- Snapshot of Standards w/timeline
- Sample Pacing Guide (1st, 2nd Semester and year at a glance)
  - 1st Nine Weeks: Essential Questions & Academic Vocabulary
  - 2nd Nine Weeks: Essential Questions & Academic Vocabulary
  - 3rd Nine Weeks: Essential Questions & Academic Vocabulary
  - 4th Nine Weeks: Essential Questions & Academic Vocabulary
- Unpacking Document: Math I with RESOURCES
  - Unpacking Document: 8th Grade with RESOURCES
  - Released EOC
  - EOC Prep
  - EOC Percentages and Weighted Distribution
  - 8 Mathematical Practices
  - MENU of RESOURCES
  - Video Links
  - Assessment Options
  - STEM / Project Based Learning Links

Math eBook

Spiral Warm-ups

ONSLOW COUNTY SCHOOLS

2017-2018

Standard Division Document

Math I (Grade 8)

First Nine Weeks
SNAPSHOT

Major Concepts: Number systems, Scientific Notation, Solving one variable, Functions notation, Linear equations & functions

Standards:

8.NS.1 8.NS.2 8.EE.2	8.EE.1 8.EE.3 8.EE.4	8.EE.7 , a, b CED.1 CED.4 REI.1 REI.3	8.F.1 8.F.3 8.F.4 8.EE.5 8.EE.6 BF.2 SSE.1a SSE.1b IF.1 IF.2 IF.3 IF.4 IF.5 IF.6	8.F.2 8.F.5 LE.5 IF.5 CED.1 CED.2 REI.10 IF.7 IF.9 IF.3 *BF.1a	8.SP.1 8.SP.2 8.SP.3 LE.1 ID.6a ID.6b ID.7 ID.8 ID.9	8.EE.8 CED.3 REI.5 REI.6 REI.11 REI.12	8.EE.1 RN.2	SSE.1a CED.1 CED.2 IF.2 IF.3 IF.4 IF.5 IF.6 IF.7 *IF.8b IF.9 LE.1 LE.3 LE.5 ID.6c *BF.1a *BF.1b BF.2	APR.1 SSE.1a	SSE.1a SSE.1b SSE.3 APR.3 REI.1 REI.4 CED.1 CED.2 IF.2 IF.4 IF.5 IF.6 IF.7 * IF.8a IF.9 *BF.1b LE.3	8.SP.4 ID.1 ID.2 ID.3	8.G.3 8.G.6 8.G.7 8.G.8 GPE.4 GPE.5 GPE.6	REVIEW & Close-out
7 days	7 days	6 days	9 days	14 days	12 days	11 days	4 days	19 days	18 days	29 days	13 days	9 days	22 days

Second Nine Weeks
SNAPSHOT

Major Concept: Scatter Plots, Solving Systems of Equations & Inequalities, exponent rules, Exponential Functions, Geometric sequences.

Standards:

Third Nine Weeks
SNAPSHOT

Major Concept: Operations with polynomials, quadratic functions.

Standards:

Fourth Nine Weeks
SNAPSHOT

Major Concept: Wrap up Quadratics, One variable statistics, Coordinate geometry, Prep for and administer EOG & EOC.

Standards:

*Power Standards

Return to Main Menu

NC.M1.N-RN.2

Extend the properties of exponents.

Rewrite algebraic expressions with integer exponents using the properties of exponents.

