorean Squares** Demonstrate knowledge of the square root and right triangle in the Pythagorean theorem.
- **Explaining a Proof of the Pythagorean Theorem** Proof of similar triangles.

#### Lesson Resources

**Engage NY**
- **Grade 8, Module 2, Topic D, Lesson 15** Know the Pythagorean Theorem, show an informal proof of the theorem and use it to find the length of a hypotenuse.
- **Grade 8, Module 7, Topic C, Lesson 15** Explain the proof of the Pythagorean Theorem.
- **Converse of the Pythagorean Theorem** Teacher scenario to prove that the teacher is correct and prove that triangles are congruent.

### Engaging Tasks
- **How can we correct the Scarecrow** How can we correct the Scarecrow’s statement so it is mathematically precise?

### Decoded Standards

**MAFS.8.G.2.7**

Students solve problems where they must apply the Pythagorean Theorem. Problems may be real-world or mathematical, and they may involve two- and three-dimensional situations. (*Common Core Mathematics Companion*, Pg. 187)

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**
- **New Television** Using the measurement given, show if the TV can fit in the space provided.
- **How Far to School** Use the Pythagorean theorem to find distance.
- **Three Dimensional Diagonal** Apply the Pythagorean theorem to a rectangular prism’s diagonal.
- **Pyramid Height** Find the height of a pyramid.

**Illustrative Mathematics**
- **Running on the Football Field** Reason how to use the Pythagorean Theorem to find the distance ran by Ben Watson and Champ Bailey.
- **Area of a Trapezoid** Decompose the given trapezoid into other polygons and use the Pythagorean Theorem to find the unknown side-lengths of a trapezoid in order to determine the area.
- **Spiderbox** Visualize and apply the Pythagorean Theorem to determine the length of a spider’s path around the outside of a box.

**Engaging Tasks**
- **Viewmongous TV** Is the 80” TV double, triple or quadruple the viewing area of a 55” TV?
- **Pythagorean Theorem Problems** Math Mistakes examines several student errors with utilizing the Pythagorean Theorem.

### Lesson Resources

**Engage NY**
- **Grade 8, Module 2, Topic D, Lesson 16** Use Pythagorean Theorem to find missing side lengths.
- **Grade 8, Module 7, Topic C, Lesson 17** Use the Pythagorean Theorem to determine the distance between two points on a coordinate plane.
- **Grade 8, Module 7, Topic C, Lesson 18** Apply the Pythagorean Theorem to real world and mathematical problems in two dimensions

**McGraw-Hill**
- **Course 3, Chapter 5**
  - Lesson 6

**Decoded Standards**

**MAFS.8.G.2.8**

Use the Pythagorean Theorem to find the distance between two points. Problems can best be modeled in a coordinate system. (*Common Core Mathematics Companion*, Pg. 188)

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**
- **New Television** Using the measurement given, show if the TV can fit in the space provided.
- **How Far to School** Use the Pythagorean theorem to find distance.
- **Three Dimensional Diagonal** Apply the Pythagorean theorem to a rectangular prism’s diagonal.
- **Pyramid Height** Find the height of a pyramid.

**Engaging Tasks**
- **Viewmongous TV** Is the 80” TV double, triple or quadruple the viewing area of a 55” TV?
- **Pythagorean Theorem Problems** Math Mistakes examines several student errors with utilizing the Pythagorean Theorem.
<table>
<thead>
<tr>
<th><strong>Engaging Tasks</strong></th>
<th><strong>McGraw-Hill</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance Between Two Points</strong> Find the distance between two points on a coordinate grid.</td>
<td><strong>Grade 8, Module 7, Topic C, Lesson 17</strong> Use the Pythagorean Theorem to determine the distance between two points on a coordinate plane.</td>
</tr>
<tr>
<td><strong>Distance on the Coordinate Plane</strong> Find the distance between two points on a coordinate plane.</td>
<td><strong>Grade 8, Module 7, Topic C, Lesson 18</strong> Apply the Pythagorean Theorem to real world and mathematical problems in two dimensions</td>
</tr>
<tr>
<td><strong>Coordinate Plane Triangle</strong> Graph the given coordinates and find the lengths of each side of the triangle.</td>
<td><strong>McGraw-Hill</strong></td>
</tr>
<tr>
<td><strong>Calculate Triangle Sides</strong> Graph the given coordinates to find the lengths of each side of the triangle.</td>
<td><strong>Course 3, Chapter 5</strong></td>
</tr>
<tr>
<td><strong>Where’s the Nearest Toys R Us?</strong> Determine how store locators measure distance and calculate several distances.</td>
<td><strong>Lesson 7</strong></td>
</tr>
<tr>
<td><strong>Pythagorean Theorem Problems</strong> Math Mistakes examines several student errors with utilizing the Pythagorean Theorem</td>
<td></td>
</tr>
</tbody>
</table>
Semester 1 | P-A Unit 6: Transformations, Congruence and Similarity | 8 days: 10/19-10/29

<table>
<thead>
<tr>
<th>Standards/Learning Goals:</th>
<th>Content Limits, Assessment Types, Calculator</th>
</tr>
</thead>
</table>
| **MAFS.8.G.1.1** Verify experimentally the properties of rotations, reflections, and translations:  
  a. Lines are taken to lines, and line segments to line segments of the same length.  
  b. Angles are taken to angles of the same measure.  
  c. Parallel lines are taken to parallel lines. | - The coordinate plane should not be used until (8.G.1.3).  
- Limit sequences to no more than two transformations.  
- A pre-image and image should not include apostrophe notation as this would give away the identification of similarity and congruence.  
- No reference to the definition of congruence or symbols relating to the definition should be used (HS Geometry).  

  * **Calculator:** NEUTRAL  
  * **Context:** ALLOWABLE  
  * **ASSESSED with MAFS.8.G.1.2 and MAFS.8.G.1.4** |

| **MAFS.8.G.1.2** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. | - The coordinate plane should not be used until (8.G.1.3).  
- Limit sequences to no more than two transformations.  
- A pre-image and image should not include apostrophe notation as this would give away the identification of similarity and congruence.  
- No reference to the definition of congruence or symbols relating to the definition should be used (HS Geometry).  

  * **Calculator:** NEUTRAL  
  * **Context:** ALLOWABLE |

| **MAFS.8.G.1.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. | - Coordinate values of x and y must be integers.  
- The number of transformations should be no more than two.  
- In items that require the student to draw a transformed figure using a dilation or a rotation, the center of the transformation must be given.  

  * **Calculator:** NEUTRAL  
  * **Context:** ALLOWABLE |

| **MAFS.8.G.1.4** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. | - Items should not include the coordinate plane as the coordinate plane is needed in 8.G.1.3.  
- Limit the sequence to no more than two transformations.  
- 2-dimensional figures are limited to no more than 7 sides.  
- A pre-image or image should not include apostrophe notation as this would give away the identification of similarity and congruence.  
- No reference to the definition of congruence or symbols relating to the definition should be used (HS Geometry).  

  * **Calculator:** NEUTRAL  
  * **Context:** ALLOWABLE |

| **MAFS.8.G.1.5** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angle created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* | - Items must not include shapes beyond triangles.  

  * **Calculator:** NEUTRAL  
  * **Context:** NO CONTEXT |
MAFS.8.EE.2.6 Use similar triangles to explain why the slope \( m \) is the same between two distinct points on a non-vertical line in the coordinate plane; derive the equation \( y = mx \) for a line through the origin and the equation \( y = mx + b \) for a line intercepting the vertical axis at \( b \).

- All triangles must be right triangles and on a coordinate grid.
- Numbers in items must be rational numbers.
- Functions must be linear.

Calculator: YES
Context: ALLOWABLE

Open Up Resources Lessons

Grade 8, Unit 1: Rigid Transformations and Congruence
- Lesson 1: Moving in the Plane
- Lesson 2: Naming the Moves
- Lesson 3: Grid Moves
- Lesson 4: Making the Moves
- Lesson 5: Coordinate Moves
- Lesson 6: Describing Transformations
- Lesson 7: No Bending or Stretching
- Lesson 8: Rotation Patterns
- Lesson 9: Moves in Parallel
- Lesson 10: Composing Figures
- Lesson 11: What is the Same?
- Lesson 12: Congruent Polygons
- Lesson 13: Congruence

Grade 8, Unit 2: Dilations, Similarity, and Introducing Slope
- Lesson 1: Projecting and Scaling
- Lesson 2: Circular Grid
- Lesson 3: Dilations with no Grid
- Lesson 4: Dilations on a Square Grid
- Lesson 5: More Dilations
- Lesson 6: Similarity
- Lesson 7: Similar Polygons
- Lesson 8: Similar Triangles
- Lesson 9: Side Length Quotients in Similar Triangles

Decoded Standard

MAFS.8.G.1.1 – students need multiple opportunities to explore the transformation of figures

Eighth graders add rotations, reflections, and translations to their study of transformations from Grade 7 dilations. Students verify through experimentation with figures on a coordinate plane that lines are taken to lines and line segments to line segments of the same length; angles are taken to angles of the same measure, and parallel lines are taken to parallel lines. This standard is an introduction, and students should spend time exploring these transformations.

See image on page 178 of the Common Core Mathematics Companion.

(Common Core Mathematics Companion, Pg. 178)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)
- Segment Transformations Translation, rotation, and reflection

Lesson Resources

Engage NY
- Grade 8, Module 2, Topic A, Lesson 1 Rigid Motion
- Grade 8, Module 2, Topic A, Lesson 2 Translations
**Engaging Tasks**

- **Angle Transformations**  Students will need rulers and transparent paper. Students experimentally verify the properties of angle transformations.
- **Parallel Line Transformations**  Students experimentally verify properties of parallel lines transformation.

**Engaging Tasks**

- **How did they make Ms. Pac-Man**  Describe Ms. Pac-Man’s movements with academic vocabulary
- **How do Skytypers Write Messages?**  Use transformation applications to create skytyping messages and translate it into a set of coordinates.
- **Naming Coordinates, Feedback and Revision**  Revise a student error involving translating a quadrilateral
- **Best Reflection**  Students compare 4 images with their reflection to determine which one is the best.
- **Pool Bounce**  Determine where each shot will hit using reflections.
- **Transformations**  – Shortest Sequence What’s the fewest number of transformations needed to take pre-image ABCT to A’B’C’D’.

**Decoded Standard**

MAFS.8.G.1.2

Students use what they previously learned about transformations to determine congruency between figures. Congruent figures share the same size and shape. When given two congruent figures, students describe the sequence of transformations that occurred to create the congruent figure. Note that dilations cannot be used for congruent figures. *(Common Core Mathematics Companion, Pg. 180)*

**Formative Tasks**

- **Proving Congruence**  Students are asked to explain congruence in terms of rigid motions.
- **Rigid Motion I**  Students are asked to describe the motion and determine if the shapes are congruent. Translation
- **Rigid Motion II-Reflection**  Describe a rigid motion to demonstrate two polygons are congruent.
- **Rigid Motion III**  Describe a rigid motion to demonstrate two polygons are congruent.
- **Multistep Congruence**  Describe a sequence of rigid motions to demonstrate the congruence of two polygons.

**Illustrative Mathematics**

- **Cutting a Rectangle Into Two**  Shows the congruence of two triangles in a particular geometric context arising by cutting a rectangle in half along the diagonal.
- **Congruent Triangles**  Develop an understanding of rigid motions in the context of demonstrating congruence and reflections refined by orientation.

**Engaging Tasks**

- **Naming Coordinates, Feedback and Revision**  Revise a student error involving translating a quadrilateral
- **Best Reflection**  Students compare 4 images with their reflection to determine which one is the best.

**Lesson Resources**

- **Engage NY**
  - **Grade 8, Module 2, Topic B, Lesson 10**  Mapping one figure onto another
  - **Grade 8, Module 2, Topic C Lesson 11**  Congruence through Rigid Motion

- **MARS/Shell**
  - **Transforming 2D Figures**  Describe in words the transformation that maps an object to a transformed image. Given a geometric figure and a rotation, reflection or translation, draw the transformed figure (or the original figure if the image is given.) Describe transformations as algebraic functions that take points in the plane as inputs and give other points as outputs.

- **McGraw-Hill**
  - **Course 3, Chapter 7**
    - Lesson 1
### Decoded Standard

**MAFS.8.G.1.3**
Students continue looking at two-dimensional figures on the coordinate plane, concentrating on the coordinates of the resulting figure after transformations, including dilations learned in Grade 7.  
*(Common Core Mathematics Companion, Pg. 181)*

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**

- **Translation Coordinates** Two problems both require students to graph a two-dimensional figure's translation and identify the new coordinates.
- **Rotation Coordinates** Two problems both require students to graph a two-dimensional figure's rotation and identify the new coordinates.
- **Reflection Coordinates** Two problems both require students to graph a two-dimensional figure's reflection and identify the new coordinates.

#### Engaging Tasks

- **How do Skytypers Write Messages?** Use transformation applications to create skytyping messages and translate it into a set of coordinates.
- **Naming Coordinates, Feedback and Revision** Revise a student error involving translating a quadrilateral.
- **Transformations – Shortest Sequence** What’s the fewest number of transformations needed to take pre-image ABCT to A'B'C'D'.
- **How did they make Ms. Pac-Man** Describe Ms. Pac-Man's movements with academic vocabulary

### Lesson Resources

**Engage NY**

- **Grade 8, Module 3, Topic A, Lesson 6** Dilations using Coordinates

**MARS/Shell**

- **Representing and Combining Transformations** Students will recognize and visualize transformations of 2D shapes. They will translate, reflect and rotate shapes, and combine these transformations.

**McGraw-Hill**

- **Course 3, Chapter 6**  
  - Lesson 1 (Translations), Lesson 2 (Reflections), Lesson 3 (Rotations) and Lesson 4 (Dilations)

### Decoded Standard

**MAFS.8.G.1.4**

With this standard, students move from congruence to similarity. Students develop the understanding that similar figures can be created by a series of transformations, including rotations, reflections, dilations, and translation, and can identify those transformations given an image and a pre-image.  
*See image on page 182 of the Common Core Mathematics Companion.*

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**

- **Proving Similarity** Explain similarity in terms of transformations
- **Similarity I** Describe a sequence of transformations to show that two polygons are similar.
- **Similarity II** Describe a sequence of transformations to show that two polygons are similar.
- **Similarity III** Describe a sequence of transformations that demonstrates two polygons are similar.

#### Lesson Resources

**Engage NY**

- **Grade 8, Module 2, Topic B, Lesson 7** Sequencing transformations that enjoy the same properties as a single translation with respect to lengths of segments and angle degrees.
- **Grade 8, Module 3, Topic B, Lesson 8** Sequence of Transformations that lead to Similarity

**McGraw-Hill**

- **Course 3, Chapter 6**  
  - Lesson 1 (Translations), Lesson 2 (Reflections), Lesson 3 (Rotations) and Lesson 4 (Dilations)
### Illustrative Mathematics
- **Are they Similar?** Provide experience applying transformations to show that two polygons are similar.
- **Creating Similar Triangles** Provide experience applying transformations to show that two polygons are similar.

### Engaging Tasks
- **Right Triangles – Trapezoids** What question comes to mind for the given image?

### Decoded Standard
MAFS.8.G.1.5
Students are expected to make informal arguments while exploring facts about the sum of the angles of a triangle, exterior angles of triangles, angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similar triangles. The example demonstrates how these facts are interrelated. Note that formal two-column proofs are not expected at this grade.

See image on page 184 of the Common Core Mathematics Companion.
*(Common Core Mathematics Companion, Pg. 184)*

### Instructional Resources
#### Formative Tasks
**Mathematics Formative Assessments (MFAS)**
- **Same Side Interior Angles** Describe and justify the relationship between same side interior angles.
- **Justifying Angle Relationships** Describe and justify the relationship between corresponding angles and alternate interior angles.
- **Justifying the Exterior Angle Theorem** Apply the Exterior Angle of a Triangle Theorem and provide an informal justification.
- **What is the Triangle Relationship?** Describe the relationship between two triangles given that two pairs of corresponding angles are congruent, and provide an informal justification of the relationship (similarity).
- **Justifying the Triangle Sum Theorem** Provide an informal justification of the Triangle Sum Theorem.

#### Lesson Resources
**Engage NY**
- **Grade 8, Module 2, Topic C, Lesson 12** Angle Relationships of Parallel Lines
- **Grade 8, Module 2, Topic C, Lesson 13** Angle Sum Theorem Triangles
- **Grade 8 Module 2, Topic C, Lesson 14** Missing Angle Measures Triangles

**McGraw-Hill**
Course 3, Chapter 7
Lesson 5

### Illustrative Mathematics
- **Rigid motions and congruent angles** Given parallel lines cut by a transversal, prove congruence between angle pairs.
- **A Triangle’s Interior Angles** Given parallel lines with a triangle drawn with its transversals, prove that $a+b+c = 180$
- **Find the Missing Angle** Find the measure of a missing angle between parallel lines.
- **Congruence of Alternate Interior Angles via Rotations** Explain why rotating a pair of parallel lines cut by a transversal demonstrates that angles are congruent.
- **Street Intersections** Apply facts about angles in order to calculate angle measures in the context of a map.

### Decoded Standard
MAFS.8.EE.2.6
Students gain additional knowledge about slope in this standard as they use similar triangles to explain how the slope $m$ of a line is the same between any two points on a given non-vertical line. Students understand
positive/negative slopes, 0 slope, and undefined slopes. Through the use of similar triangles, teachers lead students to derive the general equation \( y = mx + b \) of a line and discover that \( m \) is the slope and \( b \) is the y-intercept. *(Common Core Mathematics Companion, Pg. 124)*

<table>
<thead>
<tr>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formative Tasks</strong></td>
</tr>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
</tr>
<tr>
<td>• <strong>Slope with similar Triangles</strong> Use similar triangles to explain why the slope is the same regardless of the points used to calculate it.</td>
</tr>
<tr>
<td>• <strong>Deriving Lines I- Using the slope formula</strong> Derive the general equation of a line containing the origin.</td>
</tr>
<tr>
<td>• <strong>Deriving Lines II Using the slope formula</strong> Derive the general equation of a line with a y-intercept of ((0, b))</td>
</tr>
<tr>
<td><strong>Illustrative Mathematics</strong></td>
</tr>
<tr>
<td>• <strong>Slopes between points on a line</strong> Understand why the calculated slope will be the same for any two points on a given line.</td>
</tr>
<tr>
<td><strong>Engage NY</strong></td>
</tr>
<tr>
<td>• <strong>Grade 8, Module 4, Topic C, Lesson 16</strong> Use similar triangles to explain slope and calculate the slope between two distinct points on a non-vertical line.</td>
</tr>
<tr>
<td><strong>McGraw-Hill</strong></td>
</tr>
<tr>
<td>Course 3, Chapter 7</td>
</tr>
<tr>
<td>Lesson 6</td>
</tr>
</tbody>
</table>
### Open Up Resources Lessons

**Grade 8, Unit 5: Functions and Volume**

- Lesson 11: **Filling Containers**
- Lesson 12: **How Much Will Fit?**
- Lesson 13: **The Volume of a Cylinder**
- Lesson 14: **Finding Cylinder Dimensions**
- Lesson 15: **The Volume of a Cone**
- Lesson 16: **Finding Cone Dimensions**
- Lesson 17: **Scaling One Dimension**
- Lesson 18: **Scaling Two Dimensions**
- Lesson 19: **Estimating a Hemisphere**
- Lesson 20: **The Volume of a Sphere**
- Lesson 21: **Cylinders, Cones, and Spheres**

### Standards/Learning Goals:

<table>
<thead>
<tr>
<th>MAFS.8.G.3.9</th>
<th>Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Content Limits, Assessment Types, Calculator</strong></td>
</tr>
<tr>
<td></td>
<td>- Graphics of three-dimensional figures can be included.</td>
</tr>
<tr>
<td></td>
<td>- Dimensions must be given as rational numbers.</td>
</tr>
<tr>
<td></td>
<td>- Figures must not be composite</td>
</tr>
</tbody>
</table>

### Instructional Resources

#### Formative Tasks

**Mathematics Formative Assessments (MFAS)**

- **Cone Formula** Write the formula for the volume of a cone, explain what each variable represents, and label the variables on a diagram.
- **Cylinder Formula** Write the formula for the volume of a cylinder, explain what each variable represents, and label the variables on a diagram.
- **Sphere Formula** Write the formula for the volume of a sphere, explain what each variable represents, and label the variables on a diagram.
- **Sugar Cone** Solve a problem that requires calculating the volume of a cone.
- **Platinum Cylinder** Solve a problem that requires calculating the volume of a cylinder.
- **Burning Sphere** Solve a problem that requires calculating the volume of a sphere.

#### Illustrative Mathematics Assessment Tasks

- **Comparing Snow Cones** Find the volume of a cone.
- **Glasses** Use volume formulas for cylinders, cones and spheres.
- **Flower Vases** Use volume formulas for cylinders, cones and spheres.

### Decoded Standard

MAFS.8.G.3.9

This standard has two distinct parts. First, students learn the volume formulas for cones, cylinders, and spheres. Then they apply this knowledge to solve real-world and mathematical problems. The formulas should be taught through experiments where students figure out the formulas. ([Common Core Mathematics Companion, Pg. 190](#))

### Engage NY

- **Grade 8, Module 5, Topic B, Lesson 10** Volume of Cylinders and Cones; Solve real-world volume problems
- **Grade 8, Module 5, Topic B, Lesson 11** Volume of Spheres; Solve real-world volume problems

### McGraw-Hill

**Course 3, Chapter 8**

Lesson 1 (Cylinders), Lesson 2 (Cones – skip ex. 3), and Lesson 3 (Spheres – skip ex. 4)
### Standards/Learning Goals:

<table>
<thead>
<tr>
<th>Standards/Learning Goals</th>
<th>Content Limits, Assessment Types, Calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAFS.8.SP.1.1</strong> Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.</td>
<td>- Numbers in items must be rational numbers.</td>
</tr>
<tr>
<td><strong>MAFS.8.SP.1.2</strong> Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.</td>
<td>- Numbers in items must be rational numbers. - Trend/association is based on visual inspection. - Line of best fit must be informally assessed. - Trend/association must be linear.</td>
</tr>
<tr>
<td><strong>MAFS.8.SP.1.3</strong> Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope an intercept. For example, in a linear model for a biology experiment, interpret a slop of 1.5 cm/hr. as meaning that an additional hour of sunlight each day is associated with an additional 1.5cm in mature plant height.</td>
<td>- Numbers in items must be simple rational numbers (e.g., ½, ¼, to the 10th). - Data are required for all items. - In all items requiring a line of best fit, the equation of that line should be given.</td>
</tr>
<tr>
<td><strong>MAFS.8.SP.1.4</strong> Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?</td>
<td>- Numbers in items must be rational numbers. - Data given should include the grand total of the survey. - Tables must not include more than two columns (plus category and total) and two rows (plus category and total).</td>
</tr>
</tbody>
</table>

### Open Up Resources Lessons

- **Grade 8, Unit 6: Associations in Data**
  - Lesson 1: Organizing Data
  - Lesson 2: Plotting Data
  - Lesson 3: What a Point in a Scatter Plot Means
  - Lesson 4: Fitting a Line to Data
  - Lesson 5: Describing Trends in Scatter Plots
  - Lesson 6: The Slope of a Fitted Line
  - Lesson 7: Observing More Patterns in Scatter Plots
  - Lesson 8: Analyzing Bivariate Data
  - Lesson 9: Looking for Associations
  - Lesson 10: Using Data Displays to Find Associations

### Decoded Standard

**MAFS.8.SP.1.1**

Students study scatter plots of bivariate data by constructing and interpreting them in terms of patterns they can see. They look for the patterns of clustering, outliers, positive or negative association, and linear or nonlinear association. Examples of scatter plots below show positive and negative associations, clustering, and an outlier.