Concepts and Skills
Pre-requisite
• Using the properties of exponents to create equivalent numerical expressions (8.EE.1)
Connections
• Use operations to rewrite polynomial expressions (NC.M1.A-APR.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 7 – Look for and make use of structure 8 – Look for and express regularity in repeated reasoning
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Vocabulary – base, exponent, index Students should be able to justify their steps in rewriting algebraic expressions.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students extend the properties of integer exponents learned in middle school with numerical expressions to algebraic expressions. The process of "simplifying square roots" is not an expectation for Math 1 students In Math 2, students will extend the properties of exponents to rational exponents and rewrite, "simplify" all square roots.	Students should be able to use the properties of exponents to write expression into equivalent forms. **Example:** Rewrite the following with positive exponents: a) $(8x^{-4}y^3)(-2x^5y^{-6})^2$ b) $\frac{(3m^2p^{-2}q)^3}{9m^{-3}q^3}$ Students should be able to use the new skills of applying the properties of exponents with skills learned in previous courses. **Example:** Simplify: $\sqrt{25m^{14}p^2t^4}$ *In 8th grade, students learned to evaluate the square roots of perfect squares and the cube root of perfect cubes. In Math 1, students can combine this previous skill with algebraic expressions. When addressing a problem like this in Math 1, students should be taught to rewrite the expression using the properties of exponents and then using inverse operations to rewrite. For example,* $\sqrt{m^{14}} = \sqrt{(m^7)^2} = m^7$. *In Math 1, the limitation from 8th grade of evaluating square roots of perfect squares and cube root of perfect cubes still applies.*

Instructional Resources	
Tasks	**Additional Resources**
Raising to the Zero and Negative Power (Illustrative Mathematics) NEW	

Snapshot Overview **Return to Main Menu**

Algebra, Functions & Function Families

NC Math 1	NC Math 2	NC Math 3
Functions represented as graphs, tables or verbal descriptions in context		
Focus on comparing properties of linear function to *specific* non-linear functions and rate of change. • Linear • Exponential • Quadratic	**Focus on properties of quadratic functions and an introduction to inverse functions through the inverse relationship between quadratic and square root functions.** • Quadratic • Square Root • Inverse Variation	**A focus on more complex functions** • Exponential • Logarithm • Rational functions w/ linear denominator • Polynomial w/ degree $\leq$ three • Absolute Value and Piecewise • Intro to Trigonometric Functions
A Progression of Learning of Functions through Algebraic Reasoning		
The conceptual categories of Algebra and Functions are inter-related. Functions describe situations in which one quantity varies with another. The difference between the Function standards and the Algebra standards is that the Function standards focus more on the characteristics of functions (e.g. domain/range or max/min points), function definition, etc. whereas the Algebra standards provide the computational tools and understandings that students need to explore specific instances of functions. As students progress through high school, the coursework with specific families of functions and algebraic manipulation evolve. Rewriting algebraic expressions to create equivalent expressions relates to how the symbolic representation can be manipulated to reveal features of the graphical representation of a function. **Note:** The Numbers conceptual category also relates to the Algebra and Functions conceptual categories. As students become more fluent with their work within particular function families, they explore more of the number system. For example, as students continue the study of quadratic equations and functions in Math 2, they begin to explore the complex solutions. Additionally, algebraic manipulation within the real number system is an important skill to creating equivalent expressions from existing functions.		

Snapshot Overview

Return to Main Menu

Algebra – Seeing Structure in Expressions
NC.M1.A-SSE.1a
Interpret the structure of expressions.
Interpret expressions that represent a quantity in terms of its context.

a. Identify and interpret parts of a linear, exponential, or quadratic expression, including terms, factors, coefficients, and exponents.

Concepts and Skills	The Standards for Mathematical Practices
Pre-requisite • Identify parts of an expression using precise vocabulary (6.EE.2b) • Interpret numerical expressions written in scientific notation (8.EE.4) • For linear and constant terms in functions, interpret the rate of change and the initial value (8.F.4)	**Connections** *Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.* 2 – Reason abstractly and quantitatively. 4 – Model with mathematics 7 – Look for and make use of structure.
Connections • Creating one and two variable equations (NC.M1.A-CED.1, NC.M1.A-CED.2, NC.M1.A-CED.3) • Interpreting part of a function to a context (NC.M1.F-IF.2, NC.M1.F-IF.4, NC.M1.F-IF5, NC.M1.F-IF.7, NC.M1.F-IF.9) • Interpreting changes in the parameters of a linear and exponential function in context (NC.M1.F-LE.5)	**Disciplinary Literacy** *As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.* New Vocabulary: Quadratic term, exponential term

Mastering the Standard

Comprehending the Standard	Assessing for Understanding
The set of A-SSE standards requires students: • to write expressions in equivalent forms to reveal key quantities in terms of its context. • to choose and use appropriate mathematics to analyze situations. For this part of the standards, students recognize that the linear expression $mx + b$ has two terms, that *m* is a coefficient, and *b* is a constant. Students are expected to recognize the parts of a quadratic expression, such as the quadratic, linear and constant term, or factors. For exponential expressions, students should recognize factors, the base, and exponent(s). Students extend beyond simplifying to interpret the components of an algebraic expression.	Students should recognize that in the expression $2x + 1$, "2" is the coefficient, "2" and "*x*" are factors, and "1" is a constant, as well as "2*x*" and "1" being terms of the binomial expression. Also, a student recognizes that in the expression $4(3)^x$, 4 is the coefficient, 3 is the factor, and *x* is the exponent. Development and proper use of mathematical language is an important building block for future content. Using real-world context examples, the nature of algebraic expressions can be explored. **Example**: The height *(in feet)* of a balloon filled with helium can be expressed by $5 + 6.3s$ where *s* is the number of seconds since the balloon was released. Identify and interpret the terms and coefficients of the expression. **Example:** The expression $-4.9t^2 + 17t + 0.6$ describes the height in meters of a basketball *t* seconds after it has been thrown vertically into the air. Interpret the terms and coefficients of the expression in the context of this situation. **Example:** The expression $35000(0.87)^t$ describes the cost of a new car *t* years after it has been purchased. Interpret the terms and coefficients of the expression in the context of this situation. **Return to Main Menu**

Snapshot Overview

Instructional Resources	
Tasks	**Additional Resources**
Delivery Trucks (Illustrative Mathematics)	Interpreting Algebraic Expressions (Mathematics Assessment Project – FAL)

Return to Main Menu

NC.M1.A-SSE.1b

Interpret the structure of expressions.

Interpret expressions that represent a quantity in terms of its context.

b. Interpret a linear, exponential, or quadratic expression made of multiple parts as a combination of entities to give meaning to an expression.

Concepts and Skills
Pre-requisite
• Interpret a sum, difference, product, and quotient as a both a whole and as a composition of parts (6.EE.2b) • Understand that rewriting expressions into equivalent forms can reveal other relationships between quantities (7.EE.2) • Interpret numerical expressions written in scientific notation (8.EE.4)
Connections
• Factor to reveal the zeros of functions and solutions to quadratic equations (NC.M1.A.SSE.3) • Creating one and two variable equations (NC.M1.A-CED.1, NC.M1.A-CED.2, NC.M1.A-CED.3) • Interpreting part of a function to a context (NC.M1.F-IF.2, NC.M1.F-IF.4, NC.M1.F-IF5, NC.M1.F-IF.7, NC.M1.F-IF.9) • Interpreting changes in the parameters of a linear and exponential function in context (NC.M1.F-LE.5)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 2 – Reason abstractly and quantitatively. 4 – Model with mathematics 7 – Look for and make use of structure.
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. New Vocabulary: exponential expression, quadratic expression