See the image on page 238 of the Common Core Mathematics Companion

*(Common Core Mathematics Companion, Pg. 238)*
### Formative Tasks

**Mathematics Formative Assessments (MFAS)**
- **Sleepy Statistics** Describe the association between scores on the Epworth Sleepiness Scale and scores on the math test.
- **Population Density** Describe the relationship between population and land area.
- **Infectious Statistics** Describe the association between the passage of time and the number of bacteria.
- **Cheesy Statistics** Describe the association between time spent watching advertisements and the percent of each group willing to buy the company’s cheese crackers.
- **Bungee Cord Data** Construct a scatterplot corresponding to a given set of data.

**Illustrative Mathematics Assessment Tasks**
- **Birds’ Eggs** Identify a correlation and use it to make interpolative predictions.
- **Texting and Grades I** Describe the relationship between number of text messages sent and GPA.

**Engaging Tasks**
- **Positive Correlation** Create a set of points that have specific characteristics.
- **Interpreting Graphs Where Up Isn’t Good** Interpret data on a scatterplot that appears unconventional.

### Engage NY
- **Grade 8, Module 6, Topic B, Lesson 6** Constructing Scatter Plots
- **Grade 8, Module 6, Topic B, Lesson 7** Patterns in Scatter Plots
- **Grade 8, Module 6, Topic C, Lesson 11** Scatter plots; Fit line to data; Interpret slope

**McGraw-Hill**
- **Course 3, Chapter 9** Lesson 1

### Lesson Resources

**Engage NY**
- **Grade 8, Module 6, Topic B, Lesson 6** Constructing Scatter Plots
- **Grade 8, Module 6, Topic B, Lesson 7** Patterns in Scatter Plots
- **Grade 8, Module 6, Topic C, Lesson 11** Scatter plots; Fit line to data; Interpret slope

**McGraw-Hill**
- **Course 3, Chapter 9** Lesson 2

### Decoded Standard

MAFS.8.SP.1.2
Students focus on linear patterns of association in scatter plots and understand that linear models (straight lines) are commonly used to model linear relationships. Then they begin to informally fit a straight line to the data and learn to assess its fit by judging the closeness of the line to the data points. The most appropriate line is the one that comes closest to most data points. The use of linear regression is not expected at this grade. *(Common Core Mathematics Companion, Pg. 239)*

### Instructional Resources

**Formative Tasks**

**Mathematics Formative Assessments (MFAS)**
- **Two Scatterplots** Compare how well each line fits its set of data. Explain your reasoning.
- **Three Scatterplots** (Informally assess three lines fitted to data to determine which fit is the best.)
- **Line of Good Fit I** Fit a line to model the relationship between two quantitative variables and to assess how well that line fits the data.
- **Line of Good Fit II** See description above.

**Illustrative Mathematics Assessment Tasks**
- **Hand Span and Height** Construct and Interpret Scatter plots by generating and recording data.
- **Animal Brains** Create scatterplots, and think critically about associations and outliers in data as well as informally fit a trend line to data.
- **Laptop Battery Charge** Find and use a linear model answer this question.
### Engaging Tasks
- **Line of Best Fit** Create 4 points that could generate a line of best fit with the equation \( y = -x + 8 \).

### Decoded Standard

**MAFS.8.SP.1.3**
Students practice solving contextual linear problems. The problems involve situations using bivariate measurement data such as those collected in a biology experiment. This standard connects with what students have learned about models of linear equations, slope, and intercept. *(Common Core Mathematics Companion, Pg. 240)*

### Instructional Resources

<table>
<thead>
<tr>
<th><strong>Formative Tasks</strong></th>
<th><strong>Lesson Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
<td><strong>Engage NY</strong></td>
</tr>
</tbody>
</table>
| - **Tuition** Use this equation to predict the average tuition cost at a public university. | - **Grade 8, Module 6, Topic C, Lesson 10**  
Interpret slope and initial value |
| - **Stretching Statistics** Explain the significance of a point and the \( y \)-intercept. | - **Grade 8, Module 6, Topic C, Lesson 11**  
Scatter plots; Fit line to data; Interpret slope |
| - **Foot Length** Interpret the slope and intercept of a linear function that models the relationship between foot length and height. | |
| - **Developmental Data** Explain the significance of the slope of the equation in terms of a problem’s context. | |

| **Illustrative Mathematics Assessment Tasks** | |
| **US Airports, Assessment Variation** Use a linear function to model a relationship between two quantities. | |
| **Chicken and Steak, Variation 1** Presents a real world situation that can be modeled with a linear function best suited for an instructional context. | |

### Decoded Standard

**MAFS.8.SP.1.4**
This standard asks students to switch from using numerical data to categorical data and use frequencies to answer questions about possible associations (linear/nonlinear, positive/negative/no association). Students construct and interpret tables that display categorical data on two different variables from the same subjects. A two-way table is a table that shows categorical data classified in two different ways. An example of a two-way table that records possible data from the example in the standard about chores and curfews may be the following:

<table>
<thead>
<tr>
<th>CHORES</th>
<th>CURFEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>44</td>
</tr>
<tr>
<td>NO</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

One interpretation of the chart is that of the students who answered yes, they had a curfew, 44 had chores and 20 did not. Of the students who answered no, they did not have a curfew, 20 had chores and 44 did not. From this sample, there appears to be a positive correlation between having a curfew and having chores. *(Common Core Mathematics Companion, Pg. 214)*

### Instructional Resources

<table>
<thead>
<tr>
<th><strong>Formative Tasks</strong></th>
<th><strong>Lesson Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics Formative Assessments (MFAS)</strong></td>
<td><strong>Engage NY</strong></td>
</tr>
</tbody>
</table>
| - **Two-Way Relative Frequency Table** Convert raw data to relative frequencies by both rows and columns given a two-way frequency table. | - **Grade 8, Module 6, Topic D, Lesson 13**  
Two-way Tables; Row and Column Relative Frequencies |
<table>
<thead>
<tr>
<th>Pinellas County Schools</th>
<th>DOUBLE BLOCK P-A and A1H</th>
<th>2020-2021</th>
</tr>
</thead>
</table>

- **School Start Time** Interpret data given in a two-way table.
- **Music and Sports** Construct a two-way frequency table given a set of raw data.
- **Sibling and Pets** Interpret data given in a two-way table.

**Illustrative Mathematics Assessment Tasks**
- **What’s Your Favorite Subject?** Calculate appropriate relative frequencies using the given data.
- **Music and Sports** Investigate the association between whether a student plays a sport and whether he or she plays a musical instrument.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade 8, Module 6, Topic D, Lesson 14</strong></td>
<td>Association between Two Categorical Values</td>
</tr>
<tr>
<td><strong>MARS/Shell</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Testing a New Product</strong></td>
<td>Assess how well students are able to organize, represent and analyze bivariate categorical data in an appropriate way.</td>
</tr>
<tr>
<td><strong>McGraw-Hill</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Course 3, Chapter 9</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Lesson 3</strong></td>
<td></td>
</tr>
</tbody>
</table>
### A1H Unit 1: Solving Linear Equations and Inequalities

**5 days**

Nov. 19 – Dec. 2

#### Thanksgiving Break Nov. 21 – Nov. 29

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
</table>
| **MA.912.AR.1.1** – Identify and interpret parts of an equation or expression that represent a quantity in terms of a mathematical or real-world context, including viewing one or more of its parts as a single entity. | Clarification 1: Parts of an expression include factors, terms, constants, coefficients, and variables  
Clarification 2: Within the Mathematics for Data and Financial Literacy course, problem types focus on money and business. |
| *Example:* Derrick is using the formula $P = 1000(1 + .1)^t$ to make a prediction about the camel population in Australia. He identifies the growth factor as $(1+.1)$, or 1.1, and states that the camel population will grow at an annual rate of 10% per year. |                                                                                           |
| *Example:* The expression $1.15^t$ can be rewritten as $(1.15^{1\text{st}})^{12t}$ which is approximately equivalent to $1.012^{12t}$. This latter expression reveals the approximate equivalent monthly interest rate of 1.2% if the annual rate is 15%. |                                                                                           |
| **MA.912.AR.1.2** – Rearrange equations or formulas to isolate a quantity of interest. | Clarification 1: Instruction includes using formulas for temperature, perimeter, area, and volume; using equations for linear (standard, slope-intercept, and point-slope forms) and quadratic (standard, factored, and vertex forms) functions.  
Clarification 2: Within the Mathematics for Data and Financial Literacy course, problem types focus on money and business. |
<p>| <em>Example:</em> Given the Compound Interest Formula $A = P \left(1 + \frac{r}{n}\right)^{nt}$, solve for $P$. |                                                                                           |
| <em>Example:</em> Given the Compound Interest Formula $A = P \left(1 + \frac{r}{n}\right)^{nt}$, solve for $t$ |                                                                                           |
| <strong>MA.912.AR.2.1</strong> – Given a real world context, write and solve one variable multistep linear equations. |                                                                                           |
| <strong>MA.912.AR.2.6</strong> – Given a mathematical or real world context, write and solve one variable linear inequalities, including compound inequalities. Represent solutions algebraically or graphically. |                                                                                           |
| <em>Example:</em> The compound inequality $2x \leq 5x + 1 &lt; 4$ is equivalent to $-1 \leq 3x$ AND $5x &lt; 3$, which is equivalent to $-\frac{1}{3} \leq x &lt; \frac{3}{5}$. |                                                                                           |</p>
<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebraic Expression</td>
<td>A mathematical phrase combining numbers and/or variables.</td>
</tr>
<tr>
<td>Base</td>
<td>In an expression of the form $x^n$, the base is $x$</td>
</tr>
<tr>
<td>Coefficient</td>
<td>The numerical factor of a term.</td>
</tr>
<tr>
<td>Compound inequality</td>
<td>Two or more inequalities that are connected by the words and or or.</td>
</tr>
<tr>
<td>Constant</td>
<td>A monomial that is a real number.</td>
</tr>
<tr>
<td>Equation</td>
<td>A mathematical statement that includes an equal sign to demonstrate that two quantities/expressions have the same value.</td>
</tr>
<tr>
<td>Exponent</td>
<td>In an expression of the form $x^n$, the exponent is $n$. It indicates the number of times $x$ is used as a factor.</td>
</tr>
<tr>
<td>Expression</td>
<td>Numbers and symbols group together by operators that represent a quantity.</td>
</tr>
<tr>
<td>Factors</td>
<td>In an algebraic expression, the quantities being multiplied are called factors.</td>
</tr>
<tr>
<td>Inequality</td>
<td>An open sentence that contains the symbol $&lt;, \leq, &gt;, or \geq$.</td>
</tr>
<tr>
<td>Linear</td>
<td>An equation in the form $Ax + By = C$, with a graph that is a straight line.</td>
</tr>
<tr>
<td>Point-Slope Form</td>
<td>An equation of the form $y - y_1 = m(x - x_1)$, where $m$ is the slope and $(x_1, y_1)$ is a given point on a nonvertical line.</td>
</tr>
<tr>
<td>Power</td>
<td>In an expression of the form $x^n$, read $x$ to the $n$th power.</td>
</tr>
<tr>
<td>Product</td>
<td>In an algebraic expression, the result of quantities being multiplied is called the product.</td>
</tr>
<tr>
<td>Slope-Intercept Form</td>
<td>An equation of the form $y = mx + b$, where $m$ is the slope and $b$ is the $y$ intercept.</td>
</tr>
<tr>
<td>Standard Form (linear)</td>
<td>The standard form of a linear equation is $Ax + By = C$, where $A \geq 0$, $A$ and $B$ are not both zero and $A, B$, and $C$ are integers with a greatest common factor of 1.</td>
</tr>
<tr>
<td>Term</td>
<td>A number, variable, or a product or quotient of numbers and variables.</td>
</tr>
<tr>
<td>Variable</td>
<td>Symbols used to represent unspecified numbers or values.</td>
</tr>
</tbody>
</table>

The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

**MA.912.AR.1.1**

Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
</table>
| MA.912.AR.1.1 Identify and interpret parts of an equation or expression that represent a quantity in terms of a mathematical or real-world context, including viewing one or more of its parts as a single entity. | MAFS.912.A-SSE.1.1 Interpret expressions that represent a quantity in terms of its context.  
- Interpret parts of an expression, such as terms, factors, and coefficients.  
- Interpret complicated expressions by viewing one or more of their parts as a single entity.  
  For example, interpret $P(1 + r)^n$ as the product of $P$ and a factor not depending on $P$. |
<p>| MAFS.912.A-SSE.1.2 Use the structure of an expression to identify ways to rewrite it. |</p>
<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td>McGraw-Hill Algebra 1:</td>
</tr>
<tr>
<td>• Identify parts of an</td>
<td>Chapter 1, Lesson 1 –</td>
</tr>
<tr>
<td>expression within context</td>
<td>Variables and Expressions</td>
</tr>
<tr>
<td>• Interpret parts of an</td>
<td>• Use questions 34 – 42</td>
</tr>
<tr>
<td>expression within context</td>
<td>(on pages 7-8) to</td>
</tr>
<tr>
<td>• Understand quantities as</td>
<td>ensure students can</td>
</tr>
<tr>
<td>a single entity</td>
<td>manipulate and</td>
</tr>
<tr>
<td></td>
<td>o Example: In point-slope</td>
</tr>
<tr>
<td></td>
<td>form, students can see</td>
</tr>
<tr>
<td></td>
<td>((x - x_1)), as a single</td>
</tr>
<tr>
<td></td>
<td>entity.</td>
</tr>
<tr>
<td>IXL Algebra 1: I.2: Sort factors</td>
<td>H.3: Simplify variable</td>
</tr>
<tr>
<td>of variable expressions</td>
<td>expressions using</td>
</tr>
<tr>
<td>ML9</td>
<td>properties</td>
</tr>
<tr>
<td>H.H: Simplify variable</td>
<td>HHR</td>
</tr>
<tr>
<td>expressions using</td>
<td>Z.1: Polynomial</td>
</tr>
<tr>
<td>properties</td>
<td>vocabulary MTT</td>
</tr>
<tr>
<td>Khan Academy:</td>
<td></td>
</tr>
<tr>
<td>Algebra 1: Algebra</td>
<td></td>
</tr>
<tr>
<td>Foundations</td>
<td></td>
</tr>
<tr>
<td>Algebra Nation:</td>
<td></td>
</tr>
<tr>
<td>2019 – 2020 version:</td>
<td></td>
</tr>
<tr>
<td>Section 1:</td>
<td></td>
</tr>
<tr>
<td>Topic 1 - Using Expressions</td>
<td></td>
</tr>
<tr>
<td>to Represent Real World</td>
<td></td>
</tr>
<tr>
<td>Situations</td>
<td></td>
</tr>
<tr>
<td>Topic 2: Understanding</td>
<td></td>
</tr>
<tr>
<td>Polynomial Expressions</td>
<td></td>
</tr>
<tr>
<td>Topic 3: Algebraic</td>
<td></td>
</tr>
<tr>
<td>Expressions Using the</td>
<td></td>
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<tr>
<td>Distributive Property</td>
<td></td>
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<tr>
<td>Topic 4: Algebraic</td>
<td></td>
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<tr>
<td>Expressions Using the</td>
<td></td>
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<tr>
<td>Commutative and Associative</td>
<td></td>
</tr>
<tr>
<td>Properties</td>
<td></td>
</tr>
<tr>
<td>Topic 5: Properties of</td>
<td></td>
</tr>
<tr>
<td>Exponents</td>
<td></td>
</tr>
<tr>
<td>2020-2021 version:</td>
<td></td>
</tr>
<tr>
<td>Section 1:</td>
<td></td>
</tr>
<tr>
<td>Topic 2: Identifying</td>
<td></td>
</tr>
<tr>
<td>Properties When Solving</td>
<td></td>
</tr>
<tr>
<td>Equations</td>
<td></td>
</tr>
<tr>
<td>Illustrative Mathematics:</td>
<td></td>
</tr>
<tr>
<td>Click here to get to</td>
<td></td>
</tr>
<tr>
<td>Algebra 1</td>
<td></td>
</tr>
<tr>
<td>Teachers will be able to</td>
<td></td>
</tr>
<tr>
<td>access student resource</td>
<td></td>
</tr>
<tr>
<td>but will need to set up a (free)</td>
<td></td>
</tr>
<tr>
<td>account to access lessons with prompts and guiding questions</td>
<td></td>
</tr>
<tr>
<td>Unit 2 Sections 1.1,1.2</td>
<td></td>
</tr>
<tr>
<td>Student Task Card: Scroll to the bottom of the page to access the student task pdf file.</td>
<td></td>
</tr>
</tbody>
</table>
Sample Problem: In the following expression, \( \frac{1}{2}x^2 + 3x - \frac{1}{5}x^7 + 8x \), what is the degree of the polynomial?

---

### MA.912.AR.1.2

Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.AR.1.2</strong> Rearrange equations or formulas to isolate a quantity of interest.</td>
<td>MAFS.912.A-CED.1.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law ( V = IR ) to highlight resistance ( R ).</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:

- Manipulate a formula, or equation, to isolate the variable of interest.

**In this unit the focus is isolating variables of interest in formulas and linear equations.**

**Instructional Resources**

**McGraw-Hill Algebra 1:**

Chapter 1, Lesson 2 pages 10 -15

- This lesson is meant to refresh the students’ memory of how to correctly apply order of operations.

Chapter 2, lesson 8 pages 126 - 131

**IXL Algebra 1:**

I.9: Rearrange multi-variable equations [WSJ]

O.4: Rate of travel: word problems [2C8]

**IXL Algebra 2:**

B.6: Solve multi-variable equations [LZD]

**Khan Academy:**

Algebra 2 – Modeling: [Manipulating Formulas]

**Algebra Nation:**

Section 2:

- Topic 8: Rearranging Formulas

**Illustrative Mathematics:**

Click [here] to get to Algebra 1

- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions

- Unit 2 Section 8.1

- [Student Task Card] Scroll to the bottom of the page to access the student task pdf file.

---

Sample Problems:

1) Given the Compound Interest Formula \( A = P \left(1 + \frac{r}{n}\right)^{nt} \), solve for \( P \).
2) The volume of a cylinder can be written as \( V = \left(\frac{1}{3}\right) \pi r^2 h \). Solve for \( r \).
### Algebra Nation:

*2019-2020 Version:*

- Section 2:
  - Topic 2: Identifying Properties When Solving Equations
  - Topic 3: Solving Equations
  - Topic 4: Solving Equations Using the Zero Product Property

### Illustrative Mathematics:

Click [here](#) to get to Algebra 1

- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 2 Section 8.2,8.3
- **Student Task Card** Scroll to the bottom of the page to access the student task pdf file.
- Unit 2 Section 9.2,9.3
- **Student Task Card** Scroll to the bottom of the page to access the student task pdf file.

---

### Sample Problem:

The Environmental Club at the school took a trip to the water treatment facility. There were 26 students and 4 chaperones on the trip. The total cost of the trip was $320.00. A ticket for a chaperone was $5 more than a student ticket. What was the cost of a student ticket?

---

### MA.912.AR.2.6

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.AR.2.6</strong> Given a mathematical or real world context, write and solve one variable linear inequalities, including compound inequalities. Represent solutions algebraically or graphically.</td>
<td><strong>MAFS.912.A-REI.2.3</strong> Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</td>
</tr>
<tr>
<td><strong>MAFS.912.A-CED.1.1</strong> Create equations and inequalities in one variable and use them to solve problems.</td>
<td></td>
</tr>
</tbody>
</table>

### Instructional Learning Objectives

Students will be able to:

- Write one variable multi-step linear inequalities from a math or real-world context.

### Instructional Resources

- **McGraw-Hill Algebra 1:**
  - Chapter 5, Lessons 1 – 5, pages 285 – 322
- **IXL:**
  - Algebra 1:
- Solve one variable multi-step linear inequalities from a math or real-world context.
- Represent solutions to one variable multi-step linear inequalities derived from a math or real-world context algebraically.

K.3: Identify solutions to inequalities SUE
K.4: Solve one-step linear inequalities: addition and subtraction RZV
K.5: Solve one-step linear inequalities: multiplication and division BRJ
K.6: Solve one-step linear inequalities EEX
K.8: Solve two-step linear inequalities NPZ
K.10: Solve advanced linear inequalities 9K8
K.14: Solve compound inequalities GXA

Geometry:
A.7: Solve linear inequalities 9MX

Algebra 2:
C.2: Write inequalities from graphs NKA
C.4: Solve linear inequalities 98Z

Khan Academy:
Algebra 1 – Solving Equations and Inequalities:
- Multi-step inequalities
- Compound inequalities

Algebra Nation:
Section 2: Topics 5, 6, and 7

Illustrative Mathematics:
Click here to get to Algebra 1
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 2 Section 20
- Student Task Card Scroll to the bottom of the page to access the student task pdf file.

Sample Problem(s):

1) Solve for \( x \): \( 1 < 3x + 4 \leq 10 \)

2) Due to the drought in Florida, many communities have scaled water rates. There are different rates for Conservation Usage, Normal Usage and Excessive Usage. The usage is measured in the number of hundred cubic feet (hcf) the property owner uses. During the summer, a property owner will pay $24.72 plus $1.54 per hcf for Normal Usage. The bill for Normal Usage would be between or equal to $57.06 and $171.02. How many hcf can the owner use if he wants his usage to stay in the normal range?
<table>
<thead>
<tr>
<th>Semester 1</th>
<th>A1H Unit 2: Graphing Linear Functions and Inequalities</th>
<th>8 Days Dec. 3-8 &amp; Jan. 4-7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmarks</strong></td>
<td><strong>Benchmark Clarifications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.AR.2.2</strong> - Write a linear two-variable equation to represent relationships between quantities from a graph, a written description or a table of values within a mathematical or real-world context.</td>
<td>Clarification 1: Instruction includes the use of standard form, slope-intercept form and point-slope form, and the conversion between these forms.</td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.AR.2.3</strong> - Write a linear two-variable equation for a line that is parallel or perpendicular to a given line and goes through a given point.</td>
<td>Clarification 1: Instruction focuses on recognizing that perpendicular lines have slopes that when multiplied result in −1 and that parallel lines have slopes that are the same.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 2: Instruction includes representing a line with a pair of points on the coordinate plane or with an equation.</td>
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</tr>
<tr>
<td></td>
<td>Clarification 3: Problems include cases where one variable has a coefficient of zero.</td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.AR.2.4</strong> - Given a table, equation or written description of a linear function, graph that function, and determine and interpret its key features.</td>
<td>Clarification 1: Key features are limited to domain, range, intercepts and rate of change.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 2: Instruction includes the use of standard form, slope-intercept form and point-slope form.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 3: Instruction includes cases where one variable has a coefficient of zero.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 4: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 5: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.</td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.AR.2.5</strong> - Solve and graph mathematical and real-world problems that are modeled with linear functions. Interpret key features and determine domain constraints in terms of the context.</td>
<td>Clarification 1: Key features are limited to domain, range, intercepts and rate of change.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 2: Instruction includes the use of standard form, slope-intercept form and point-slope form.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarification 3: Instruction includes representing the domain, range and constraints with inequality notation, interval notation or set-builder notation.</td>
<td></td>
</tr>
</tbody>
</table>
Clarification 4: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.

Clarification 5: Within the Mathematics for Data and Financial Literacy course, problem types focus on money and business.

**MA.912.AR.2.7** - Write two-variable linear inequalities to represent relationships between quantities from a graph or a written description within a mathematical or real-world context.

Clarification 1: Instruction includes the use of standard form, slope-intercept form and point-slope form and any inequality symbol can be represented.

Clarification 2: Instruction includes cases where one variable has a coefficient of zero.

**MA.912.AR.2.8** - Given a mathematical or real-world context, graph the solution set to a two-variable linear inequality.

Clarification 1: Instruction includes the use of standard form, slope-intercept form and point-slope form and any inequality symbol can be represented.

Clarification 2: Instruction includes cases where one variable has a coefficient of zero.

---

**Essential Vocabulary**

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>A line or curve that separates the coordinate plane into regions.</td>
</tr>
<tr>
<td>Closed Half-Plane</td>
<td>The solution of a linear inequality that includes the boundary line.</td>
</tr>
<tr>
<td>Constant</td>
<td>A monomial that is a real number.</td>
</tr>
<tr>
<td>Constant Function</td>
<td>A linear function of the form $y = b$.</td>
</tr>
<tr>
<td>Constraint</td>
<td>A condition that a solution must satisfy.</td>
</tr>
<tr>
<td>Domain</td>
<td>The set of first numbers of the ordered pairs in a relation, a set of all possible</td>
</tr>
<tr>
<td></td>
<td>values of the independent variable, or a list of inputs of the function.</td>
</tr>
<tr>
<td>Linear Equation</td>
<td>An equation in the form $Ax + By = C$, with a graph that is a straight line.</td>
</tr>
<tr>
<td>Open Half-Plane</td>
<td>The solution of a linear inequality that does not include the boundary line.</td>
</tr>
<tr>
<td>Parallel Lines</td>
<td>Lines in the same plane that do not intersect and either have the same slope or</td>
</tr>
<tr>
<td></td>
<td>are vertical lines.</td>
</tr>
<tr>
<td>Perpendicular Lines</td>
<td>Lines that intersect to form a right angle.</td>
</tr>
<tr>
<td>Point-Slope Form</td>
<td>An equation of the form $y - y_1 = m(x - x_1)$ where $m$ is the slope and $(x_1, y_1)$</td>
</tr>
<tr>
<td></td>
<td>is a given point on a nonvertical line.</td>
</tr>
<tr>
<td>Range</td>
<td>The set of second numbers of the ordered pairs in a relation, set of all possible</td>
</tr>
<tr>
<td></td>
<td>values of the dependent variable or a list of outputs of the function.</td>
</tr>
<tr>
<td>Rate of Change</td>
<td>How a quantity is changing with respect to a change in another quantity.</td>
</tr>
<tr>
<td>Set-builder notation</td>
<td>A concise way of writing a solution set.</td>
</tr>
<tr>
<td>Slope</td>
<td>The ratio of the change in the $y$-coordinates (rise) to the corresponding change in</td>
</tr>
<tr>
<td></td>
<td>the $x$-coordinates (run) as you move from one point to another along a line.</td>
</tr>
<tr>
<td>Slope-Intercept Form</td>
<td>An equation of the form $y = mx + b$ where $m$ is the slope and $b$ is the $y$-</td>
</tr>
<tr>
<td></td>
<td>intercept.</td>
</tr>
</tbody>
</table>
### Standard Form
The standard form of a linear equation is $Ax + By = C$, where $A \geq 0$, $A$ and $B$ are not both zero, and $A$, $B$, and $C$ are integers with a greatest common factor of 1.

### $x$-intercept
The $x$-coordinate of a point where a graph crosses the $x$-axis.

### $y$-intercept
The $y$-coordinate of a point where a graph crosses the $y$-axis.

---

**The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).**

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

**MA.912.AR.2.2**

<table>
<thead>
<tr>
<th>Connections between B.E.S.T. and Florida Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.E.S.T.</strong></td>
</tr>
<tr>
<td>MA.912.AR.2.2 Write a linear two-variable equation to represent relationships between quantities from a graph, a written description or a table of values within a mathematical or real-world context.</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:
- Write a linear equation* given a graph
- Write a linear equation* given a written description
- Write a linear equation* given a table of values
- Write a direct variation equation
- Convert standard form and point-slope form to slope-intercept form
- Convert slope-intercept to standard form

*linear equation in standard form, slope-intercept form, and/or point-slope form

**Instructional Resources**

**Mc-Graw-Hill Algebra 1:**
- Chapter 3: Linear Functions
  - Lesson 1: Graphing Linear Equations
  - Lesson 2: Solving Linear Equations by Graphing
  - Lesson 3: Rate of Change and Slope
  - Lesson 4: Direct Variation
- Chapter 4: Equations of Linear Functions
  - Lesson 1: Graphing Equations in Slope Intercept Form
  - Lesson 2: Writing Equations in Slope Intercept Form
  - Lesson 3: Writing Equations in Point-Slope Form

**Algebra Nation:**
- Section 3: Introduction to Functions
  - Topic 7: Key Features of Graphs of Functions - Part 1
  - Topic 8: Key Features of Graphs of Functions - Part 2
  - Topic 9: Average Rate of Change Over and Interval
- Section 4: Linear Equations, Functions & Inequalities
  - Topic 2: Rate of Change of Linear Functions
  - Topic 3: Interpreting Rate of Change and y-intercept in a Real-World Context - Part 1
  - Topic 4: Interpreting Rate of Change and y-intercept in a Real-World Context - Part 2

**IXL Math Algebra 1:**
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.

Direct variation
1. Write direct variation equations (Y6M)

Slope-intercept form
2. Slope-intercept form: write an equation from a graph (9GW)
3. Slope-intercept form: write an equation (A42)
4. Slope-intercept form: write an equation from a table (SSE)

Standard form
5. Write equations in standard form (ESP)

Point-slope form
6. Point-slope form: write an equation (PPE)
7. Point-slope form: write an equation from a graph (LBX)

Virtual Nerd Videos:
• How Do You Write the Equation of a Line in Slope-Intercept Form if You Have the Slope and y-intercept?
• How Do You Write the Equation of a Line in Slope-Intercept Form if You Have a Graph?
• How Do You Write the Equation of a Line in Slope-Intercept Form if You Have a Table?
• How Do You Write an Equation of a Line in Point-Slope Form Given Slope and a Point?
• How Do You Write an Equation of a Line in Point-Slope Form and Standard for if You Have Two Points?
• How Do You Use Point-Slope Form to Write an Equation from a Table?
• How Do You Put an Equation in Point-Slope Form into Standard or Slope-Intercept Form?

Khan Academy:
Courses ➔ Algebra 1 ➔ Forms of Linear Equations
• Intro to slope-intercept form
• Slope and y-intercept from equation
• Worked examples: slope-intercept intro
• Linear equation word problems
• Slope-intercept equation from graph
• Slope-intercept equation from slope & point
• Slope-intercept equation from two points
• Constructing linear equations from context
• Intro to point-slope form
Sample Problems:

1. A pool starts off with 300 liters of water and is being filled at a rate of 25 liters per minute. Let $W$ represent the amount of water in the pool after $T$ minutes of filling it with additional water. Write an equation to represent this situation.

2. Which function is represented by the input-output table below?

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>26</td>
</tr>
</tbody>
</table>

A. $f(x) = 3x + 2$
B. $f(x) = 2x + 3$
C. $f(x) = 0.5x + 4.5$
D. $f(x) = 4.5x + 0.5$

---

**MA.912.AR.2.3**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.AR.2.3</strong> Write a linear two-variable <strong>equation</strong> for a line that is <strong>parallel</strong> or <strong>perpendicular</strong> to a given line and goes through a given point.</td>
<td>Geometry Standard: MAFS.912.G-GPE.2.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:
- Recognize parallel lines have the same slopes
- Recognize perpendicular lines have slopes whose product is -1
- Write a linear equation for a line perpendicular/parallel to a given line through a given point.

**Instructional Resources**

**Mc-Graw-Hill Algebra 1:**
- Chapter 4: Equations of Linear Functions
  - Lesson 4: Parallel and Perpendicular Lines

**Algebra Nation:**
- Geometry Section 1: Introduction to Geometry
  - Topic 8: Parallel and Perpendicular Lines – Part 1
  - Topic 9: Parallel and Perpendicular Lines – Part 2
IXL Math Algebra 1:
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.  
1. Slopes of parallel and perpendicular lines (ADB)  
2. Write an equation for a parallel or perpendicular line (SSH)

Virtual Nerd Videos:  
- How Do You Know if Two Lines are Parallel?  
- How Do You Know if Two Lines are Perpendicular?  
- How to Find the Slope of a Line if You Have a Parallel Line?  
- How to Find the Slope of a Line if You Have a Perpendicular Line?  
- How Do You Write an Equation of a Line in Slope-Intercept Form if You Have One Point and a Parallel Line?  
- How Do You Write an Equation of a Line in Slope-Intercept Form if You Have One Point and a Perpendicular Line?

Sample Problems:  
1. Determine whether the graphs of the pair of equations are parallel, perpendicular, or neither.  
   \[y = -6x + 8\]  
   \[3x + \frac{1}{2}y = -3\]

2. An archaeologist is comparing the location of a jeweled box she just found to the location of a brick wall. The wall can be represented by the equation \[y = -\frac{5}{3}x + 13\]. The box is located at the point (10, 9). Write an equation representing a line that is perpendicular to the wall and that passes through the location of the box.

MA.912.AR.2.4

Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.2.4</td>
<td>MAFS.912.F-IF.2.4</td>
</tr>
</tbody>
</table>
### Instructional Learning Objectives

Students will be able to:

- Graph a linear function given a table
- Graph a linear function given an equation
- Graph a linear function given a written description
- Determine and interpret a graph’s key features
- Identify slope, y-intercept, and x-intercept in a given linear function

### Instructional Resources

**Mc-Graw-Hill Algebra 1:**

- Chapter 3: Linear Functions
  - Lesson 1: Graphing Linear Equations
  - Lesson 2: Solving Linear Equations by Graphing
  - Lesson 3: Rate of Change and Slope
  - Lesson 4: Direct Variation

- Chapter 4: Equations of Linear Functions
  - Lesson 1: Graphing Equations in Slope Intercept Form
  - Lesson 2: Writing Equations in Slope Intercept Form
  - Lesson 3: Writing Equations in Point-Slope Form

**Algebra Nation:**

- Section 3: Introduction to Functions
  - Topic 7: Key Features of Graphs of Functions - Part 1
  - Topic 8: Key Features of Graphs of Functions - Part 2
  - Topic 9: Average Rate of Change Over and Interval

- Section 4: Linear Equations, Functions & Inequalities
  - Topic 2: Rate of Change of Linear Functions
  - Topic 3: Interpreting Rate of Change and y-intercept in a Real-World Context - Part 1
  - Topic 4: Interpreting Rate of Change and y-intercept in a Real-World Context - Part 2

**IXL Math Algebra 1:**

You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click [here](#).

Identify key features

1. Find the slope of a graph (E7D)
2. Slope-intercept form: find the slope and y-intercept (R5T)
3. Standard form: find x- and y-intercepts (8SN)

Graph linear functions

4. Slope-intercept form: graph an equation (UWB)
5. Complete a table and graph a linear function (JFG)
6. Standard form: graph an equation (U6U)
### 7. Point-slope form: graph an equation (F8H)

**Virtual Nerd Videos:**
- How Do You Graph a Linear Equation in Slope-Intercept Form by Making a Table?
- How Do You Graph a Line if You’re Given the Slope and the Intercept?

**SAFARI Montage:**
- Graphing a Linear Equation - worksheet

**Khan Academy:**
Courses → Algebra 1 → Forms of Linear Equations →
Graphing slope-intercept equations
- Graph from slope-intercept equation

Courses → Algebra 1 → Forms of Linear Equations →
Standard Form
- Graphing linear equation: $5x + 2y = 20$

**Illustrative Mathematics:**
Click [here](#) to get to Algebra 1
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 4 Lesson 4, 5, & 6

### Sample Problems:

1. Graph a linear function with a slope of -4 and the same y-intercept as the function below.
   \[ y = \frac{2}{3}x + 3 \]

2. Identify the x-intercept, y-intercept, slope, and equation of the linear function graphed below.

![Graph of a linear function](image.png)

- x-intercept: _________
- y-intercept: _________
- slope: _________
- equation: _________
<table>
<thead>
<tr>
<th><strong>MA.912.AR.2.5</strong></th>
<th><strong>Connections between B.E.S.T. and Florida Standards</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.E.S.T.</strong></td>
<td><strong>Florida Standard</strong></td>
</tr>
<tr>
<td>Solve and <strong>graph</strong> mathematical and real-world problems that are modeled with linear functions. <strong>Interpret key features</strong> and determine <strong>domain</strong> constraints in terms of the context.</td>
<td><strong>MAFS.912.F-IF.2.4</strong> For a function that models a relationship between two quantities, <strong>interpret key features</strong> of <strong>graphs</strong> and tables in terms of the quantities and sketch <strong>graphs</strong> showing <strong>key features</strong> given a verbal description of the relationship. <strong>Key features</strong> include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Instructional Learning Objectives</strong></th>
<th><strong>Instructional Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td><strong>Mc-Graw-Hill Algebra 1:</strong></td>
</tr>
<tr>
<td>• Create, solve, and graph equations and inequalities in a real-world relationship</td>
<td></td>
</tr>
<tr>
<td>• explain the steps for solving equations</td>
<td></td>
</tr>
<tr>
<td>• explain the steps for solving inequalities</td>
<td><strong>Chapter 3: Linear Functions</strong></td>
</tr>
<tr>
<td></td>
<td>• Lesson 1: Graphing Linear Equations</td>
</tr>
<tr>
<td></td>
<td>• Lesson 2: Solving Linear Equations by Graphing</td>
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<td></td>
<td>• Lesson 3: Rate of Change and Slope</td>
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<td>• Lesson 4: Direct Variation</td>
</tr>
<tr>
<td></td>
<td><strong>Chapter 4: Equations of Linear Functions</strong></td>
</tr>
<tr>
<td></td>
<td>• Lesson 1: Graphing Equations in Slope Intercept Form</td>
</tr>
<tr>
<td></td>
<td>• Lesson 2: Writing Equations in Slope Intercept Form</td>
</tr>
<tr>
<td></td>
<td>• Lesson 3: Writing Equations in Point-Slope Form</td>
</tr>
<tr>
<td></td>
<td><strong>Chapter 5: Linear Inequalities</strong></td>
</tr>
<tr>
<td></td>
<td>• Lesson 6: Graphing Inequalities in Two Variables</td>
</tr>
</tbody>
</table>

**Algebra Nation:**

Section 2: Equations and Inequalities

• Topic 5: Solving Inequalities – Part 1
• Topic 6: Solving Inequalities – Part 2
• Topic 9: Solutions Sets to Equations with Two Variables

**IXL Math Algebra 1:**
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.

1. Slope-intercept form: write an equation from a word problem (HWM)
2. Write linear functions to solve word problems (9RQ)
Virtual Nerd Videos:
- How Do You Write the Equation of a Line in Slope-Intercept Form from a Word Problem?
- How Do You Solve and Graph Inequalities from a Word Problem?

SAFARI Montage:
- Graphing and Interpreting Functions - worksheet

Khan Academy:
Courses → Algebra 1 → Linear equations & graphs → Two-variable linear equations intro
- Two-variable linear equations intro
- Solutions to two-variable equations
- Worked example: solutions to 2-variable equations
- Completing solutions to 2-variable equations
Courses → Algebra 1 → Inequalities (systems & graphs) → Graphing two-variable inequalities
- Intro to graphing two-variable inequalities

Illustrative Mathematics:
Click here to get to Algebra 1
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 4 Lesson 12
  Student Task Scroll to the bottom of the page to access the student task pdf file.

Sample Problem:
Lizzy’s mother is planning a 16th birthday party. To help budget for the party she uses the function $C(p)=450+7.75p$, where $C(p)$ represents the total cost of a rental space and $p$ is the number of people attending. Lizzy’s mom wants to spend no more than $850 for the party. Graph the function in terms of the context.

### MA.912.AR.2.7 Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.2.7 <strong>Write</strong> two-variable linear <strong>inequalities</strong> to represent relationships between quantities from a graph or a written description within a mathematical or real-world context.</td>
<td>MAFS.912.A-CED.1.3 <strong>Represent</strong> constraints by equations or <strong>inequalities</strong> and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a <strong>modeling context</strong>.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td>Mc-Graw-Hill Algebra 1:</td>
</tr>
<tr>
<td>• write two-variable linear inequalities from a graph</td>
<td>Chapter 5: Linear Inequalities</td>
</tr>
<tr>
<td></td>
<td>• Lesson 6: Graphing Inequalities in Two Variables</td>
</tr>
</tbody>
</table>
• write two-variable linear inequalities from a written description
• write two-variable linear inequalities from a real-world situation

Algebra Nation:  
Section 2: Equations and Inequalities
• Topic 5: Solving Inequalities – Part 1
• Topic 6: Solving Inequalities – Part 2
• Topic 9: Solutions Sets to Equations with Two Variables

IXL Math Algebra 1:  
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.  
1. Linear inequalities: word problems (ZAY)

Khan Academy:  
Courses → Algebra 1 → Inequalities (systems & graphs) → Graphing two-variable inequalities
• Two-variable inequalities from their graphs
Courses → Algebra 1 → Inequalities (systems & graphs) → Modeling with linear inequalities
• Writing two-variable inequalities word problem

Illustrative Mathematics:  
Click here to get to Algebra 1
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
• Unit 2 Lesson 21  
  Student Task Scroll to the bottom of the page to access the student task pdf file.
• Unit 2 Section 22  
  Student Task Scroll to the bottom of the page to access the student task pdf file.

Sample Problems:
1. Match the following two variable inequalities to their graph.

A. \( y < 2x + 1 \)  
B. \( y \geq 2x + 1 \)  
C. \( y > 2x + 1 \)  
D. \( y \leq 2x + 1 \)
2. Liam is selling tickets to a school jazz concert. Student tickets cost $7.50 each and guest tickets cost $12.00 each. Liam’s goal is to sell at least $120.00 in tickets. Write an inequality that represents the number of student tickets $s$ and guest tickets $g$ that Liam must sell to reach his goal.

### MA.912.AR.2.8

<table>
<thead>
<tr>
<th>Connections between B.E.S.T. and Florida Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.E.S.T.</strong></td>
</tr>
<tr>
<td><strong>MA.912.AR.2.8 Given a mathematical or real-world context, graph the solution set to a two-variable linear inequality.</strong></td>
</tr>
</tbody>
</table>

### Instructional Learning Objectives

Students will be able to:
- model a real-world situation with a two-variable inequality
- interpret the meaning of the solutions and represent them on a graph

### Instructional Resources

- **Mc-Graw-Hill Algebra 1:**
  Chapter 5: Linear Inequalities
  - Lesson 6: Graphing Inequalities in Two Variables

- **Algebra Nation:**
  Section 2: Equations and Inequalities
  - Topic 9: Solutions Sets to Equations with Two Variables
  Section 4: Linear Equations, Functions & Inequalities
  - Topic 9: Solution Sets to Inequalities with Two Variables

- **IXL Math Algebra 1:**
  You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.
  1. Graph a two-variable inequality (HHP)

- **Virtual Nerd Videos:**
  - How Do You Solve and Graph Inequalities from a Word Problem?
  - How Do You Determined a Situation that a Graph Represents?

- **Khan Academy:**
  Courses ➔ Algebra 1 ➔ Inequalities (systems & graphs) ➔ Graphing two-variable inequalities
  - Graphing two-variable inequalities
  Courses ➔ Algebra 1 ➔ Inequalities (systems & graphs) ➔ Modeling with linear inequalities
  - Solving two-variable inequalities word problem
  - Graphs of two-variable inequalities word problem
<table>
<thead>
<tr>
<th>Pinellas County Schools</th>
<th>Double Block P-A and A1H</th>
<th>2020-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Interpreting two-variable inequalities word problem</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Illustrative Mathematics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Click <a href="#">here</a> to get to Algebra 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unit 2 Lesson 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="#">Student Task</a> Scroll to the bottom of the page to access the student task pdf file.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample Problem:**
The Drama Club sold cider and donuts to raise money for new costumes. They sold small boxes of donut holes for $1.25 and cider for $2.50 a gallon. To cover their expenses, they needed to raise at least $100. Write and graph an inequality that represents this situation.

![Graph]

The graph shows the relationship between the number of donut holes and the amount of cider sold. The x-axis represents the number of donut holes, and the y-axis represents the amount of cider sold. The inequality that represents this situation can be written as:

\[1.25d + 2.50c \geq 100\]

where \(d\) is the number of donut holes and \(c\) is the amount of cider sold in gallons.