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
The set of A-SSE standards requires students: • to write expressions in equivalent forms to reveal key quantities in terms of its context. • to choose and use appropriate mathematics to analyze situations.	Students should understand that working with unsimplified expressions often reveals key information from a context. **Example**: The expression $20(4x) + 500$ represents the cost in dollars of the materials and labor needed to build a square fence with side length *x* feet around a playground. Interpret the constants and coefficients of the expression in context. **Example**: A rectangle has a length that is 2 units longer than the width. If the width is increased by 4 units and the length increased by 3 units, write two equivalent expressions for the area of the rectangle.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students identify parts of an expression as a single quantity and interpret the parts in terms of their context.	***Solution**: The area of the rectangle is $(x+5)(x+4) = x^2 + 9x + 20$. Students should recognize $(x+5)$ as the length of the modified rectangle and $(x+4)$ as the width. Students can also interpret $x^2 + 9x + 20$ as the sum of the three areas (a square with side length x, a rectangle with side lengths 9 and x, and another rectangle with area 20 that have the same total area as the modified rectangle.* **Example**: Given that income from a concert is the price of a ticket times each person in attendance, consider the equation $I = 4000p - 250p^2$ that represents income from a concert where p is the price per ticket. What expression could represent the number of people in attendance? ***Solution:** The equivalent factored form, $p\,(4000 - 250p)$, shows that the income can be interpreted as the price times the number of people in attendance based on the price charged. Students recognize $(4000 - 250p)$ as a single quantity for the number of people in attendance.* **Example**: The expression $10{,}000(1.055)^n$ is the amount of money in an investment account with interest compounded annually for *n* years. Determine the initial investment and the annual interest rate. ***Note**: The factor of* 1.055 *can be rewritten as* $(1 + 0.055)$, *revealing the growth rate of* 5.5% *per year.*

Instructional Resources	
Tasks	**Additional Resources**
	FAL: Generating Polynomials from Patterns (Math Assessment Project) NEW

Snapshot Overview

Return to Main Menu

NC.M1.A-SSE.3

Write expressions in equivalent forms to solve problems.

Write an equivalent form of a quadratic expression by factoring, where a is an integer of the quadratic expression, $ax^2 + bx + c$, to reveal the solutions of the equation or the zeros of the function the expression defines.

Concepts and Skills
Pre-requisite
• Factoring and expanding linear expressions with rational coefficients (7.EE.1) • Understand that rewriting expressions into equivalent forms can reveal other relationships between quantities (7.EE.2)
Connections
• Interpreting the factors in context (NC.M1.A-SSE.1b) • Understanding the relationship between factors, solutions, and zeros (NC.M1.A-APR.3) • Solving quadratic equations (NC.M1.A-REI.4) • Rewriting quadratic functions into different forms to show key features of the function (NC.M1.F-IF.8a)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 7 – Look for and make use of structure.
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to compare and contrast the zeros of a function and the solutions of a function. New Vocabulary: quadratic expression, zeros, linear factors

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students factor a quadratic in the form $ax^2 + bx + c$ where a is an integer in order to reveal the zeroes of the quadratic function. Students use the linear factors of a quadratic function to explain the meaning of the zeros of quadratic functions and the solutions to quadratic equations in a real-world problem.	Students should understand that the reasoning behind rewriting quadratic expressions into factored form is to reveal different key features of a quadratic function, namely the zeros/x-intercepts. **Example:** The expression $-4x^2 + 8x + 12$ represents the height of a coconut thrown from a person in a tree to a basket on the ground where *x* is the number of seconds. a. Rewrite the expression to reveal the linear factors. b. Identify the zeroes and intercepts of the expression and interpret what they mean in regard to the context. c. How long is the ball in the air? **Example:** Part A: Three equivalent equations for $f(x)$ are shown. Select the form that reveals the zeros of $f(x)$ without changing the form of the equation. $f(x) = -2x^2 + 24x - 54$ $f(x) = -2(x-3)(x-9)$ $f(x) = -2(x-6)^2 + 18$

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	Part B: Select all values of x for which $f(x) = 0$. $-54, -18, -9, -6, -3, 0, 3, 6, 9, 18, 54$ (from the *Smarter Balanced Assessment Consortium*) Students should understand that the reasoning behind rewriting quadratic expressions into factored form is to reveal the solutions to quadratic equations. **Example:** A vacant rectangular lot is being turned into a community vegetable garden with a uniform path around it. The area of the lot is represented by $4x^2 + 40x - 44$ where x is the width of the path in meters. Find the width of the path surrounding the garden.

Instructional Resources	
Tasks	**Additional Resources**
Graphs of Quadratic Functions (Illustrative Mathematics) NEW	

Snapshot Overview

Return to Main Menu

Algebra – Arithmetic with Polynomial Expressions

NC.M1.A-APR.1

Perform arithmetic operations on polynomials.