---

*Note: The actual graph is not provided in the text.*
## A1H Unit 3: System of Equations and Inequalities

### 6 days  
Jan. 8 – Jan. 15

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
</table>
| **MA.912.AR.9.1** Given a mathematical or real-world context, write and solve a system of two-variable linear equations algebraically or graphically. | Clarification 1: Within this benchmark, the expectation is to solve systems using elimination, substitution and graphing.  
Clarification 2: Within the Algebra 1 course, the system is limited to two equations. |
| **MA.912.AR.9.4** Graph the solution set of a system of two-variable linear inequalities. | Clarification 1: Instruction includes cases where one variable has a coefficient of zero.  
Clarification 2: Within the Algebra 1 course, the system is limited to two inequalities. |
| **MA.912.AR.9.6** Given a real-world context, represent constraints as systems of linear equations or inequalities. Interpret solutions to problems as viable or non-viable options. | Clarification 1: Instruction focuses on analyzing a given function that models a real-world situation and writing constraints that are represented as linear equations or linear inequalities. |

### Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System of Equations</td>
<td>A set of two or more equations that has a common set of solutions</td>
</tr>
<tr>
<td>Elimination Method</td>
<td>Method of solving a system in which two equations are added together in a manner that will eliminate one of the two variables.</td>
</tr>
<tr>
<td>Substitution Method</td>
<td>Method for solving a system of linear equations in which the equivalent expression of a variable is substituted for that variable into the other equation.</td>
</tr>
<tr>
<td>Inconsistent System</td>
<td>A type of system that does not have a solution</td>
</tr>
<tr>
<td>Consistent system</td>
<td>A type of system that has at least one solution</td>
</tr>
<tr>
<td>Dependent System</td>
<td>A type of system that has infinitely many solution (its graph has only one visible line)</td>
</tr>
<tr>
<td>Independent System</td>
<td>A system with exactly one solution (Its graph has two intersecting lines)</td>
</tr>
<tr>
<td>The point of intersection</td>
<td>The point at which two lines cross</td>
</tr>
<tr>
<td>Solution to a System</td>
<td>The point of intersection for a system of equations</td>
</tr>
<tr>
<td>System of inequalities</td>
<td>A system made up of two or more inequalities</td>
</tr>
</tbody>
</table>

### MA.912.AR.9.1  
Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>MA.912.AR.9.1</em> Given a mathematical or real-world context, write and <strong>solve a system of</strong> two-variable linear equations algebraically or graphically.</td>
<td><em>MAFS.912.A-REI.3.6</em> Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables</td>
</tr>
<tr>
<td></td>
<td><em>MAFS.912.A-REI.3.5</em> Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equations and a multiple of the other produces a system with the same solutions.</td>
</tr>
</tbody>
</table>
MAFS.912.A-REI.4.11 Explain why the x-coordinates of the points where the graphs of the equations y=f(x) and y=g(x) intersect, are the solutions of the equation f(x)=g(x); find the solutions approximately, e.g. using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td>McGraw-Hill Algebra 1:</td>
</tr>
<tr>
<td>• Write a system of linear equations that represents a real-world problem.</td>
<td>• 6-1 Graphing Systems of Equations</td>
</tr>
<tr>
<td>• Solve system of equations by graphing.</td>
<td>• 6-2 Substitution</td>
</tr>
<tr>
<td>• Solve system of equations by substitution</td>
<td>• 6-3 Elimination Using Addition and Subtraction</td>
</tr>
<tr>
<td>• Solve system of equations by elimination</td>
<td>• 6-4 Elimination Using Multiplication</td>
</tr>
<tr>
<td>• Determine whether a given system has one solution, no solution, or infinitely many solutions</td>
<td>• 6-5 Applying Systems of Linear Equations</td>
</tr>
<tr>
<td>• Determine whether a system is consistent or inconsistent</td>
<td></td>
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<tr>
<td>• Determine whether a system is dependent or independent</td>
<td></td>
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<tr>
<td>• Determine the best method to solve a given system of equations</td>
<td></td>
</tr>
<tr>
<td>• Determine whether an ordered pair is a solution of a system of equations</td>
<td></td>
</tr>
<tr>
<td>• Solve application problems by graphing a system of equations</td>
<td></td>
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<tr>
<td></td>
<td>IXL Math Algebra 1</td>
</tr>
<tr>
<td></td>
<td>• Classify a system of equations LTA</td>
</tr>
<tr>
<td></td>
<td>• Classify a system of equations by graphing T2D</td>
</tr>
<tr>
<td></td>
<td>• Is (x, y) a solution to the system of equations? LRL</td>
</tr>
<tr>
<td></td>
<td>• Find the number of solutions to a system of equations by graphing HIW</td>
</tr>
<tr>
<td></td>
<td>• Find the number of solutions to a system of equations ACN</td>
</tr>
<tr>
<td></td>
<td>• Solve a system of equations by graphing: word problems BVB</td>
</tr>
<tr>
<td></td>
<td>• Solve a system of equations by graphing TSS</td>
</tr>
<tr>
<td></td>
<td>• Solve a system of equations using substitution 8P9</td>
</tr>
<tr>
<td></td>
<td>• Solve a system of equations using substitution: word problems US9</td>
</tr>
<tr>
<td></td>
<td>• Solve a system of equations using elimination: word problems NHR</td>
</tr>
<tr>
<td></td>
<td>• Solve a system of equations using elimination A48</td>
</tr>
<tr>
<td></td>
<td>Khan Academy</td>
</tr>
<tr>
<td></td>
<td>• Introduction to Systems of Equations</td>
</tr>
<tr>
<td></td>
<td>• Solving systems of equations with substitution</td>
</tr>
<tr>
<td></td>
<td>• Equivalent systems of equations and the elimination method</td>
</tr>
<tr>
<td></td>
<td>• Number of solutions to systems of equations</td>
</tr>
<tr>
<td></td>
<td>• Systems of equations word problems</td>
</tr>
<tr>
<td></td>
<td>Algebra Nation</td>
</tr>
<tr>
<td></td>
<td>Section 4 Linear Equations: Functions and Inequalities</td>
</tr>
<tr>
<td></td>
<td>• Topic 5 – Introduction to Systems of Equations</td>
</tr>
</tbody>
</table>
### Double Block P-A and A1H

- **Topic 6** – Finding Solution Sets to Systems of Equations using Substitution and Graphing
- **Topic 7** – Using Equivalent Systems of Equations
- **Topic 8** – Finding Solution Sets to Systems of Equations Using Elimination

**MFAS Formative Assessments**
- [Solution Sets of Systems](#)
- [Solving Systems](#)

**Illustrative Mathematics**
Click [here](#) to get to Algebra 1
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 2 Lesson 12, 13, 14, 15, 16 & 17

**Sample Problem:**
Tickets to the Homecoming Game cost $5 for students and $8 for adults. So far, 374 tickets were sold and $2044 were collected. Write and solve a system of equations to determine the number of student tickets, \(s\), and the number of adult tickets, \(a\), sold.

### MA.912.AR.9.4

#### Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.AR.9.4</strong> Graph the solution set of a system of two-variable linear inequalities.</td>
<td><strong>MAFS.912.A.REI.4.12</strong> Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.</td>
</tr>
</tbody>
</table>

#### Instructional Learning Objectives

<table>
<thead>
<tr>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students will be able to:</strong></td>
</tr>
<tr>
<td>- Graph a system of linear inequalities.</td>
</tr>
<tr>
<td>- Determine which region (if any) represents all the solutions to the given system of linear inequalities</td>
</tr>
<tr>
<td>- Determine whether an ordered pair is a solution of a system of inequalities.</td>
</tr>
<tr>
<td>- Solve application problems by graphing a system of inequalities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>McGraw-Hill Algebra 1:</strong></td>
</tr>
<tr>
<td>- 6-6 Systems of Inequalities</td>
</tr>
<tr>
<td>- Extend 6-6 Using a graphing calculator</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IXL Math</strong></td>
</tr>
<tr>
<td>- Solve systems of linear inequalities by graphing <a href="#">SGH</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Khan Academy</strong></td>
</tr>
<tr>
<td>- <a href="#">Inequalities (systems and graphs)</a></td>
</tr>
</tbody>
</table>
Sample Problem
Graph the solution to the following system of inequalities:
\[
\begin{align*}
 y &< \frac{1}{3}x + 1 \\
 x - 6y &\leq 12
\end{align*}
\]

MA.912.AR.9.5
Connections between B.E.S.T. and Florida Standards

B.E.S.T.  

**MA.912.AR.9.6** Given a real-world context, represent constraints as systems of linear equations or inequalities. Interpret solutions to problems as viable or non-viable options.

Florida Standard  

**MAFS.912.A-CED.1.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

Instructional Learning Objectives  

Students will be able to:
- Determine constraints for the given system of equations or inequalities based on the context of a given problem.

Instructional Resources  

McGraw-Hill Algebra 1:
- 5-6 Graphing Inequalities in Two Variables
- 6-1 Graphing Systems of Equations
• Explain why these constraints are necessary.
• Determine whether the solution to the given system is viable based on the context of a given problem.

6-5 Applying Systems of Linear Equations and Inequalities

**IXL Math**
- Linear inequalities: word problems ZAY
- Solve a system of equations by graphing: word problems BVB
- Solve a system of equations using substitution: word problems US9
- Solve a system of equations using elimination: word problems NHR
- Solve a system of equations using any method: word problems GDQ

**Mathematics Formative Assessments (MFAS)**
- Constraints on Equations
- Sugar and Protein
- The New School

**Illustrative Mathematics**
Click here to get to Algebra 1
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 2 Lesson 26
Lesson 26, Scroll to the bottom of the page to access the student task pdf file.

**Sample Problem**
Which y-values make the ordered pair \((0, y)\) a solution of the system of inequalities represented by the graph?

(A) \(-2 \leq y < 6\)
(B) \(-2 < y \leq 6\)
(C) \(-2 < y \leq 3\)
(D) \(-2 \leq y < 3\)
## A1H Unit 4: Exponent Rules and Radicals

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
</table>
| **MA.912.NSO.1.1** - Extend previous understanding of the Laws of Exponents to include rational exponents. Apply the Laws of Exponents to evaluate numerical expressions and generate equivalent numerical expressions involving rational exponents. | Clarification 1: Instruction includes the use of technology when appropriate.  
Clarification 2: Refer to the K-12 Formulas (Appendix E) for the Laws of Exponents.  
Clarification 3: Instruction includes converting between expressions involving rational exponents and expressions involving radicals.  
Clarification 4: Within the Mathematics for Data and Financial Literacy course, it is not the expectation to generate equivalent numerical expressions. |
| **MA.912.NSO.1.2** - Generate equivalent monomial algebraic expressions using the properties of exponents. | |
| **MA.912.NSO.1.4** - Apply previous understanding of operations with rational numbers to add, subtract, multiply and divide numerical radicals. | Clarification 1: Within the Algebra 1 course, expressions are limited to a single arithmetic operation involving two square roots or two cube roots. |

## Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>In an expression of the form (x^n), the base is (x).</td>
</tr>
<tr>
<td>Constant</td>
<td>A monomial that is a real number.</td>
</tr>
<tr>
<td>Cube Root</td>
<td>If (a^3 = b), then (a) is the cube root of (b).</td>
</tr>
<tr>
<td>Exponent</td>
<td>In an expression in the form (x^n), the exponent is (n). It indicates the number of times (x) is used as a factor.</td>
</tr>
<tr>
<td>Exponential Equation</td>
<td>An equation in which the variables occur as exponents.</td>
</tr>
<tr>
<td>Monomial</td>
<td>A number, a variable, or a product of a number and one or more variables.</td>
</tr>
<tr>
<td>Power</td>
<td>An expression of the form (x^n), read (x) to the (n^{th}) power.</td>
</tr>
<tr>
<td>(n^{th}) Root</td>
<td>If (a^n = b), then (a) is the (n^{th}) root of (b).</td>
</tr>
<tr>
<td>Radical Expression</td>
<td>An expression that contains a radical, such as a square root.</td>
</tr>
<tr>
<td>Radical Function</td>
<td>A function that contains radicals with variables in the radicand.</td>
</tr>
<tr>
<td>Radicand</td>
<td>The expression that is under the radical sign.</td>
</tr>
<tr>
<td>Rational Exponent</td>
<td>For any positive real number (b) and any integers (m) and (n&gt;1), (b^{m/n} = (\sqrt[n]{b})^m) or (\sqrt[n]{b^m}). (\frac{m}{n}) is a rational exponent.</td>
</tr>
<tr>
<td>Rationalizing the Denominator</td>
<td>A method used to eliminate radicals from the denominator of a fraction.</td>
</tr>
<tr>
<td>Square Root</td>
<td>One of two equal factors of a number.</td>
</tr>
<tr>
<td>Square Root Function</td>
<td>A function that contains the square root of a variable.</td>
</tr>
</tbody>
</table>
The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

### MA.912.NSO.1.1

**B.E.S.T.**  
MA.912.NSO.1.1 Extend previous understanding of the Laws of Exponents to include rational exponents. Apply the Laws of Exponents to evaluate numerical expressions and generate equivalent numerical expressions involving rational exponents.

**Florida Standard**  
MAFS.912.A-SSE.2.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td>Mc-Graw-Hill Algebra 1:</td>
</tr>
</tbody>
</table>
| • Evaluate and rewrite expressions involving rational exponents | Chapter 7: Exponents and Exponential Functions  
  • Lesson 3: Rational Exponents |
|                                  | Algebra Nation:         |
|                                  | Section 1: Expressions  |
|                                  | • Topic 4: Radical Expressions and Expressions with Rational Exponents |
|                                  | • Topic 5: Adding Expressions with Radicals and Rational Exponents |
|                                  | • Topic 6: More Operations with Radicals and Rational Exponents |
IXL Math Algebra 1:
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.

1. Evaluate integers raised to rational exponents (PQH)
2. Multiplication with rational exponents (YG7)
3. Division with rational exponents (H47)
4. Power rule with rational exponents (QF8)
5. Simplify expressions involving rational exponents (89Q)

Khan Academy:
- Algebra 2 Intro to Rational Exponents
- Algebra 2 Rewriting roots as rational exponents

Illustrative Mathematics Assessment Tasks:
- Evaluating Exponential Expressions This task is to use properties of exponents for whole numbers in order to explain how expression with fractional exponents are defined.
- Checking a Calculation of a Decimal Exponent This task is to connect properties of fractional exponents with ordering of real numbers.

MARS/Shell Center:
- Evaluating Statements about Radicals In this lesson students will use the properties of exponents, including rational exponents and manipulate algebraic statements involving radicals. Discriminate between equations and identities.

Illustrative Mathematics:
Click here to get to Algebra 2
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 3 Lesson 3, 4 & 5
  Lesson 3, Lesson 4, Lesson 5 Scroll to the bottom of the page to access the student task pdf file.

Sample Problems:
1. Simplify $625^{\frac{1}{4}}$.

\[
625^{\frac{1}{4}} = \sqrt[4]{625} = \sqrt{\sqrt{625}} = \sqrt{5 \cdot 5 \cdot 5 \cdot 5} = 5
\]

Simplify
2. Evaluate $27^{\frac{1}{3}} \times 3^{\frac{1}{3}}$

$27^{\frac{1}{3}} \times 3^{\frac{1}{3}} = (27 \times 3)^{\frac{1}{3}}$

$= 81^{\frac{1}{3}}$

$= \sqrt[3]{81}$

$= 3$

## MA.912.NSO.1.2

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.NSO.1.2</td>
<td>MAFS.912.A-SSE.2.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</td>
</tr>
</tbody>
</table>

a. Use the properties of exponents to transform expressions for exponential functions. For example, the expression $1.15^t$ can be rewritten as $(1.15^{\frac{1}{12}})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAFS.912.F-IF.3.8</td>
<td>Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.</td>
</tr>
</tbody>
</table>

a. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.012)^{12t}$, $y = (1.2)^{12t}$, and classify them as representing exponential growth or decay.

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAFS.912.N-RN.1.2</td>
<td>Rewrite expressions involving radicals and rational exponents using the properties of exponents.</td>
</tr>
</tbody>
</table>

## Instructional Learning Objectives

Students will be able to:

- Multiply and divide monomials using the properties of exponents
- Simplify expressions using the properties of exponents
- Use the properties of exponents to rewrite expressions with integer exponents

## Instructional Resources

**Mc-Graw-Hill Algebra 1:**

Chapter 7: Exponents and Exponential Functions
- Lesson 1: Multiplication Properties of Exponents
- Lesson 2: Division Properties of Exponents

**Algebra Nation:**

Section 1: Expressions
- Topic 2: Properties of Exponents

**IXL Math Algebra 1:**

You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.

1. Multiply monomials (52N)
2. Divide monomials (B48)
3. Multiply and divide monomials (48P)
4. Powers of monomials (7Q8)

Virtual Nerd Videos:
- How Do You Take the Power of a Monomial?
- How Do You Take a Monomial to a Power?
- How Do You Multiply Monomials?
- How Do You Divide Monomials Using Quotient of Powers?
- How Do You Solve a Word Problem by Dividing Monomials?
- How Do You Solve a Word Problem by Taking a Monomial to a Power?

Khan Academy:
Courses → Algebra 1 → Exponents & radicals → Exponents properties review
- Multiplying and dividing powers (integer exponents)
- Powers of products and quotients (integer exponents)

Illustrative Mathematics:
Click here to get to Algebra 2
*Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.*
- Unit 3 Lesson 9
  Lesson 9 Scroll to the bottom of the page to access the student task pdf file.

Sample Problems:
1. Simplify \((-2ab^2)^3(a^2)^4\).
\[
(-2ab^2)^3 (a^2)^4 = (-2ab^2)^3(a^8) = (-2)^3(a^3)(b^2)^3(a^8) = (-2)^3(a^{11})(b^2)^3 = -8a^{11}b^6
\]

2. Simplify \(\frac{4a^{-3}b^6}{16a^2b^6c^{-5}}\). Assume that no denominator equals zero.
\[
\frac{4a^{-3}b^6}{16a^2b^6c^{-5}} = \frac{\frac{4}{16}}{a^{-3-2}}(b^6)^{-1}(c^5) = \frac{1}{4}a^{-5}b^0c^5 = \frac{1}{4}\left(\frac{1}{a}\right)c^5 = \frac{c^5}{4a^5}
\]
3. The expression $1.5^{3t+2}$ is equivalent to the expression $2.25(1.5)^{3t}$ which is equivalent to $2.25(3.375)^t$.

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### MA.912.NSO.1.4

<table>
<thead>
<tr>
<th>Connections between B.E.S.T. and Florida Standards</th>
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</thead>
<tbody>
<tr>
<td><strong>B.E.S.T.</strong></td>
</tr>
<tr>
<td><strong>MA.912.NSO.1.4</strong> Apply previous understanding of operations with rational numbers to add, subtract, multiply and divide numerical radicals.</td>
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<td></td>
</tr>
</tbody>
</table>

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### Instructional Learning Objectives

- Simplify radical expressions by using the Product Property of Square Roots
- Simplify radical expression by using the Quotient Property of Square Roots
- Add and subtract radical expressions
- Multiply radical expressions
- Divide radical expressions

---

### Instructional Resources

- **Mc-Graw-Hill Algebra 1:**
  - Chapter 10: Radical Function and Geometry
  - Lesson 2: Simplifying Radical Expressions
  - Lesson 3: Operations with Radical Expressions

- **Algebra Nation:**
  - Section 1: Expressions
  - Topic 2: Properties of Exponents
  - Topic 4: Radical Expressions and Expressions with Rational Exponents
  - Topic 5: Adding Expressions with Radicals and Rational Exponents
  - Topic 6: More Operations with Radicals and Rational Exponents

- **IXL Math Algebra 1:**
  - You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.
  - 1. Simplify radical expressions (ZFF)
  - 2. Add and subtract radical expressions (DLV)
  - 3. Divide radical expressions (TYC)
  - 4. Simplify radicals with fractions (9ND)
  - 5. Multiply radicals (BKA)
Virtual Nerd Videos:
- What is the Product Property of Square Roots?
- How Do You Multiply Two Radicals?
- What is the Quotient Property of Square Roots?
- How Do You Simplify a Radical Using the Product Property?
- How Do You Rationalize a Denominator?
- How Do You Subtract Radicals with Unlike Radicands?
- How Do You Subtract Radicals with Like Radicands?
- How Do You Add Radicals with Like Radicands?

Khan Academy:
Courses → Algebra 1 → Exponents & radicals → Simplifying square roots
- Simplify square roots
- Simplify square roots (variables)
- Simplify square root expressions

Illustrative Mathematics:
Click here to get to Algebra 2
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
- Unit 3 Lesson 10, 11, 12, 13, 14, & 15

Sample Problems:
1. Simplify $\sqrt[4]{120a^2b^5c^4}$.

$$\sqrt[4]{120a^2b^5c^4} = \sqrt[4]{120} \cdot a^2 \cdot b^5 \cdot c^4$$
$$= \sqrt[4]{2^3 \cdot 3 \cdot 5} \cdot a^2 \cdot b^5 \cdot c^4$$
$$= \sqrt[4]{2^2} \cdot \sqrt[4]{2} \cdot \sqrt[4]{3} \cdot \sqrt[4]{5} \cdot \sqrt[4]{a^2} \cdot \sqrt[4]{b^4} \cdot \sqrt[4]{b} \cdot \sqrt[4]{c^4}$$
$$= 2 \cdot \sqrt[4]{2} \cdot \sqrt[4]{3} \cdot \sqrt[4]{5} \cdot \sqrt[4]{|a|} \cdot b \cdot \sqrt[4]{b} \cdot c$$
$$= 2|a|b^2c^2\sqrt[4]{30b}$$

2. Which expression is equivalent to $(\sqrt[4]{27})^4$?

A. 12  B. $9^2$  C. $8^4$  D. $27^\frac{4}{3}$

Remember the index of a radical can be rewritten as the denominator of a rational exponent.

$$(\sqrt[4]{27})^4 = (27^{\frac{1}{3}})^4 = 27^{\frac{4}{3}}$$

3. The expression $\frac{\sqrt{136}}{\sqrt{2}}$ is equivalent to $\sqrt{\frac{136}{2}}$ which is equivalent to $\sqrt{68}$ which is equivalent to $2\sqrt{17}$. 
### A1H Unit 5: Exponential Functions

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.AR.5.3</strong> Given a mathematical or real-world context, classify an exponential function as representing growth or decay.</td>
<td>Clarification 1: Within the Algebra 1 course, exponential functions are limited to the forms ( f(x) = ab^x ), where ( b ) is a whole number greater than 1 or a unit fraction, or ( f(x) = a(1 \pm r)^x ), where ( 0 &lt; r &lt; 1 ).</td>
</tr>
</tbody>
</table>
| **MA.912.AR.5.4** Write an exponential function to represent a relationship between two quantities from a graph, a written description or a table of values within a mathematical or real-world context. | Clarification 1: Within the Algebra 1 course, exponential functions are limited to the forms \( f(x) = ab^x \), where \( b \) is a whole number greater than 1 or a unit fraction, or \( f(x) = a(1 \pm r)^x \), where \( 0 < r < 1 \).  
Clarification 2: Within the Algebra 1 course, tables are limited to having successive nonnegative integer inputs so that the function may be determined by finding ratios between successive outputs. |
| **MA.912.AR.5.6** Given a table, equation or written description of an exponential function, graph that function and determine its key features. | Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; constant percent rate of change; end behavior and asymptotes.  
Clarification 2: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.  
Clarification 3: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.  
Clarification 4: Within the Algebra 1 course, exponential functions are limited to the forms \( f(x) = ab^x \), where \( b \) is a whole number greater than 1 or a unit fraction, or \( f(x) = a(1 \pm r)^x \), where \( 0 < r < 1 \). |

### Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponential Function</td>
<td>A function that can be described by an equation of the form ( y = ab^x ), where ( a ) is the initial amount and ( b ) is the constant ratio ((a \neq 0, b &gt; 0, \text{ and } b \neq 1))</td>
</tr>
<tr>
<td>Exponential Growth Function</td>
<td>Functions of the form ( y = ab^x ), where ( a &gt; 0 ) and ( b &gt; 1 )</td>
</tr>
<tr>
<td>Exponential Decay Function</td>
<td>Functions of the form ( y = ab^x ), where ( a &gt; 0 ) and ( 0 &lt; b &lt; 1 )</td>
</tr>
<tr>
<td>Common Ratio</td>
<td>The number by which an exponential function repeatedly multiplies the initial amount.</td>
</tr>
</tbody>
</table>
Growth/Decay rate | The percent (written as a decimal) by which a given function is increasing (growth) or decreasing (decay)
---|---
Growth Factor | Common ratio when \( b > 1 \). Growth factor of an exponential function is equal to 1 plus growth rate \( b = 1 + r \)
Decay Factor | Common ratio when \( 0 < b < 1 \). Decay factor of an exponential function is equal to 1 minus decay rate \( b = 1 - r \)
Asymptote | A line that the graph of a function gets closer to as \( x \) gets larger in absolute value
Geometric Sequence | A number sequence in which each term after the first term is found by multiplying the previous term by a common ratio

### MA.912.AR.5.3
**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
</table>
| **MA.912.AR.5.3** Given a mathematical or real-world context, classify an **exponential function** as representing **growth** or **decay**. | **MAFS.912.F-LE.1.1** Distinguish between situations that can be modeled with linear functions and with **exponential functions**.  
a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.  
c. Recognize situations on which a quantity **grows** or **decays** by a constant percent rate per unit interval relative to another.  
**MAFS.912.F-IF.3.8b** Use the properties of exponents to interpret expressions for **exponential functions**.  
**MAFS.912.F-LE.2.5** Interpret the parameters in a linear or **exponential function** in terms on a context. |

### Instructional Learning Objectives

**Students will be able to:**
- Use contextual situations to determine if a situation is exponential and then recognize whether a given situation represents growth or decay
- Identify the growth or decay factor
- Identify the growth or decay rate

### Instructional Resources

**McGraw-Hill Algebra 1**
- 7-5 Exponential Functions
- 7-6 Growth and Decay

**IXL Math**
- Exponential Growth and Decay: word problems [UKG](#)
- Identify Linear and Exponential Functions [CWH](#)
- Describe Linear and Exponential Growth and Decay [KLF](#)
- Exponential Growth and Decay word problems [TYQ](#)

**Algebra Nation**
**Section 7: Exponential Functions**
- Topic 5 – Growth and Decay Rates of Exponential Functions
**Sample Problem:**
Determine whether each of the following represents growth or decay (circle the appropriate term). Then identify the value of the growth/decay factor.

1. The population of Pinellas county has been increasing by 0.89% per year
   Growth/Decay Factor ____________

2. The value of a car depreciates at an estimated rate of 10% per year
   Growth/Decay Factor ____________

3. The number of bacteria doubles every hour
   Growth/Decay Factor ____________

---

**MA.912.AR.5.4**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.5.4 Write an exponential function to represent a relationship between two quantities from a graph, a written description or a table of values within a mathematical or real-world context.</td>
<td>MAFS.912.F-LE.1.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph and a description of a relationship or two input-output pairs (including reading these from a table). MAFS.912.F-LE.2.5 Interpret the parameters in a linear or exponential function in terms of a context.</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

- Write an exponential function from a graph
- Write an exponential function given a table
- Write an exponential function given a written description of a real-world situation

**McGraw-Hill Instructional Resource**

- 7-7 Geometric Sequences as Exponential Functions

**IXL Math**

- Evaluate an Exponential Function D6H
- Find the growth/decay factor from a table, graph and verbal description
- Interpret the initial value and the common ratio in an exponential function
- Write a recursive and explicit formula for a geometric sequence

<table>
<thead>
<tr>
<th>Double Block P-A and A1H</th>
<th>2020-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Write a formula for a geometric sequence QSV</td>
<td></td>
</tr>
<tr>
<td>• Evaluate Exponential Functions LWE</td>
<td></td>
</tr>
</tbody>
</table>

**Algebra Nation**
Section 7 – Exponential Functions
- Topic 1 – Geometric Sequences
- Topic 2 – Exponential Functions

**Khan Academy**
- Introduction to Geometric Sequences
- Constructing Geometric Sequences
- Modeling with Sequences
- General Sequences

**MFAS Formative Assessments**
- What is the Function Rule?
- Writing an Exponential Function from a Description
- Writing an Exponential Function from a Table
- Writing an Exponential Function from Its Graph

**Illustrative Mathematics**
Click [here](#) to get to Algebra 2
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 4 Lesson 6 & 7
Lessons 6, Lesson 7 Scroll to the bottom of the page to access the student task pdf file.

**Sample Problem:**
Chantel drew a picture of her dog on a piece of paper that is 12 centimeters long. She used a copy machine to enlarge her drawing. She used the 115% setting to make each new copy. She then used each new copy to generate the next copy, using the same copier setting.

Enter a recursive formula that will give the length of each new copy.

\[
a_1 = \ldots
\]

\[
a_n = \ldots
\]
### Instructional Learning Objectives

**Students will be able to:**

- Graph an Exponential Function given its equation or a table of values
- Graph an exponential function given a written description or key features
- Determine and interpret the domain and range of an exponential function

### Instructional Resources

**McGraw-Hill Algebra 1**

- 7-5 Exponential Functions

**IXL Math**

- Match Exponential Functions and Graphs [72J](#)
- Domain and Range of Exponential Functions: Graphs [ANC](#)
- Domain and Range of Exponential Functions: Equations [DZE](#)
- Match Exponential Functions and Graphs [PCX](#)

**Algebra Nation**

Section 7 – Exponential Functions

- Topic 3 – Graphs of Exponential Functions-Part 1
- Topic 4 – Graphs of Exponential Functions-Part 2

**Khan Academy**

- Exponential functions from tables and graphs

**MFAS Formative Assessments**

- Graphing an Exponential Function

---

<table>
<thead>
<tr>
<th>MA.912.AR.5.6</th>
<th>Connections between B.E.S.T. and Florida Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.E.S.T.</strong></td>
<td><strong>Florida Standard</strong></td>
</tr>
<tr>
<td>MA.912.AR.5.6</td>
<td>MAFS.912.F-IF.2.4</td>
</tr>
</tbody>
</table>

*Given a table, equation or written description of an exponential function, graph that function and determine its key features.*

**MAFS.912.F-IF.2.4**

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts, intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

**MAFS.912.F-IF.2.5**

Relate the domain of a function to its graph and where applicable, to the quantitative relationship it describes.

**MAFS.912.F-IF.3.7**

Graph functions symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases.
Sample Problem
A small ball is dropped from a height of 12 ft and it begins to bounce. The height of each bounce is three-fourths of the height of the previous bounce. Graph the function that represents the height of ball, $h$, versus the number of bounces, $b$. Then identify each of the following:

y-intercept _______________
Common ratio _______________
Domain _____________
Range _________________
### A1H Unit 6: Financial Literacy

#### Benchmarks

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Clarification</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.FL.3.2</strong> – Solve problems involving simple, compound and continuously compounded interest in a real-world context.</td>
<td></td>
<td>Clarification 1: Interest is limited to simple and compound.</td>
</tr>
<tr>
<td><em>Example: Find the amount of money on deposit at the end of 5 years if you started with $500 and it was compounded quarterly at 6% interest per year.</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Example: Joe won $25,000 on a lottery scratch-off ticket. How many years will it take at 6% interest compounded yearly for his money to double?</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.FL.3.4</strong> – Explain the relationship between simple interest and linear growth. Explain the relationship between compound interest and exponential growth and the relationship between continuously compounded interest and exponential growth.</td>
<td></td>
<td>Clarification 1: Exponential growth is limited to compound interest.</td>
</tr>
</tbody>
</table>

### Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound Interest</td>
<td>Interest paid on both the principal and on accrued interest. A special application of exponential growth.</td>
</tr>
<tr>
<td>Continuously Compound Interest</td>
<td>A principal amount is constantly earning interest because the interest keeps earning on the interest already earned.</td>
</tr>
<tr>
<td>Formula for continuously compounded interest: ( A = P \times e^{r \times t} )</td>
<td></td>
</tr>
<tr>
<td>Where A is the total amount, P is the principal amount (the starting amount), e is the mathematical constant, r is the rate of interest and t is the time in years.</td>
<td></td>
</tr>
<tr>
<td>Exponential Growth</td>
<td>A growth whose rate becomes ever more rapid in proportion to the growing total number or size.</td>
</tr>
<tr>
<td>An exponential function will take the form ( y = abx ), where a&gt;0 and b&gt;1.</td>
<td></td>
</tr>
<tr>
<td>Linear Growth</td>
<td>A growth that has a constant rate of change.</td>
</tr>
<tr>
<td>Simple Interest</td>
<td>Interest payable only on the principal. An application of linear growth.</td>
</tr>
</tbody>
</table>
The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

### MA.912.FL.3.2

#### Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.FL.3.2 Solve problems involving simple, compound and continuously compounded interest in a real-world context.</td>
<td>There are no direct correlations to the past standards, however, this new standard is an application from the previous exponential unit and linear unit (Units 2 and 5).</td>
</tr>
</tbody>
</table>

Example: Find the amount of money on deposit at the end of 5 years if you started with $500 and it was compounded quarterly at 6% interest per year.

Example: Joe won $25,000 on a lottery scratch-off ticket. How many years will it take at 6% interest compounded yearly for his money to double?

#### Instructional Learning Objectives

- Identify simple, compound and continuously compound interest.
- Evaluate simple interest problems
- Evaluate compound interest problems
- Evaluate continuously compounded interest problems

#### Instructional Resources

- **McGraw-Hill Algebra 1:**
  - Chapter 7, lesson 6 - Growth and Decay
  - This lesson was also suggested for Unit 5
  - Chapter 7, lesson 6 – Algebra Lab: Transforming Exponential Expressions

- **Illustrative Mathematics:**
  - Click [here](#) to get Algebra 1
  - Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
  - Unit 5, lesson 16 (all): [Student Task Card](#) Scroll to the bottom of the page to access the student task pdf file.
  - This lesson (unit 5, lesson 7 [all]) focuses on compound interest: [Student Task Card](#)

- **IXL:**
  - You can access problems for these new standards as long as you ensure you choose the B.E.S.T. standards to push out to your students. There are only three practice sections for this standard: Simple interest, Compounded interest, and Continuously compounded interest. To access click [here](#).
**IXL Codes:**
- Simple interest: Q8G
- Compound interest: LVY
- Continuously Compounded: OZG

**Khan Academy:**
Courses → Economics and Finance --> Finance and capital markets → Microeconomics
– use the first section titled “Interest and Debt” to learn about $e$, compound interest, and continuously compounded interest basics.

**Sample problems:**

1. Determine the amount of money on deposit at the end of 5 years if you started with $500 and it was compounded quarterly at 6% interest per year.

2. Joe won $25,000 on a lottery scratch-off ticket. How many years will it take at 6% interest compounded yearly for his money to double?

---

### MA.912.FL.3.4

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.FL.3.4</strong> Explain the relationship between simple interest and linear growth. Explain the relationship between compound interest and exponential growth and the relationship between continuously compounded interest and exponential growth.</td>
<td>There are no direct correlations to the past standards, however, this new standard is an application from the previous linear function unit (Unit 2) and the exponential unit (Unit 5).</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

- Identify simple interest
- Identify linear growth
- Determine and explain the relationship between simple interest and linear growth.
- Identify and understand compound interest.
- Identify and understand exponential growth.
- Identify and understand continuously compounded interest.
- Explain the relationship between compound interest and exponential growth.

**Instructional Resources**

**McGraw-Hill Algebra 1:**
Double click the icon below to open a useful pdf document on simple interest.

[Adobe Acrobat Document]

**Illustrative Mathematics:**
Click [here](#) to get to Algebra 1
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
### Explain the relationship between continuously compounded interest and exponential growth.

### For simple interest: Unit 5, Section 19 (all)
- Student Task Card. Scroll to the bottom of the page to access the student task pdf file.

### For compound interest: Unit 5, Section 20 (all)
- Student Task Card. Scroll to the bottom of the page to access the student task pdf file.

### IXL:
You can access problems for these new standards as long as you ensure you choose the B.E.S.T. standards to push out to your students. There are only three practice sections for this standard: Simple interest, Compounded interest, and Continuously compounded interest. To access click here.

### IXL Codes:
- Simple interest: Q8G
- Compound interest: LVY
- Continuously Compounded: QZG

### Khan Academy:
Courses → Finance and capital markets → Microeconomics
– use the first section titled “Interest and Debt” to learn about $e$, compound interest, and continuously compounded interest basics.

### Sample Problems:
Savanna and Rachelle are analyzing the chart below. Savanna says the graph below is showing compound interest, however, Rachelle disagrees, she says it’s showing simple interest. Which girl is correct? Justify your answer.
Pinellas County Schools  
Double Block P-A and A1H  
2020-2021

| Semester 2 | A1H Unit 7: Polynomials | 5 days  
Feb. 17 – Feb. 23 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmarks</strong></td>
<td><strong>Benchmark Clarifications</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **MA.912.AR.1.3** – Add, subtract and multiply polynomial expressions with rational number coefficients. | Clarification 1: Instruction includes an understanding that when any of these operations are performed with polynomials the result is also a polynomial.  
Clarification 2: Polynomial expressions are limited to 3 or fewer terms. |
| **MA.912.AR.1.4** – Divide a polynomial expression by a monomial expression with rational number coefficients. | Clarification 1: Polynomial expressions are limited to 3 or fewer terms. |
| **MA.912.AR.1.7** - Rewrite a polynomial expression as a product of polynomials over the real number system. | Clarification 1: Within the Algebra 1 course, polynomial expressions are limited to 4 or fewer terms with integer coefficients. |

<table>
<thead>
<tr>
<th>Essential Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vocabulary</strong></td>
</tr>
<tr>
<td>Area Model</td>
</tr>
<tr>
<td>Binomial</td>
</tr>
<tr>
<td>Coefficient</td>
</tr>
<tr>
<td>Monomial</td>
</tr>
<tr>
<td>Polynomial</td>
</tr>
</tbody>
</table>

The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA). In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

**MA.912.AR.1.3**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.AR.1.3 Add, subtract and multiply polynomial expressions with rational number coefficients.</strong></td>
<td><strong>MAFS.912.A-APR.1.1</strong> Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:
- Identify when a polynomial is closed (produces another polynomial).
- Add polynomial expressions.
- Subtract polynomial expressions.
- Multiply polynomial expressions using the area model method or the FOIL method.

**Instructional Resources**

- McGraw-Hill Algebra 1:  
  Chapter 8: Algebra lab (pg.463)  
  Lessons 1 – 4  
  **Illustrative Mathematics:**  
  Click here to get Algebra 1
  - Teachers will be able to access student resource but will need to set up a (free)
account to access lessons with prompts and guiding questions

- Use *Algebra 2* Unit 2, Lesson 4 (all parts). Click [here](#) and scroll down to the bottom to get the student task card. This is for combining polynomials.
- *For Multiplying polynomials*, use the following lesson ([Algebra 1, Unit 6, lesson 8](#))

**IXL:**
Access [Algebra 1](#) (from the MAFS standards) [here](#) and have students work on *Section Z, 2 – 10.*

**IXL Codes:**
2. Model polynomials with algebra tiles *TYV*
3. Add and subtract polynomials using algebra tiles *J7V*
4. Add and subtract polynomials *SEK*
5. Add polynomials to find perimeter *8AS*
6. Multiply a polynomial by a monomial *G2G*
7. Multiply two polynomials using algebra tiles *WR5*
8. Multiply two binomials *M7Q*
9. Multiply two binomials: special cases *9JN*
10. Multiply polynomials *S8A*

**Khan Academy:**
Have students work in the Algebra II course with the *Polynomial Arithmetic.* Students can complete all the sections of that unit with the exception of “Average rate of change of polynomials.”

**Algebra Nation:**
Section 3 – Topics 3, 4, and 5

**Sample problems:**

1) What is the sum of the following polynomials: $(-3x^2 + 12)$ and $[(x - 5)^2 + 7]$

See next page for sample #2...
2) Determine the area of the envelope *NOT* covered by the address label?

\[(7x + 3)\]

\[(6x + 4)\]

\[(2x + 3)\]

\[(x + 10)\]

Ms. Math
111 Pascal Way
Euclid, Greece
16180

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### MA.912.AR.1.4

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>MA.912.AR.1.4</em> Divide a polynomial expression by a monomial expression with rational number coefficients.</td>
<td><em>MAFS.912.A-APR.2.2</em> Know and apply the Remainder Theorem: For a polynomial (p(x)) and a number (a), the remainder on division by (x - a) is (p(a)), so (p(a) = 0) if and only if ((x - a)) is a factor of (p(x)).</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:

- Divide a polynomial expression by a monomial.
- Recognize when a monomial is a factor of an expression.
- Correctly write a remainder of a polynomial division problem when necessary.

**Instructional Resources**

**McGraw-Hill Algebra 1:**
- Chapter 11, Lesson 4 pg. 698
- Chapter 11, Lesson 5 pg. 706

**Illustrative Mathematics:**
- Click [here](#) to get to Algebra 1
  - Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
  - *For dividing polynomials*, use the following two lessons: [Algebra 2, Unit 2, Lesson 12](#) and [Algebra 2, Unit 2, Lesson 13](#).
  - *To work on the remainder theorem*, use the lesson Algebra 2, Unit 2, Lesson 15. Click [here](#) to get to the student task card (scroll to the bottom of the page to get the pdf access).
**IXL:**
Access Algebra 1 (from the MAFS standards) [here](#) and have students work on *Section GG, 5 – 6.*

**IXL Codes:**
5. Divide polynomials by monomials 72C
6. Divide polynomials using long division LY7

**Khan Academy:**
Have students work in the Algebra II course with the *Polynomial Division* unit. Students should complete all parts of this unit.

**Sample Problems:**

1) Determine the quotient of the following problem: \( \frac{-12a^5+30a^4+21a^3}{3a^2} \)

2) Let \( f(x) = 2x^3 - 3x^2 - 5x + 6 \). Is \((x - 1)\) a factor?

<table>
<thead>
<tr>
<th><strong>MA.912.AR.1.7</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connections between B.E.S.T. and Florida Standards</strong></td>
</tr>
<tr>
<td>B.E.S.T.</td>
</tr>
</tbody>
</table>
| MA.912.AR.1.7 *Rewrite a polynomial expression as a product of polynomials.* | **MAFS.912.A-APR.4.6** *Rewrite simple rational expressions in different forms;* write \( a(x)/b(x) \) in the form \( q(x) + r(x)/b(x) \), where \( a(x) \), \( b(x) \), \( q(x) \), and \( r(x) \) are polynomials with the degree of \( r(x) \) less than the degree of \( b(x) \), using inspection, long division, or, for the more complicated examples, a computer algebra system. **MAFS.912.A-SSE.1.2** Use the structure of an expression to *identify ways to rewrite it.* For example, see \( x^4 - y^4 \) as \( (x^2)^2 - (y^2)^2 \), thus recognizing it as a *difference of squares* that can be factored as \( (x^2 - y^2)(x^2 + y^2) \).

<table>
<thead>
<tr>
<th><strong>Instructional Learning Objectives</strong></th>
<th><strong>Instructional Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td><strong>McGraw-Hill Algebra 1:</strong></td>
</tr>
<tr>
<td>• Identify perfect squares</td>
<td>Chapter 8, Lesson 8 pg. 516</td>
</tr>
<tr>
<td>• Recognize a pattern with the difference, or sum, of squares</td>
<td><strong>Illustrative Mathematics:</strong></td>
</tr>
<tr>
<td>• Rewrite polynomial expressions as a difference of squares or as the product that leads to the simplified expression.</td>
<td>Click <a href="#">here</a> to get to Algebra 1</td>
</tr>
<tr>
<td></td>
<td>• Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions</td>
</tr>
<tr>
<td>IXL:</td>
<td>Access Algebra 1 (from the MAFS standards) <a href="#">here</a> and have students work on Section Z.9, Section AA.6</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>In Algebra II, students can work on “Factor using a quadratic pattern,” in Section I.4.</td>
</tr>
</tbody>
</table>
| IXL Codes: | A1- Z.9: Multiply two binomials: special cases [9JN](#)  
A1 – AA.6: Factor quadratics: special cases [56E](#) |
|      | A2-I.4: Factor using quadratic pattern [QKF](#)                                                |
| Khan Academy: | Have students work in the Algebra II course with the Special Products of Polynomials unit Students can complete all parts of this unit. |
| Algebra Nation: | Section 1 - Topics 3, 4, and 5  
Section 2 - Topic 2  
Section 3 - Topics 3 and 4  
Section 5 - Topics 2, 5, and 6 |

**Sample Problems:**
Tyreek says that you can re-write the expression \([(x - 4)(x + 4)] as \(x^2 - 16\). Jenn thinks this is incorrect and that it should be written as \((x^2 + 8x - 16)\). Who is correct and explain why.
A1H Unit 8: Quadratic Equations

5 days
Feb. 24 – Mar. 2

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.3.1 - Given a mathematical or real-world context, write and solve one-variable quadratic equations over the real number system.</td>
<td>Clarification 1: Within the Algebra 1 course, instruction includes the concept of non-real answers, without determining non-real solutions. Clarification 2: Within this benchmark, the expectation is to solve by factoring techniques, taking square roots, the quadratic formula and completing the square.</td>
</tr>
</tbody>
</table>

### Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completing the Square</td>
<td>To add a constant term to a binomial of form (x^2 + bx) so that the resulting trinomial is a perfect square.</td>
</tr>
<tr>
<td>Difference of Two Squares</td>
<td>Two perfect squares separated by a subtraction sign.</td>
</tr>
<tr>
<td>Discriminant</td>
<td>In the Quadratic Formula, the expression under the radical sign, (b^2 - 4ac).</td>
</tr>
<tr>
<td>Factoring</td>
<td>To express a polynomial as the product of monomials and polynomials. Finding the completely factored form.</td>
</tr>
<tr>
<td>Factoring by Grouping</td>
<td>To use the Distributive Property to factor some polynomials having four or more terms. Terms are put into groups and then factored.</td>
</tr>
<tr>
<td>Perfect Square Trinomial</td>
<td>A trinomial that is the square of a binomial.</td>
</tr>
<tr>
<td>Prime Polynomial</td>
<td>A polynomial that cannot be written as a product of two polynomials with integral coefficients.</td>
</tr>
<tr>
<td>Quadratic Equation</td>
<td>An equation of the form (ax^2 + bx + c = 0) where (a \neq 0).</td>
</tr>
<tr>
<td>Quadratic Formula</td>
<td>The solutions of a quadratic equation are given by the formula (x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}).</td>
</tr>
<tr>
<td>Zero Product Property</td>
<td>If the product of two factors is 0, then at least one of the factors must be 0.</td>
</tr>
</tbody>
</table>

The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

### MA.912.AR.3.1

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.3.1 Given a mathematical or real-world context, write and <strong>solve one-variable quadratic equations</strong> over the real number system.</td>
<td>MAFS.912.A-REI.2.4 <strong>Solve quadratic equations</strong> in one variable.</td>
</tr>
<tr>
<td>a. Use the method of completing the square to transform any quadratic equation in (x) into an equation of the form ((x - p)^2 = q) that has the same solutions. Derive the quadratic formula from this form.</td>
<td></td>
</tr>
</tbody>
</table>
### Instructional Learning Objectives

<table>
<thead>
<tr>
<th>Students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Solve equations of the form of $ax^2 + bx = 0$</td>
</tr>
<tr>
<td>• Solve equations of the form $x^2 + bx + c = 0$</td>
</tr>
<tr>
<td>• Use the difference of squares to solve equations</td>
</tr>
<tr>
<td>• Solve equations involving perfect squares</td>
</tr>
<tr>
<td>• Complete the square to write perfect square trinomials</td>
</tr>
<tr>
<td>• Solve quadratic equations by taking the square root of each side (square root property)</td>
</tr>
<tr>
<td>• Solve quadratic equations by completing the square</td>
</tr>
<tr>
<td>• Solve quadratic equations by using the Quadratic Formula</td>
</tr>
<tr>
<td>• Use the discriminant to determine the number of solutions to a quadratic equation</td>
</tr>
</tbody>
</table>

### Instructional Resources

<table>
<thead>
<tr>
<th>Mc-Graw-Hill Algebra 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 8: Quadratic Expressions and Equations</td>
</tr>
<tr>
<td>* Only part 2, Solve Equations by Factoring in these lessons</td>
</tr>
<tr>
<td>• Lesson 5: Using the Distributive Property *</td>
</tr>
<tr>
<td>• Lesson 6: Solving $x^2 + bx + c = 0$ *</td>
</tr>
<tr>
<td>• Lesson 7: Solving $ax^2 + bx + c = 0$ *</td>
</tr>
<tr>
<td>• Lesson 8: Difference of Two Squares *</td>
</tr>
<tr>
<td>• Lesson 9: Perfect Squares *</td>
</tr>
<tr>
<td>Chapter 9: Quadratic Functions and Equations</td>
</tr>
<tr>
<td>• Lesson 4: Solving Quadratic Equations by Completing the Square</td>
</tr>
<tr>
<td>• Lesson 5: Solving Quadratic Equations by Using the Quadratic Formula</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Algebra Nation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 2: Equations and Inequalities</td>
</tr>
<tr>
<td>• Topic 4: Solving Equations using the Zero Product Property</td>
</tr>
<tr>
<td>Section 5: Quadratic Functions – Part 1</td>
</tr>
<tr>
<td>• Topic 2: Factoring Quadratic Expressions</td>
</tr>
<tr>
<td>• Topic 3: Solving Quadratic Equations by Factoring</td>
</tr>
<tr>
<td>• Topic 4: Solving Other Quadratic Equations by Factoring</td>
</tr>
<tr>
<td>• Topic 5: Solving Quadratic Equations by Factoring - Special Cases</td>
</tr>
<tr>
<td>• Topic 6: Solving Quadratic Equations by Taking Square Roots</td>
</tr>
<tr>
<td>• Topic 7: Solving Quadratic Equations by Completing the Square</td>
</tr>
<tr>
<td>• Topic 8: Deriving the Quadratic Formula</td>
</tr>
</tbody>
</table>
• Topic 9: Solving Quadratic Equations Using the Quadratic Formula
• Topic 10: Quadratic Functions in Action
• Section 6: Quadratic Functions – Part 2
• Topic 2: Nature of the Solutions of Quadratic Equations and Functions
• Section 8: Summary of Functions
• Topic 5: Modeling with Functions

IXL Math Algebra 1:
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.

Square roots
1. Solve a quadratic equation using square roots (ERF)

Factoring
2. Solve a quadratic equation using the zero product property (TNM)
3. Solve a quadratic equation by factoring (CSS)

Completing the square
4. Complete the square (RD2)
5. Solve a quadratic equation by completing the square (XCL)

Quadratic formula
6. Solve a quadratic equation using the quadratic formula (XCF)
7. Using the discriminant (SMF)

Virtual Nerd Videos:
• How Do You Solve a Quadratic Equation by Factoring?
• How Do You Solve a Word Problem by Factoring a Quadratic Equation?
• How Do You Use the Square Root Method to Solve a Quadratic Equation with Two Variables?
• How Do You Solve a Quadratic Equation by Completing the Square?
• How Do You Solve a Quadratic Equation by Using the Quadratic Formula?
• How Can You Tell When a Quadratic Equation Has No Real Solutions by Using the Quadratic Formula?
• What is the Discriminant?
• How Do You Use the Discriminant to Determine the Number of Solutions of a Quadratic Equation?
Khan Academy:
Courses → Algebra 1 → Quadratic functions & equations
- Solving and graphing in factored form
- Solving by taking the square root
- Solving quadratics by factoring
- The quadratic formula
- Completing the square

Illustrative Mathematics:
Click here to get to Algebra 1
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
- Unit 7 Lessons 3 – 21

Sample Problems:
1. Which of the quadratic equations below have the solutions of -2 and 5? Select all that apply.
   A. $x^2 - 3x - 10 = 0$
   B. $x^2 + 3x = 10$
   C. $2x^2 - 6x = 20$
   D. $-x^2 + 10 = 3x$
   E. $-x^2 + 3x + 10 = 0$

2. Find the value of $x$ for the figure below by completing the square. Round to the nearest tenth if necessary.

3. A flying squirrel drops 60 feet from a tree before leveling off. A function that approximates this drop is $h = -16t^2 + 60$, where $h$ is the distance it drops in feet and $t$ is the time in seconds. About how many seconds does it take for the squirrel to drop 60 feet?
<table>
<thead>
<tr>
<th>Semester 2</th>
<th>A1H Unit 9: Quadratic Functions</th>
<th>6 days Mar. 3 – Mar. 10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmarks</strong></td>
<td><strong>Benchmark Clarifications</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **MA.912.AR.3.4** - Write a quadratic function to represent the relationship between two quantities from a graph, a written description or a table of values within a mathematical or real-world context. | Clarification 1: Within the Algebra 1 course, a graph, written description or table or values must include the vertex and two points that are equidistant from the vertex.  
Clarification 2: Instruction includes the use of standard form, vertex form, and factored form. |  |
| **MA.912.AR.3.5** - Given the x-intercepts and another point on the graph of a quadratic function, write the equation for the function. |  |  |
| **MA.912.AR.3.6** - Given an expression or equation representing a quadratic function, determine the vertex and zeros and interpret them in terms of a real-world context. |  |  |
| **MA.912.AR.3.7** - Given a table, equation or written description of a quadratic function, graph that function, and determine and interpret its key features. | Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior; vertex; and symmetry.  
Clarification 2: Instruction includes the use of standard form, vertex form, and factored form, and sketching a graph using the zeros and vertex.  
Clarification 3: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.  
Clarification 4: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder. |  |
| **MA.912.AR.3.8** - Solve and graph mathematical and real-world problems that are modeled with quadratic functions. Interpret key features and determine domain constraints in terms of the context. | Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior; vertex; and symmetry.  
Clarification 2: Instruction includes the use of standard form, vertex form, and factored form.  
Clarification 3: Instruction includes representing the domain, range, and constraints with inequality notation, interval notation, or set-builder notation.  
Clarification 4: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder. |  |
## Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratic Function</td>
<td>A function of the form ( y = ax^2 + bx + c ), where ( a \neq 0 )</td>
</tr>
<tr>
<td>Parabola</td>
<td>A U-shape curve that opens up or down (the shape of a quadratic function)</td>
</tr>
<tr>
<td>Axis of Symmetry</td>
<td>The vertical line containing the vertex of a parabola</td>
</tr>
<tr>
<td>Vertex</td>
<td>The maximum or minimum point of a parabola</td>
</tr>
<tr>
<td>Minimum</td>
<td>The lowest point on the graph of a parabola</td>
</tr>
<tr>
<td>Maximum</td>
<td>The highest point on the graph of a parabola</td>
</tr>
<tr>
<td>Zeros</td>
<td>The x-intercepts of the graph of a function; the values of x for which ( f(x) = 0 )</td>
</tr>
<tr>
<td>Discriminant</td>
<td>In the Quadratic Formula, the expression under the radical sign, ( b^2 - 4ac )</td>
</tr>
<tr>
<td>Quadratic Formula</td>
<td>[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} ]</td>
</tr>
<tr>
<td>Standard Form of a Quadratic Function</td>
<td>A quadratic function in the form ( y = ax^2 + bx + c ), where ( a \neq 0 )</td>
</tr>
<tr>
<td>Vertex Form of a Quadratic Function</td>
<td>A quadratic function in the form ( f(x) = a(x - h)^2 + k ) where ((h, k)) represents the vertex</td>
</tr>
<tr>
<td>Factored Form of a Quadratic Function</td>
<td>A quadratic function in the form ( f(x) = a(x - r_1)(x - r_2) ) where ( r_1 ) and ( r_2 ) represent the roots of the function</td>
</tr>
<tr>
<td>Vertical Motion Model</td>
<td>The equation ( h(t) = -16t^2 + v_0x + h_0 ) use to represent the height of an object ( t ) seconds after it was thrown straight up or dropped.</td>
</tr>
</tbody>
</table>

### MA.912.AR.3.4

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.3.4 <em>Write a quadratic function to represent the relationship between two quantities</em> from a graph, a written description or a table of values within a mathematical or real-world context.</td>
<td><strong>MAFS.912.A-CED.1.1</strong> <em>Create equations</em> and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational, absolute, and exponential functions. <strong>MAFS.912.A-CED.1.2</strong> Create equations in two or more variables <em>to represent relationships between quantities</em>; graph equations on coordinate axes with labels and scales.</td>
</tr>
</tbody>
</table>

### Instructional Learning Objectives

**Students will be able to:**
- Write a quadratic function from a graph
- Write a quadratic function from a written description
- Write a quadratic function from a table

### Instructional Resources

**McGraw-Hill Algebra 1**
- 9-6 Analyzing Functions with Successive Differences

**IXL Math**
- Write a quadratic function from its vertex and another point [YGV](#)

**MFAS Formative Assessments**
- Quilts
- Hotel Swimming Pool
**Sample Problem:**
Given the table of values below from a quadratic function, write an equation of that function.

<table>
<thead>
<tr>
<th>x</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>2</td>
<td>-1</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
</tr>
</tbody>
</table>

---

**MA.912.AR.3.5**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.3.5 Given the x-intercepts and another point on the graph of a quadratic function, write the equation for the function.</td>
<td></td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

**Students will be able to:**
- Write the equation of a quadratic function given x-intercepts and another point

**Instructional Resources**

<table>
<thead>
<tr>
<th>IXL Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Write a quadratic function from its zeros G2Q</td>
</tr>
</tbody>
</table>

**Algebra Nation**

<table>
<thead>
<tr>
<th>Section 6 - Quadratic Functions Part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Topic 2 – Nature of the Zeros of Quadratic Equations and Functions</td>
</tr>
</tbody>
</table>

**Sample Problem:**
An arched bridge is 60ft wide at the base and 40 ft wide 5 ft above the base. Write the equation of a quadratic function that can be used to model the shape of this bridge.
### MA.912.AR.3.6

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
</table>
| **MA.912.AR.3.6** Given an expression or equation representing a quadratic function, **determine the vertex and zeros** and interpret them in terms of a real-world context. | **MAFS.912.A-SSE.2.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.  
  a. Factor a quadratic expression to **reveal the zeros** of the function it defines.  
  b. Complete the square in a quadratic expression to **reveal the maximum or minimum value** of the function it defines. |
| **MAFS.912.F-IF.3.8a** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  
  a. Use the process of factoring and completing the square in a quadratic function to **show zeros**, **extreme values**, and symmetry of the graph, and interpret these in terms of a context. | |

### Instructional Learning Objectives

**Students will be able to:**
- Use vertex form to find the vertex
- Use factored form to find the zeros
- Convert the standard form to vertex form or to factored form (if possible)
- Interpret the vertex and zeros of quadratic function in terms of real-world context

**Instructional Resources**

- **McGraw-Hill Algebra 1**
  - Solving Quadratic Equations by Completing the Square
  - Extend Lesson 9-4 Finding the Maximum or Minimum Value

- **IXL Math Algebra 1 and 2**
  - Characteristics of quadratic functions: equations
  - Convert equations of parabolas from general to vertex form

- **Algebra Nation**
  - Section 6 Quadratic Functions – Part 2
    - Topic 1 – Observations from a Graph of a Quadratic Function
    - Topic 4 – Graphing Quadratic Functions Using the Vertex and Intercepts
    - Topic 5 – Graphing Quadratic Functions using Vertex Form – Part 1
    - Topic 6 – Graphing Quadratic Functions Using Vertex Form – Part 2

- **Khan Academy**
  - Quadratic standard form
  - Features & forms of quadratic functions

- **MFAS Formative Assessments**
  - Jumping Dolphin
Sample Problem
During a track practice, Jaylen throws the shot put with initial velocity of 48ft/s. The height above the ground, \( h \), after \( t \) seconds, can be modeled by \( h(t) = -16t^2 + 32t + 5 \).

(a) From what height above the ground was the shot put released?
(b) What was the maximum height of the shot put?
(c) How long did it take for the shot put to fall to the ground?

MA.912.AR.3.7
Connections between B.E.S.T. and Florida Standards

B.E.S.T. | Florida Standard
--- | ---
MA.912.AR.3.7 Given a table, equation or written description of a quadratic function, graph that function, and determine and interpret its key features. | MAFS.912.F-IF.2.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include intercepts, intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity

MAFS.912.F-IF.3.7a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

(a) Graph linear and quadratic functions and show intercepts, maxima, and minima.

Instructional Learning Objectives
Students will be able to:
- Graph quadratic function given a table
- Graph quadratic function given an equation
- Graph quadratic function given a written description
- Identify key features of the graph: domain, range, vertex, axis of symmetry, intercepts, intervals where the function is decreasing or increasing, end behavior
- Interpret key features of the graph in real-world context

Instructional Resources
McGraw-Hill Algebra 1
- 9-1 Graphing Quadratic Functions

IXL Math Algebra 1 and 2
- Characteristics of quadratic functions: graphs HW8
- Complete a functions table: quadratic functions LFV
- Graph quadratic functions in vertex form C7T
- Graph quadratic functions in standard form HMW
- Match quadratic functions and graphs AU8

Algebra Nation
Section 6 – Quadratic Functions Part 2
- Topic 1 – Observations from a Graph of a Quadratic Function
- Topic 3 – Graphing Quadratic Functions Using a Table
Double Block P-A and A1H

- Topic 4 – Graphing Quadratics Using the Vertex and Intercepts
- Topic 5 – Graphing Quadratic Functions Using Vertex Form – Part 1
- Topic 7 – Graphing Quadratic Functions Using Vertex Form – Part 2

**Khan Academy**
- [Solving and graphing with factored form](#)
- [Vertex Form](#)
- [Features & forms of quadratic functions](#)

**MFAS Formative Assessments**
- [Model Rocket](#)
- [Graphing a Quadratic Function](#)

---

**Sample Problem**
Using the graph of a quadratic function shown below, determine each of the following:

- a. Domain
- b. Range
- c. x-intercept(s)
- d. y-intercept
- e. axis of symmetry
- f. minimum
- g. vertex
- h. domain
- i. range
- j. interval on which the function is decreasing
- k. interval on which the function is increasing

---

**MA.912.AR.3.8**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.AR.3.8 Solve and graph mathematical and real-world problems that are modeled with quadratic functions. Interpret key features and determine domain constraints in terms of the context.</td>
<td>MAFS.912.A-REI.2.4 Solve quadratic equations in one variable.</td>
</tr>
<tr>
<td>Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.</td>
<td></td>
</tr>
<tr>
<td>Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as</td>
<td></td>
</tr>
</tbody>
</table>
appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers $a$ and $b$.

\begin{align*}
&\textit{MAFS.912.F-IF.1.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.} \\
&\textit{MAFS.912.F-IF.2.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function } h(n) \textit{gives the number of person-hours it takes to assemble engines in a factory, then the positive integers would be an appropriate domain for the function.}
\end{align*}

<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students will be able to:</strong></td>
<td><strong>McGraw-Hill Algebra 1</strong></td>
</tr>
<tr>
<td>Model real-world problems with quadratic functions</td>
<td>9-2 Solving Quadratic Equations by Graphing</td>
</tr>
<tr>
<td>Determine domain and range in context of the real-world problems</td>
<td><strong>Algebra Nation</strong></td>
</tr>
<tr>
<td>Solve real-world problems modeled with quadratic functions</td>
<td>Section 5 – Quadratic Functions – Part 1</td>
</tr>
<tr>
<td></td>
<td>Topic 1 Real-World Examples of Quadratic Functions</td>
</tr>
<tr>
<td></td>
<td>Topic 10 Quadratic Functions In Action</td>
</tr>
<tr>
<td></td>
<td><strong>Khan Academy</strong></td>
</tr>
<tr>
<td></td>
<td>Solving Quadratics by Factoring</td>
</tr>
</tbody>
</table>

**Sample Problem**
The value of a classic car produced in 1972 can be modeled by the function
\[ V(t) = 19.25t^2 - 440t + 3500, \text{ where } t \text{ is the number of years since 1972.} \]
In what year does the car’s value start to increase?
**A1H Unit 10: Transformations and Special Cases**

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
</table>
| **MA.912.F.2.1** - Identify the effect on the graph or table of a given function after replacing \( f(x) \) by \( f(x+k) \), \( kf(x) \), \( f(kx) \) and \( f(x+k) \) for specific values of \( k \). | Clarification 1: Within the Algebra 1 course, functions are limited to linear, quadratic and absolute value.  
Clarification 2: Instruction focuses on including positive and negative values for \( k \). |
| **MA.912.F.2.3** - Given the graph or table of \( f(x) \) and the graph or table of \( f(x+k) \), \( kf(x) \), \( f(kx) \) and \( f(x+k) \), state the type of transformation and find the value of the real number \( k \). | Clarification 1: Within the Algebra 1 course, functions are limited to linear, quadratic and absolute value. |

**Essential Vocabulary**

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Value function</td>
<td>A type of a piecewise linear function written as ( f(x) = a</td>
</tr>
<tr>
<td>Dilation</td>
<td>A transformation that stretches or compresses the graph of a function.</td>
</tr>
<tr>
<td>Linear function</td>
<td>A function with ordered pairs for which the graph is a line.</td>
</tr>
<tr>
<td>Parent function</td>
<td>The simplest of functions in a family of functions.</td>
</tr>
<tr>
<td>Quadratic function</td>
<td>A non-linear function written in the form of ( f(x) = ax^2 + bx + c ), where ( a \neq 0 ).</td>
</tr>
<tr>
<td>Reflection</td>
<td>A transformation where the graph is flipped across a line.</td>
</tr>
<tr>
<td>Slope-Intercept form</td>
<td>A linear function in the form of ( y = mx + b ), where ( m ) is the slope and ( b ) is the y-intercept.</td>
</tr>
<tr>
<td>Transformation</td>
<td>A movement of a graph on a coordinate plane.</td>
</tr>
<tr>
<td>Translation</td>
<td>A transformation where a figure is slid from one position to another (moves up, down, left, right, or in two directions) without being turned.</td>
</tr>
<tr>
<td>Vertex</td>
<td>The minimum or maximum point of a graph.</td>
</tr>
<tr>
<td>Vertex-form</td>
<td>A quadratic function in the form of ( f(x) = a(x - h)^2 + k ), where ( a, h, ) and ( k ) are constants and ((h, k)) is the vertex.</td>
</tr>
</tbody>
</table>

*The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).*

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

<table>
<thead>
<tr>
<th>Connections between B.E.S.T. and Florida Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.F.2.1</strong> Identify the effect on the graph or table of a given function after replacing ( f(x) ) by ( f(x+k) ), ( kf(x) ), ( f(kx) ) and ( f(x+k) ) for specific values of ( k ).</td>
</tr>
</tbody>
</table>
## Instructional Learning Objectives

- Identify translations, dilations, and reflections to linear functions
- Identify translations, dilations, and reflections to quadratic functions
- Identify translations, dilations, and reflections to absolute value functions*  

* **Students are expected to recognize an absolute value function and identify transformations to the function**

## Instructional Resources

### Mc-Graw-Hill Algebra 1:

- Chapter 9: Quadratic Functions and Equations
  - Lesson 3: Transformations of Quadratic Functions
  - Lesson 7: Special Functions (pg. 599-601) *
  
  * **Students are expected to recognize an absolute value function and identify transformations to the function**

### Algebra Nation:

- Section 3: Introduction to Functions
  - Topic 10: Transformations of Functions
- Section 6: Quadratic Equations and Functions – Part 2
  - Topic 7: Transformations of the Dependent Variable of Quadratic Functions
  - Topic 8: Transformations of the Independent Variable of Quadratic Functions

### IXL Math Algebra 1:

You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click [here](#).

1. Transformations of linear functions (C8G)
2. Transformations of quadratic functions (6YS)
3. Transformation of absolute value functions (9TC)

### Virtual Nerd Videos:

- **What is a Parent Function?**
- **How Do You Graph the Parent Quadratic Function \( y = x^2 \)?**
- **How Do You Translate a Function?**
- **How Do You Graph a Translation of a Function?**
- **How Do You Reflect a Function?**
- **How Do You Graph a Reflection of a Function?**
- **What is an Absolute Value Function?**
- **How Do You Graph an Absolute Value Function?**

### Khan Academy:

Courses → Algebra 1 → Quadratic functions & equations → **Transforming quadratic functions**

- Intro to parabola transformations
- Shifting parabolas
- Scaling & reflecting parabolas

Courses → Algebra 1 → Absolute value & piecewise functions → **Graphs of absolute value functions**

- Shifting absolute value graphs
- Scaling & reflecting absolute value function: equation
- Scaling & reflecting absolute value function: graph

**desmos**
- Marbleslide: Lines In this activity, students will transform lines so that the marbles go through the stars. Students will test their ideas by launching the marbles and will have a chance to revise before trying the next challenge.
- Marbleslide: Parabolas In this activity, students will transform parabolas so that the marbles go through the stars. Students will test their ideas by launching the marbles and will have a chance to revise before trying the next challenge.

**Sample Problems:**

1. The graph of \( g(x) = a(x - h) \) is a transformation of the graph \( f(x) = x \). If \( a < 0 \) and \( h > 0 \), describe the transformation in \( g(x) \) as it relates to the graph of \( f(x) = x \).

2. The graph of \( f(x) = x^2 \) is reflected across the \( x \)-axis and translated to the left 4 units. What is the value of \( h \) when the equation of the transformed graph is written in vertex form?

3. Which transformations of the graph of \( f(x) = |x| \) are needed to produce the graph of \( g(x) = -|x - 1| \)?

**MA.912.F.2.3**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.F.2.3 Given the graph or table of ( f(x) ) and the graph or table of ( f(x+k), kf(x), f(kx) ) and ( f(x+k) ), state the type of transformation and find the value of the real number ( k ).</td>
<td>MAFS.912.F-BF.2.3 Identify the effect on the graph of replacing ( f(x)+k, kf(x), f(kx) ) and ( f(x+k) ) for specific values of ( k ) (both positive and negative); find the value of ( k ) given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

- Identify and describe the effects of transformations of linear functions from a table or graph
- Identify and describe the effects of transformations of quadratic functions from a table or graph
- Identify and describe the effects of transformations of absolute value functions from a table or graph

*Students are expected to recognize an absolute value function and its transformations*

**Instructional Resources**

- **Mc-Graw-Hill Algebra 1:** Chapter 9: Quadratic Functions and Equations
  - Lesson 3: Transformations of Quadratic Functions
  - Lesson 7: Special Functions (pg. 599-601) *
  *Students are expected to recognize an absolute value function and its transformations*

- **Algebra Nation:** Section 3: Introduction to Functions
  - Topic 10: Transformations of Functions
  - Section 6: Quadratic Equations and Functions – Part 2
  - Topic 7: Transformations of the Dependent Variable of Quadratic Functions
- Interpret the meaning of transformations in real-world situations.

- Topic 8: Transformations of the Independent Variable of Quadratic Functions

**IXL Math Algebra 1:**
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click [here](#).

- 4. Transformations of linear functions (C8G)
- 5. Transformations of quadratic functions (6YS)
- 6. Transformation of absolute value functions (9TC)

**Virtual Nerd Videos:**
- [How Do You Write an Equation for a Translation of an Absolute Value Function?](#)
- [What Does the Constant ‘k’ do in \( y = |x| + k \)?](#)
- [What Does the Constant ‘h’ do in \( y = |x – h| \)?](#)

**Khan Academy:**
Courses → Algebra 1 → Quadratic functions & equations → Transforming quadratic functions
- Intro to parabola transformations
- Shifting parabolas
- Scaling & reflecting parabolas

Courses → Algebra 1 → Absolute value & piecewise functions → Graphs of absolute value functions
- Shifting absolute value graphs
- Scaling & reflecting absolute value function: equation
- Scaling & reflecting absolute value function: graph

**Sample Problems:**

1. The graph of \( g(x) = (ax) + k \) shown is a transformation of the graph \( f(x) = x \). Describe the transformations across \( g(x) \). What is the value of \( k \) and \( a \)?
2. Abbie graphed the parent quadratic function as shown. Then, she graphed a second function that is a translation of the parent graph 2 units down and 3 units to the left. What is the equation for the 2nd graph?

3. Use the numbers and symbols in the box to complete the equation for the absolute value function shown in the graph. You may use a number or symbol more than once.

\[ f(x) = |x \, \square \, \square | \, \square \, \square \]
<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
</table>
| **MA.912.F.1.1** - Given an equation or graph that defines a function, classify the function type. Given an input-output table, determine a function type that could represent it. | Clarification 1: Within the Algebra 1 course, functions represented as tables are limited to linear, quadratic and exponential. Clarification 2: Within the Algebra 1 course, functions represented as equations or graphs are limited to vertical or horizontal translations or reflections over the x-axis of the following parent functions: 
\[ f(x) = x, f(x) = x^2, f(x) = x^3, f(x) = \sqrt{x}, \\
\] 
\[ f(x) = \sqrt[3]{x}, f(x) = |x|, f(x) = 2^x, \text{ and } f(x) = \left(\frac{1}{2}\right)^x \] |
| **MA.912.F.1.2** - Given a function represented in function notation, evaluate the function for an input in its domain. For a real-world context, interpret the output. | Clarification 1: Problems include simple functions in two-variables, such as \[ f(x, y) = 3x - 2y. \] Clarification 2: Within the Algebra 1 course, functions are limited to one-variable such as \[ f(x) = 3x. \] |
| **MA.912.F.1.3** - Calculate and interpret the average rate of change of a real-world situation represented graphically, algebraically or in a table over a specified interval. | Clarification 1: Instruction includes making the connection to determining the slope of a particular line segment. |
| **MA.912.F.1.6** - Compare key features of linear and nonlinear functions each represented algebraically, graphically, in tables or written descriptions. | Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior and asymptotes. Clarification 2: Within the Algebra 1 course, functions other than linear, quadratic or exponential must be represented graphically. Clarification 3: Within the Algebra 1 course, instruction includes verifying that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. |
| **MA.912.F.1.8** - Determine whether a linear, quadratic or exponential function best models a given real-world situation. | Clarification 1: Key features include domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior and asymptotes. |

### Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous function</td>
<td>A function that can be graphed with a line or a smooth curve.</td>
</tr>
<tr>
<td>Constant of variation</td>
<td>The number ( k ) in the equation in the form ( y = kx ).</td>
</tr>
<tr>
<td>Discrete function</td>
<td>A function of points that are not connected.</td>
</tr>
<tr>
<td>Domain</td>
<td>The set of the first numbers of the ordered pairs in a relation.</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Function</td>
<td>A relation in which each element of the domain is paired with exactly one element of the range.</td>
</tr>
<tr>
<td>Function notation</td>
<td>A way to name a function that is defined by an equation. In function notation, the equation $y = 3x - 8$ is written as $f(x) = 3x - 8$.</td>
</tr>
<tr>
<td>Nonlinear function</td>
<td>A function with a graph that is not a straight line.</td>
</tr>
<tr>
<td>Range</td>
<td>The set of second numbers of the ordered pairs in a relation.</td>
</tr>
<tr>
<td>Rate of change</td>
<td>How a quantity is changing with respect to a change in another quantity.</td>
</tr>
<tr>
<td>Relation</td>
<td>A set of ordered pairs.</td>
</tr>
<tr>
<td>Slope</td>
<td>The ratio of the change in the $y$-coordinates (rise) to the corresponding change in the $x$-coordinates (run) as you move from one point to another along a line.</td>
</tr>
<tr>
<td>Vertical line test</td>
<td>If any vertical line passes through no more than one point of the graph of a relation, then the relation is a function.</td>
</tr>
</tbody>
</table>

The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

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<td><strong>Connections between B.E.S.T. and Florida Standards</strong></td>
</tr>
</tbody>
</table>

**B.E.S.T.**

*MA.912.F.1.1* Given an equation or graph that defines a function, classify the function type. Given an input-output table, determine a function type that could represent it.

**Florida Standard**

*MAFS.912.F-F.2.4* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

### Instructional Learning Objectives

- Determine whether a relation is a function
- Identify linear, quadratic, and exponential functions from given equation, graph, or table

### Instructional Resources

**Mc-Graw-Hill Algebra 1:**

- Chapter 1: Relations
  - Lesson 7: Functions (part 1 pg. 47-49)
- Chapter 9: Quadratic Functions and Equations
  - Lesson 6: Analyzing Functions with Successive Differences

**Algebra Nation:**

- Section 8: Summary of Functions
  - Topic 1: Comparing Linear, Quadratic, and Exponential Functions – Part 1
  - Topic 2: Comparing Linear, Quadratic, and Exponential Functions – Part 2

**IXL Math Algebra 1:**

You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click [here](#).

**Identify linear functions**
1. Identify linear functions from graphs and equations (VMQ)
2. Identify linear functions from tables (F5G)

**Identify linear, quadratic, and exponential functions**
3. Identify linear and exponential functions from graphs (UEC)
4. Identify linear, quadratic, and exponential functions from graphs (DHB)
5. Identify linear and exponential functions from tables (LZF)
6. Identify linear, quadratic, and exponential functions from tables (SP5)

**Virtual Nerd Videos:**
- How Do You Figure Out if a Relation is a Function?
- How Can You Tell if a Relation is Not a Function?
- How Do You Find f(x) When You Have a Value For x?
- What is Function Notation?

**Khan Academy:**
Courses → Algebra 1 → Functions → Recognizing functions
- Recognizing functions from graph
- Does a vertical line represent a function?
- Recognizing functions from table
- Recognizing functions from verbal description

**Illustrative Mathematics:**
Click here to get to Algebra 1
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
- Unit 4 Lessons 1-9

**Sample Problems:**

1. Does the following graph represent a function?

![Graph](image)
2. The table compares the heights (in centimeters) and the weights (in kilograms) of Matt’s friends. Can the weight of Matt’s friends be represented as a function of their height?

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>163</td>
<td>65</td>
</tr>
<tr>
<td>167</td>
<td>70</td>
</tr>
<tr>
<td>154</td>
<td>60</td>
</tr>
<tr>
<td>172</td>
<td>70</td>
</tr>
<tr>
<td>167</td>
<td>68</td>
</tr>
<tr>
<td>159</td>
<td>58</td>
</tr>
<tr>
<td>160</td>
<td>64</td>
</tr>
<tr>
<td>166</td>
<td>69</td>
</tr>
</tbody>
</table>

**MA.912.F.1.2**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.F.1.2 Given a function represented in function notation, evaluate the function for an input in its domain. For a real-world context, interpret the output.</td>
<td>MAFS.912.F-IF.1.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:

- Find function values
- Interpret function notation using real world examples
- Determine input and output values from a graph of a function
- Complete a function table from a given graph
- Complete a function table from a given equation or function

**Instructional Resources**

- **Mc-Graw-Hill Algebra 1:**
  - Chapter 1: Relations
    - Lesson 7: Functions (part 2 pg. 50)

- **Algebra Nation:**
  - Section 3: Introduction to Functions
    - Topic 1: Input and Output Values
    - Topic 2: Representing, Naming, and Evaluating Functions
  - Section 8: Summary of Functions
    - Topic 6: Understanding Piecewise-Defined Functions

- **IXL Math Algebra 1:**
  - You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.

**Evaluate a function**

1. Evaluate a function
2. Evaluate a function: plug in an expression
3. Evaluate an exponential function

**Interpret function notation**

4. Interpret functions using everyday language

**Tables and graphs**

5. Find values using function graphs
6. Complete a function table from a graph (HXF)
7. Complete a function table from an equation (Z73)
8. Complete a function table: quadratic functions (LFV)
9. Complete a function table: absolute value functions (2DH)

Virtual Nerd Videos:
- How Do You Solve a Word Problem Using a Function?
- How Can You Tell if a Function is Linear or Nonlinear From a Graph?
- How Can You Tell if a Function is Linear or Nonlinear From a Table?

Sample Problems:
1. The function \( f(x) = \frac{x}{2} - 8 \) models Alicia’s position in miles relative to a water stand \( x \) minutes into a marathon. Evaluate and interpret for a quarter of an hour into the race.

2. The science classroom has a fish tank that holds 10,450 ml of water. The water is leaking at a rate of 270 ml per minute. Define the input and the output for this scenario. Write a function to model this situation.

3. Consider the function \( f(x) = x^2 + 2x - 5 \). Find \( f(-3) \).

MA.912.F.1.3

Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.F.1.3 <strong>Calculate and interpret the average rate of change</strong> of a real-world situation represented graphically, algebraically or in a table over a specified interval.</td>
<td>MAFS.912.F-IF.2.6 <strong>Calculate and interpret the average rate of change</strong> of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.</td>
</tr>
</tbody>
</table>

Instructional Learning Objectives

Students will be able to:
- Use rate of change to solve real-world problems
- Find the constant of variation
- Find the slope of a line

Instructional Resources

- **Mc-Graw-Hill Algebra 1:** Section 3: Introduction to Functions
  - Lesson 3: Rate of Change and Slope
  - Lesson 4: Direct Variation

- **Algebra Nation:** Section 3: Introduction to Functions
  - Topic 9: Average Rate of Change over an Interval

- **IXL Math Algebra 1:** You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click [here](#).

Rate of change

1. Rate of change: tables (PLA)
2. Rate of change: graphs (BNH)

Constant of variation
3. Find the constant of variation (9TD)

Slope
4. Find the slope of a graph (E7D)
5. Find the slope from two points (MDS)
6. Slope-intercept form: find the slope and y-intercept (RST)

Virtual Nerd Videos:
• What is Rate of Change?
• How Do You Find the Rate of Change Between Two Points in a Table?
• How Do You Find the Rate of Change Between Two Points on a Graph?
• How Do You Find the Slope of Line from Two Points?
• How Do You Find the Slope of Line a Graph?

Khan Academy:
Courses → Algebra 1 → Functions → Average rate of change
• Introduction to Average Rate of Change

Illustrative Mathematics:
Click here to get to Algebra 1
Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
• Unit 4 Lesson 7
  Student Task Scroll to the bottom of the page to access the student task pdf file.

Sample Problems:
1. A pack of gum is on sale for “buy one get one free”. If Anna buys one pack of gum she gets a total of two packs. If she buys 2 packs of gum, she gets 4 packs, etc. What is the rate of change? Write an equation to represent this situation if she buys “x” number of packs of gum?

2. Jackie earns extra spending money by babysitting children in her neighborhood. On Tuesday, she earned $16 for babysitting for two hours. On Saturday, she earned $40 for babysitting for 5 hours. Let x represent the number of hours and y represent the amount earned. What is the rate of change?

MA.912.F.1.6

Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
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<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.F.1.6</td>
<td>MAFS.912.F-IF.3.9</td>
</tr>
</tbody>
</table>

*Compare key features of linear and nonlinear functions each represented algebraically, graphically, in tables or written descriptions.*
<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td></td>
</tr>
</tbody>
</table>
| • Identify and compare features of linear, quadratic, and exponential functions from a given table, graph, or written description. | **Algebra Nation:**  
  Section 8: Summary of Functions  
  • Topic 1: Comparing Linear, Quadratic, and Exponential Functions - Part 1  
  • Comparing Linear, Quadratic, and Exponential Functions – Part 2 |
| | **Virtual Nerd Videos:**  
  • How do you determine if a graph represents a linear, exponential, or quadratic function? |
| | **Khan Academy:**  
  Courses → Common Core Math → Functions: Linear, Quadratic, and Exponential Models  
  • Functions: Linear, Quadratic, and Exponential Models |
| | **CK-12 Foundation Video:**  
  • Comparing Linear, Exponential, and Quadratic Functions |
| | **MARS/Shell Center:**  
  • Sorting Functions: In this task students are asked to match each graph with an equation, table, and rule. |
| | desmos  
  • Comparing Linear, exponential, and quadratic |

**Sample Problems:**
1. Complete the table below so that the data is best modeled by a linear equation. Then write the linear equation that represents the data.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>3</td>
<td>0</td>
<td>-3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Compare the two functions. Which function decreases faster?

$$f(x) = -2x + 10$$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$g(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>7.5</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2.5</td>
</tr>
</tbody>
</table>
**MA.912.F.1.8**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.F.1.8 Determine whether a linear, quadratic, or exponential function best models a given real-world situation.</td>
<td>MAFS.912.F-IF.2.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.</td>
</tr>
<tr>
<td>MAFS.912.F-LE.1.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function</td>
<td></td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

Students will be able to:

- Identify linear, quadratic, and exponential functions from a given real-world problem.

**Instructional Resources**

**Algebra Nation:**
Section 8: Summary of Functions
1. Topic 1: Comparing Linear, Quadratic, and Exponential Functions - Part 1
2. Topic 2: Comparing Linear, Quadratic, and Exponential Functions – Part 2
3. Topic 3: Comparing Arithmetic and Geometric Sequences
4. Topic 5: Modeling with Functions

**IXL Math Algebra 1:**
You can access problems for these new standards by choosing the Florida’s B.E.S.T. Standards: Algebra 1 skill plan. To access click here.
1. Write linear functions: word problems (9RQ)
2. Exponential growth and decay: word problems (UKG)
3. Identify linear and exponential functions from tables (LZF)
4. Identify linear, quadratic, and exponential functions from tables (SPS)

**Virtual Nerd Videos:**
- **How do you determine if a graph represents a linear, exponential, or quadratic function?**

**CK-12 Foundation Video:**
- **Comparing Linear, Exponential, and Quadratic Functions**

**MARS/Shell Center:**
- **Representing Functions of Everyday Situations:**
  This lesson develops depth and understanding of functions through interpretation, identifying, and analyzing situations that make up functions.
Sample Problems:

1. The prize for a radio station contest begins with a $100 cash prize. Once a day, a name is announced. The person has 15 minutes to call or the prize increases by 2.5% for the next day.
   - Write an equation to represent the amount of the cash prize in dollars after $t$ days with no winners.
   - How much will the prize be worth if no one wins after 10 days?

2. The table shows the height of a plant for four consecutive weeks. Determine which kind of function best models the height. Then write a function that models the data.

<table>
<thead>
<tr>
<th>Week</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (in)</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
</tbody>
</table>
Semester 2 | A1H Unit 12: Composition of Functions | 3 days
---|---|---
Apr. 7 – Apr. 9

**Benchmarks**

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>The set of the first numbers of the ordered pairs in a relation.</td>
</tr>
<tr>
<td>Inequality (Interval) notation</td>
<td>A way of writing subsets of the real number line. For a closed interval, closed brackets are used []. For an open interval, parentheses are used (). There are also intervals that are half open and half closed which use both the bracket and a parenthesis. For example, the set for the inequality ( { x</td>
</tr>
<tr>
<td>Linear function</td>
<td>A function with ordered pairs that satisfy a linear equation</td>
</tr>
<tr>
<td>Quadratic function</td>
<td>An equation of the form ( y = ax^2 + bx + c ), where ( a \neq 0 )</td>
</tr>
<tr>
<td>Set builder notation</td>
<td>A concise way of writing a solution set. For example, ( { t</td>
</tr>
</tbody>
</table>

**Essential Vocabulary**

The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

**MA.912.AR.1.1**

Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
</table>
| MA.912.F.3.1 Given a mathematical or real-world context, **combine two functions**, limited to linear and quadratic, **using arithmetic operations**. When appropriate, include domain restrictions for the new function. | **MAFS.912.F-BF.1.1** Write a function that describes a relationship between two quantities. ★  
  a. Determine an explicit expression, a recursive process, or steps for calculation from a context.  
  b. **Combine standard function types using arithmetic operations**. For example, **build a function that models the temperature of a cooling body by adding a constant function to a** |

This standard IS NOT the composition of functions (i.e. \( f (g(x)) \)) and is missing large parts of the...
MAFS.912.F-BF.1.1. standard that is not addressed elsewhere within the B.E.S.T. standards. Therefore, there will be resources for the MAFS standard, as well, as students will still be tested on this MAFS standard for the next two years.

decaying exponential, and relate these functions to the model.

c. **Compose functions.** For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.

**MAFS.912.A-APR.4.6** Rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, (This was pointed out as “combining” functions by an arithmetic operation. In this case, division.) where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

### Instructional Learning Objectives

<table>
<thead>
<tr>
<th>Students will be able to:</th>
<th>McGraw-Hill Algebra 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Implement function notation.</td>
<td>Chapter 1, Lesson 6 page 40: Introduces students to relations and what it means to be a domain of a function.</td>
</tr>
<tr>
<td>2) Understand that the combination of two functions creates a new function that has its own domain.</td>
<td>Chapter 3, Lesson 5: Arithmetic Sequences as Linear Functions</td>
</tr>
<tr>
<td>3) Combine functions by adding, subtracting, multiplying, or dividing them.</td>
<td>Chapter 5, Lesson 1 focuses on solving inequalities by adding or subtracting but has students write the solution in set builder notation.</td>
</tr>
<tr>
<td>4) Compose functions.</td>
<td>Chapter 7, Lesson 7: Geometric Sequences as Exponential Functions</td>
</tr>
<tr>
<td>5) Write a domain for a function with set notation.</td>
<td>IXL:</td>
</tr>
<tr>
<td>6) Write a domain for a function with inequality notation.</td>
<td>• Add and subtract functions (A1-Q.) <strong>45B</strong></td>
</tr>
<tr>
<td></td>
<td>• Multiply functions (A1-Q.) <strong>8PM</strong></td>
</tr>
<tr>
<td></td>
<td>• Add and subtract polynomials (A1-Z.4) <strong>5EK</strong></td>
</tr>
<tr>
<td></td>
<td>• Multiply polynomials (A1-Z.10) <strong>58A</strong></td>
</tr>
<tr>
<td></td>
<td>• Evaluate a function: plug in an expression (A1-Q.8) <strong>VNZ</strong></td>
</tr>
<tr>
<td></td>
<td>Khan Academy:</td>
</tr>
<tr>
<td></td>
<td>For practice on combining functions (add, subtract, multiply, and divide), students can use the following link to view all the videos, practice problems, and quizzes to address the current and future standard: <strong>Combining Functions.</strong></td>
</tr>
</tbody>
</table>
Located in Pre-Calculus is a section on “Composite Functions.” Parts of this section will help students how to compose functions. This section has a video and practice problems on how to evaluate composite functions from a table.

Algebra Nation (2020-2021):
Section 3 - Topic 6: Real-World Combinations and Compositions of Functions
Section 4 - Topic 1: Arithmetic Sequences
Section 7 - Topic 1: Geometric Sequences
Section 8 - Topic 4: Exploring Non-Arithmetic, Non-Geometric Sequences

Illustrative Mathematics:
Click [here](#) to get to Algebra 1

- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- In Algebra 1, Unit 4 provides many lessons that help with function notation (lessons 2 – 5) and domain (lessons 10 -11). [Click here](#) to get to Unit 4.
- In Algebra 2, Unit 1 all the lessons cover different types of sequences. [Click here](#) to access.

Sample Problem:

1. Let $f(x) = 3x^2 - 2x + 8$ and $h(x) = 7x - 9$. Evaluate $(f - h)(3)$.

2. You are standing in the store trying to decide if you can afford a really awesome pair of sneakers (x).
   Let $f(x) =$ the discounted price of the sneakers and $g(x) =$ the 7% tax on the discounted price. The original price of the sneakers is $K$ and they are now 20% off. Write a composite function to represent the total amount you would pay for the sneakers after the discount and the tax.
<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.DP.1.1</strong> - Given a set of data, select an appropriate method to represent the data, depending on whether it is numerical or categorical data and on whether it is univariate or bivariate.</td>
<td>Clarification 1: Instruction includes discussions regarding the strengths and weaknesses of each data display.</td>
</tr>
<tr>
<td></td>
<td>Clarification 2: Numerical univariate includes histograms, stem-and-leaf plots, box plots and line plots; numerical bivariate includes scatter plots and line graphs; categorical univariate includes bar charts, circle graphs, line plots, frequency tables and relative frequency tables; and categorical bivariate includes segmented bar charts, joint frequency tables and joint relative frequency tables.</td>
</tr>
<tr>
<td></td>
<td>Clarification 3: Instruction includes the use of appropriate units and labels and, where appropriate, using technology to create data displays.</td>
</tr>
<tr>
<td><strong>MA.912.DP.1.2</strong> - Interpret data distributions represented in various ways. State whether the data is numerical or categorical, whether it is univariate or bivariate and interpret the different components and quantities in the display.</td>
<td>Clarification 1: Within the Probability and Statistics course, instruction includes the use of spreadsheets and technology.</td>
</tr>
<tr>
<td><strong>MA.912.DP.1.3</strong> - Explain the difference between correlation and causation in the contexts of both numerical and categorical data.</td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.DP.1.4</strong> - Estimate a population total, mean or percentage using data from a sample survey; develop a margin of error through the use of simulation.</td>
<td>Clarification 1: Within the Algebra 1 course, the margin of error will be given.</td>
</tr>
</tbody>
</table>

**Essential Vocabulary**

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Univariate data</td>
<td>Data with one variable</td>
</tr>
<tr>
<td>Bivariate Data</td>
<td>Data with two variables</td>
</tr>
<tr>
<td>Correlation</td>
<td>The degree to which two sets of data are related or linked together.</td>
</tr>
<tr>
<td>Causation</td>
<td>A relationship between two events where one event is affected by the other.</td>
</tr>
<tr>
<td>Margin of error</td>
<td>The range of values below and above the sample statistic</td>
</tr>
<tr>
<td>Measures of center</td>
<td>Numbers or pieces of data that can represent the whole set of data.</td>
</tr>
<tr>
<td>Positive Association</td>
<td>Two associated sets of data that increase as the other set increases</td>
</tr>
<tr>
<td>Negative Association</td>
<td>Two associated sets of data that decrease as the other set decreases</td>
</tr>
<tr>
<td>No Association</td>
<td>Two sets of data that have no association or pattern to distinguish between the sets.</td>
</tr>
</tbody>
</table>
The 2020-2021 school year we are transitioning from the Florida Mathematics Standards (MAFS) to the B.E.S.T. standards (MA).

In the unit guides we have identified which B.E.S.T. standard matches with which MAFS standard(s).

### Connections between B.E.S.T. and Florida Standards

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.DP.1.1 Given a set of data, select an appropriate method to represent the data, depending on whether it is numerical or categorical data and on whether it is univariate or bivariate.</td>
<td>MAFS.912.S-ID.1.1 Represent data with plots on the real number line (dot plots, histograms, and box plots)</td>
</tr>
</tbody>
</table>

### Instructional Learning Objectives

- Create and interpret dot plot given data
- Create and interpret histograms
- Create and interpret Box plots

### Instructional Resources

- **McGraw-Hill Algebra 1:** Chapter 12, Lesson 3: Distributions of Data, p. 765
- **IXL:** Create bar graphs, line graphs, and histograms (A1-N.2) [MHB](#)
- From the BEST standards, you can use this IXL code: Create bar graphs, line graphs, and histograms (A1-N.2) [EF6](#)
- **Khan Academy:** Within the Statistics and Probability course there are two units students can go through: Displaying quantitative data with graphs and Describing and comparing distributions.
- **Algebra Nation:** Section 9 - Topics 1, 2, 3, and 4
- **Illustrative Mathematics:** Click [here](#) to get to Algebra 1
  - Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
  - This lesson is in Grade 8 and can be accessed here: [Student Task Statements](#)

### Sample problem:
Represent the following data using a dot plot, histogram, and box plot: \[20, 5, 8, 22, 10, 1, 7, 15, 16, 1, 5, 8, 13, 6, 22.\]
### MA.912.DP.1.2

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.DP.1.2</strong> <em>Interpret data distributions</em> represented in various ways. State whether the data is numerical or categorical, whether it is univariate or bivariate and interpret the different components and quantities in the display.</td>
<td><strong>MAFS.912.S-ID.1.3</strong> <em>Interpret</em> differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</td>
</tr>
<tr>
<td><strong>MAFS.912.S-ID.1.2</strong> <em>Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data set</em> The standard listed above has no natural connection to a new BEST standard. However, it will be tested for the next two years on the Algebra 1 EOC and, thus, still needs to be addressed.</td>
<td></td>
</tr>
</tbody>
</table>

### Instructional Learning Objectives

<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
<td></td>
</tr>
<tr>
<td>1. Identify measure centers</td>
<td>McGraw-Hill Algebra 1:</td>
</tr>
<tr>
<td>2. Interpret the spread of graphs presented in various ways to make real world connection to the data.</td>
<td>Chapter 12, Lesson 3: Distributions of Data, p. 765</td>
</tr>
<tr>
<td>3. Properly identify all parts of a graph as it relates to the context.</td>
<td>IXL:</td>
</tr>
<tr>
<td></td>
<td>Interpret bar graphs, line graphs, and histograms (A1-N.1) <strong>89A</strong></td>
</tr>
<tr>
<td></td>
<td>Interpret circle graphs (A1-N.3) <strong>UHY</strong></td>
</tr>
<tr>
<td></td>
<td>Interpret stem-and-leaf plots (A1-N.4) <strong>EBJ</strong></td>
</tr>
<tr>
<td></td>
<td>Interpret box-and-whisker plots (A1-N.5) <strong>YE9</strong></td>
</tr>
<tr>
<td></td>
<td>Interpret a scatter plot (A1-KK.8) <strong>8BS</strong></td>
</tr>
<tr>
<td></td>
<td>Khan Academy:</td>
</tr>
<tr>
<td></td>
<td>Within the Statistics and Probability course there are two units students can go through: Displaying quantitative data with graphs and Describing and comparing distributions.</td>
</tr>
<tr>
<td></td>
<td>Algebra Nation:</td>
</tr>
<tr>
<td></td>
<td>Section 9, Topic 9</td>
</tr>
<tr>
<td></td>
<td>Illustrative Mathematics:</td>
</tr>
<tr>
<td></td>
<td>Click <a href="#">here</a> to get to Algebra 1</td>
</tr>
<tr>
<td></td>
<td>- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions</td>
</tr>
</tbody>
</table>
Lesson 9 assists with “Looking for Associations” and is in Grade 8 and can be accessed here: Student Task Statements.
Lesson 10 is over “Using Data Displays to Find Associations” and is in Grade 8 and can be accessed here: Student Task Statements.
Lesson 5 is “Describing Trends in Scatter Plots” and can be accessed here: Student Task Statements.

Sample problem:
Corinne is planning a beach vacation in July and is analyzing the daily high temperatures for her potential destination. She would like to choose a destination with a high median temperature and a small interquartile range. She constructed box plots shown in the diagram below.

Which destination has a median temperature above 80 degrees and the smallest interquartile range?

---

**MA.912.DP.1.3**

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.DP.1.3 Explain the difference between correlation and causation in the contexts of both numerical and categorical data.</td>
<td>MAFS.912.S-ID.1.3 Distinguish between correlation and causation.</td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

1) Understand correlation between two sets of data.
2) Understand causation between two sets of data.
3) Determine when two sets of data are correlated.
4) Determine when there is causality between two sets of data.

**Instructional Resources**

McGraw-Hill Algebra 1:
Chapter 4, lesson 5: Scatter Plots and Lines of Fit, p. 247 – discusses positive, negative, or no association.
Chapter 4, Lesson 5 Algebra Lab: Correlation and Causation, p. 254 fully addresses the standard.

Khan Academy:
Within the Statistics and Probability course there is a lesson students can go through: Correlation and Causation | Lesson.
### Sample problem:
There is a strong positive correlation between the number of Nobel prizes won by country and the per capita chocolate consumption by country. Does this mean that increased chocolate consumption in America will increase the United States of America’s chances of a Nobel prize winner?

<table>
<thead>
<tr>
<th>MA.912.DP.1.4</th>
<th>Connections between B.E.S.T. and Florida Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.E.S.T.</strong></td>
<td><strong>Florida Standard</strong></td>
</tr>
<tr>
<td>MA.912.DP.1.4</td>
<td>Estimate a population total, mean or percentage using data from a sample survey; develop a margin of error through the use of simulation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Students will be able to:</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Calculate the measure of center given a real-world scenario.</td>
<td>McGraw-Hill Algebra 1: Chapter 12, Lesson 1: Samples and Studies p. 747 Chapter 12, Lesson 1 Algebra Lab: Evaluating Published Data, p. 755 Chapter 12, Lesson 2: Statistics and Parameters, p. 757</td>
</tr>
<tr>
<td>2. Use a sample survey to justify conclusion for entire population.</td>
<td>IXL: Find confidence intervals for population means (A2-EE.9) JVK Find confidence intervals for population proportions (A2-EE.10) QAD</td>
</tr>
<tr>
<td></td>
<td>Khan Academy: Within the Statistics and Probability Course there is a unit entitled “Sampling distribution of a sample mean.”</td>
</tr>
</tbody>
</table>

**Algebra Nation:**
Section 9, Topic 9

**Illustrative Mathematics:**
Click [here](#) to get to Algebra 1
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions.
- In Algebra 1, Lesson 9 discusses “Causal Relationships” and can be accessed here: [Student Task Card](#).
Algebra Nation:
Section 9 - Honors Topic 1 (available online)

Illustrative Mathematics:
Click here to get to Algebra 2
- Teachers will be able to access student resource but will need to set up a (free) account to access lessons with prompts and guiding questions
- Unit 7, Lesson 10
- Unit 7, Lesson 11
- Unit 7, Lesson 12

Sample problem:
Based on a survey of 100 households in Twin Lakes, the newspaper reports that the average number of televisions per household is 3.5 with a margin of error of ±0.6. The actual population mean can be estimated to be between 2.9 and 4.1 television per household. Since there are 5,500 households in Twin Lakes the estimated number of televisions is between 15,950 and 22,550.
<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>Benchmark Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.DP.2.4:</strong> Fit a linear function to bivariate numerical data that suggests a linear association and interpret the slope and y-intercept of the model. Use the model to solve real-world problems in terms of the context of the data.</td>
<td>Clarification 1: Instruction includes fitting a linear function both informally and formally with the use of technology. Clarification 2: Problems include making a prediction or extrapolation, inside and outside the range of the data, based on the equation of the line of fit.</td>
</tr>
<tr>
<td><strong>MA.912.DP.2.5:</strong> Given a scatter plot that represents bivariate numerical data, assess the fit of a given linear function by plotting and analyzing residuals.</td>
<td>Clarification 1: Within the Algebra 1 course, instruction includes determining the number of positive and negative residuals; the largest and smallest residuals; and the connection between outliers in the data set and the corresponding residuals.</td>
</tr>
<tr>
<td><strong>MA.912.DP.2.6:</strong> Given a scatter plot with a line of fit and residuals, determine the strength and direction of the correlation. Interpret strength and direction within a real-world context.</td>
<td>Clarification 1: Instruction focuses on determining the direction by analyzing the slope and informally determining the strength by analyzing the residuals.</td>
</tr>
<tr>
<td><strong>MA.912.DP.3.1:</strong> Construct a two-way frequency table summarizing bivariate categorical data. Interpret joint and marginal frequencies and determine possible associations in terms of a real-world context.</td>
<td></td>
</tr>
<tr>
<td><strong>MA.912.DP.3.2:</strong> Given marginal and conditional frequencies, construct a two-way relative frequency table summarizing categorical bivariate data.</td>
<td>Clarification 1: Construction includes cases where not all frequencies are given but enough are provided to be able to construct a two-way relative frequency table. Clarification 2: Instruction includes the use of a tree diagram when calculating relative frequencies to construct tables.</td>
</tr>
<tr>
<td><strong>MA.912.DP.3.3:</strong> Given a two-way relative frequency table or segmented bar graph summarizing categorical bivariate data, interpret joint, marginal and conditional relative frequencies in terms of a real-world context.</td>
<td>Clarification 1: Instruction includes problems involving false positive and false negatives.</td>
</tr>
</tbody>
</table>
## Essential Vocabulary

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-way frequency table</td>
<td>A table that displays the relationship between two categorical variables</td>
</tr>
<tr>
<td>Joint frequency</td>
<td>Frequency in the body of the table, joining two categories</td>
</tr>
<tr>
<td>Marginal frequency</td>
<td>Frequency at the margin of the table, representing the total of the row or column</td>
</tr>
<tr>
<td>Two-way relative frequency table</td>
<td>A table that displays relative frequencies (percentage, decimal, or ratios) instead of just frequency counts</td>
</tr>
<tr>
<td>Joint Relative Frequency</td>
<td>The ratio of the joint frequency to the total number of data points.</td>
</tr>
<tr>
<td>Marginal Relative Frequency</td>
<td>The ratio of the marginal frequency to the total number of data points.</td>
</tr>
<tr>
<td>Conditional relative frequency</td>
<td>The ratio of the joint frequency to the related marginal frequency.</td>
</tr>
<tr>
<td>Bivariate data set</td>
<td>Data set with two variables</td>
</tr>
<tr>
<td>Scatter Plot</td>
<td>A plot that shows the relationship between two variables for the set of data</td>
</tr>
<tr>
<td>Association</td>
<td>Relationship between two variables, may be described in terms of strength (strong, weak, or none) and direction (positive, negative, or none)</td>
</tr>
<tr>
<td>Line of Best Fit</td>
<td>The trend line that most closely matches the data</td>
</tr>
<tr>
<td>Correlation</td>
<td>Measure of relationship between two variables.</td>
</tr>
<tr>
<td>Correlation coefficient</td>
<td>A number between -1 and 1, that indicates the strength and direction of a linear relationship between two quantitative variables</td>
</tr>
<tr>
<td>Residual</td>
<td>The difference between the actual y-value and the predicted y-value</td>
</tr>
<tr>
<td>Residual Plot</td>
<td>A plot of residual values that shows how well a linear model fits the data set</td>
</tr>
<tr>
<td>Causation</td>
<td>Describes a cause-and-effect relationship of how change in one variable causes the change in the other variable</td>
</tr>
<tr>
<td>Interpolation</td>
<td>Using a model to estimate a value within the range of known values</td>
</tr>
<tr>
<td>Extrapolation</td>
<td>Using a model to estimate a value outside the range of known values</td>
</tr>
</tbody>
</table>

### MA.912.DP.2.4

**Connections between B.E.S.T. and Florida Standards**

**B.E.S.T.**  | **Florida Standard**  |
---|---|
**MA.912.DP.2.4** Fit a linear function to bivariate numerical data that suggests a linear association and interpret the slope and y-intercept of the model. Use the model to solve real-world problems in terms of the context of the data. | MAFS.912.S-ID.2.6 Represent data on two quantitative variables on a scatter plot and describe how the variables are related.  
1. **Fit a function to the data;** use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, and exponential models.  
2. **Fit a linear function for a scatter plot that suggests a linear association.**  
3. **MAFS.912.S-ID.3.7 Interpret the slope** (rate of change) and the **intercept** (constant term) of a linear model in the context of the data. |

### Instructional Learning Objectives

**Students will be able to:**  
- Fit a linear function for a scatter plot that suggests a linear association

### Instructional Resources

- McGraw-Hill Algebra 1  
- 4-5 Scatter Plots and Lines of Fit
Sample Problem:
The table below shows the predicted annual cost for a middle-income family to raise a child from birth until adulthood. Create a scatter plot of the data and sketch a line of best fit. Then answer questions below.

<table>
<thead>
<tr>
<th>Child's Age</th>
<th>Cost of Raising a Child Born in 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10,700</td>
</tr>
<tr>
<td>6</td>
<td>11,700</td>
</tr>
<tr>
<td>9</td>
<td>12,600</td>
</tr>
<tr>
<td>12</td>
<td>15,000</td>
</tr>
<tr>
<td>15</td>
<td>16,700</td>
</tr>
</tbody>
</table>

a) Write the equation of line of best fit

b) What does the y-intercept represent in context of the data?

c) What does the slope represent in the context of data?
### MA.912.DP.2.5

<table>
<thead>
<tr>
<th>Connections between B.E.S.T. and Florida Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.DP.2.5 Given a scatter plot that represents bivariate numerical data, <strong>assess the fit of a given linear function by plotting and analyzing residuals.</strong></td>
</tr>
<tr>
<td><strong>b. Informally assess the fit of a function by plotting and analyzing residuals</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Learning Objectives</th>
<th>Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students will be able to:</strong></td>
<td><strong>Algebra Nation</strong></td>
</tr>
<tr>
<td>• Calculate residuals</td>
<td>Section 10 – Two-Variable Statistics</td>
</tr>
<tr>
<td>• Construct a residual plot for the given data set and the given linear function</td>
<td>• Topic 5 – Residuals and Residual Plots – Part 1</td>
</tr>
<tr>
<td>• Analyze the residual plot to assess the fit of the given linear function</td>
<td>• Topic 6 – Residuals and Residual Plots – Part 2</td>
</tr>
<tr>
<td><strong>Khan Academy</strong></td>
<td><strong>Calculating and Interpreting residuals</strong></td>
</tr>
<tr>
<td>• Introduction to residuals</td>
<td><strong>MFAS Formative Assessments</strong></td>
</tr>
<tr>
<td>• Calculating and Interpreting residuals</td>
<td></td>
</tr>
<tr>
<td><strong>MFAS Formative Assessments</strong></td>
<td>• Residuals</td>
</tr>
</tbody>
</table>

### Sample Problem:

A line of best fit was drawn for the scatter plot below: Determine the residual associated with each point and use it to create a residual plot.

![Sample Problem Image]

<table>
<thead>
<tr>
<th>$x$</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the residual plot, state whether the equation is a good fit for the data. Justify your answer.
<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.DP.2.6 Given a scatter plot with a line of fit and residuals, determine the strength and direction of the correlation. Interpret strength and direction within a real-world context.</td>
<td>MAFS.912.S-ID.3.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.</td>
</tr>
<tr>
<td>MAFS.912.S-ID.3.9 Distinguish between correlation and causation.</td>
<td></td>
</tr>
</tbody>
</table>

### Instructional Learning Objectives

**Students will be able to:**
- Determine the strength and direction of correlation when given a scatter plot
- Interpret the strength and direction of correlation within a real-world context
- Distinguish between correlation and causation

### Instructional Resources

- **McGraw-Hill Algebra 1**
  - Extend 4-5 Correlation and Causation
- **IXL Math Algebra 1 and 2**
  - Interpret a scatter plot 8BS
  - Match correlation coefficients to scatter plots FQ7
- **Algebra Nation**
  - Section 10 – Two-variable Statistics
  - Topic 7 – Examining Correlation
- **Khan Academy**
  - Correlation coefficient review
- **MFAS Formative Assessments**
  - Correlation for Life Expectancy
  - Correlation Order
  - How Big Are Feet?
  - July December Correlation
  - Sleep and Reading

### Sample Problem

The graph below shows the relationship between the number of hours studied and the test scores.

Sketch a line of best fit and describe the correlation between the number of hours studied and the test scores.

![Graph showing relationship between number of hours studied and test scores]
### MA.912.DP.3.1

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.DP.3.1 Construct a two-way frequency table summarizing bivariate categorical data. Interpret joint and marginal frequencies and determine possible associations</strong> in terms of a real-world context.</td>
<td><strong>MAFS.912.S-ID.2.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.</strong></td>
</tr>
</tbody>
</table>

**Instructional Learning Objectives**

- Construct and two-way frequency table based on the given bivariate data
- Identify joint and relative frequencies
- Interpret joint and relative frequencies in context of the data
- Determine possible associations within the data

**Instructional Resources**

- McGraw-Hill Algebra 1
  - Extend 12-7 Two Way Frequency Tables
- IXL Math Algebra 1 and 2
  - Find probabilities using two-way frequency tables *93R*
- Algebra Nation
  - Section 10 – Two-Variable Statistics
    - Topic 1 – Relationship between Two-Categorical Variables – Marginal and Joint Frequency – Part 1
    - Topic 2 – Relationship between Two-Categorical Variables – Marginal and Joint Frequency – Part 2
- Khan Academy
  - Two-Way Tables
- MFAS Formative Assessments
  - Breakfast Drink Preference

**Sample Problem**

Complete the frequency table below.

<table>
<thead>
<tr>
<th></th>
<th>Has an A in math</th>
<th>Doesn’t have an A in math</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plays an instrument</td>
<td>20</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Doesn’t play an instrument</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>350</td>
</tr>
</tbody>
</table>

Based on the information in the table, is there any association between the grade in math class and ability to play an instrument?

### MA.912.DP.3.2

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MA.912.DP.3.2 Given marginal and conditional frequencies, construct a two-way relative frequency table summarizing categorical bivariate data.</strong></td>
<td><strong>MAFS.912.S-ID.2.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.</strong></td>
</tr>
</tbody>
</table>
## Instructional Learning Objectives

**Students will be able to:**
- Construct a two-way relative frequency table
- Calculate joint relative and marginal relative frequencies
- Calculate conditional relative frequencies

## Instructional Resources

**McGraw-Hill Algebra 1**
- 9-2 Solving Quadratic Equations by Graphing

**IXL Math**
- Find conditional probabilities using two-way frequency tables [BZZ](#)

**Algebra Nation**
- Section 10 – Two-Variable Statistics
  - Topic 3 – Two Categorical Variables – Conditional Relative Frequency

**Khan Academy**
- Two-way relative frequency tables
- Distributions in two-way tables

**MFAS Formative Assessments**
- Conditional Relative Frequency

## Sample Problem

A study shows that 9% of the population have diabetes and 91% do not. The study also shows that 95% of the people who do not have diabetes, test negative on a diabetes test while 80% who do have diabetes, test positive. Based on the given information, complete the following two-way relative frequency table.

<table>
<thead>
<tr>
<th>Has diabetes</th>
<th>Test Positive</th>
<th>Test Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doesn’t have diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

---

## MA.912_DP.3.3

**Connections between B.E.S.T. and Florida Standards**

<table>
<thead>
<tr>
<th>B.E.S.T.</th>
<th>Florida Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA.912.DP.3.3 Given a two-way relative frequency table or segmented bar graph summarizing categorical bivariate data, interpret joint, marginal and conditional relative frequencies in terms of a real-world context.</td>
<td>MAFS.912.S-ID.2.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data</td>
</tr>
</tbody>
</table>

## Instructional Learning Objectives

**Students will be able to:**
- Use a two-way relative frequency to determine relative frequencies

## Instructional Resources

**MFAS Formative Assessments**
- Marginal and Joint Frequency
- Who is a Vegetarian?
Sample Problem
Use the given two-way relative frequency table to answer the following questions:

<table>
<thead>
<tr>
<th>Has diabetes</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does't have diabetes</td>
<td>4.55%</td>
<td>86.45%</td>
<td>91%</td>
</tr>
<tr>
<td>Has diabetes</td>
<td>7.2%</td>
<td>1.8%</td>
<td>9%</td>
</tr>
</tbody>
</table>

a) What is the ratio of true positives to false positives?

b) What is the likelihood that a person who tested positive has diabetes?

c) What is the probability that a person who tested positive does not have diabetes?