Build an understanding that operations with polynomials are comparable to operations with integers by adding and subtracting quadratic expressions and by adding, subtracting, and multiplying linear expressions.

Concepts and Skills

Pre-requisite

- Add, subtract, factor and expand linear expressions (7.EE.1)
- Understand that rewriting expressions into equivalent forms can reveal other relationships between quantities (7.EE.2)

Connections

- Rewrite expressions using the properties of exponents (NC.M1.N-RN.2)
- Understanding the process of elimination (NC.M1.A-REI.5)
- Rewrite a quadratic function to reveal key features (NC.M1.F-IF.8a)
- Building functions to model a relationship (NC.M1.F-BF.1b)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

2 – Reason abstractly and quantitatively

7 – Look for and make use of structure

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to compare operations with polynomials to operations with integers.

New Vocabulary: polynomial, quadratic expression

Mastering the Standard

Comprehending the Standard

Students connect their knowledge of integer operations to polynomial operations.

At the Math 1 level, students are only responsible for the following operations:

- adding and subtracting quadratic expressions
- adding, subtracting, and multiplying linear expressions

Assessing for Understanding

Students should be able to rewrite polynomial expressions using the properties of operations.

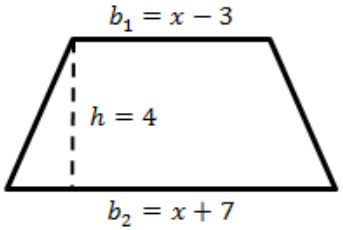
Example: Write at least two equivalent expressions for the area of the circle with a radius of $5x - 2$ kilometers.

Example: Simplify each of the following:

a. $(4x + 3) - (2x + 1)$

b. $(x^2 + 5x - 9) + 2x(4x - 3)$

Example: The area of a trapezoid is found using the formula $A = \frac{1}{2}h(b_1 + b_2)$, where A is the area, h is the height, and b_1 and b_2 are the lengths of the bases.



Snapshot Overview

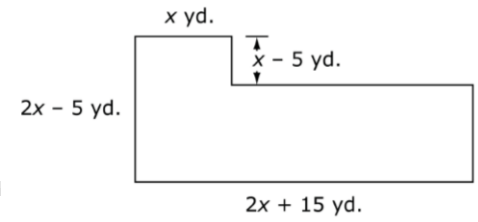
Return to Main Menu

What is the area of the above trapezoid?

A) $A = 4x + 2$
B) $A = 4x + 8$
C) $A = 2x^2 + 4x - 21$
D) $A = 2x^2 + 8x - 42$

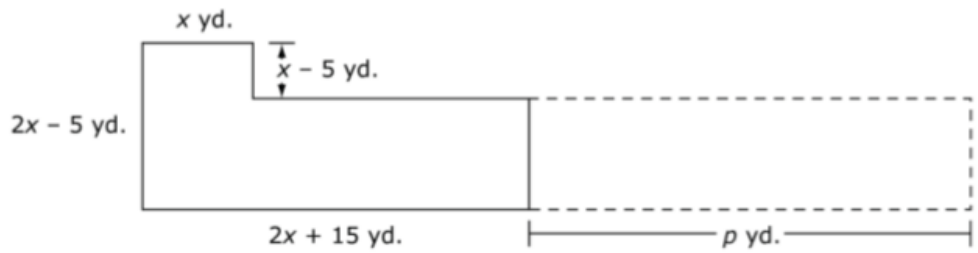
(*NCDPI Math I released EOC #33*)

Example: A town council plans to build a public parking lot. The outline below represents the proposed shape of the parking lot.



a) Write an expression for the area, in square feet, of this proposed parking lot. Explain the reasoning you used to find the expression.

b) The town council has plans to double the area of the parking lot in a few years. They plan to increase the length of the base of the parking lot by p yards, as shown in the diagram below.



Write an expression in terms of *x* to represent the value of *p*, in feet. Explain the reasoning you used to find the value of *p*.

Example: A cardboard box as a height of *x*, a width that is 3 units longer than the height, and a length that is 2 units longer than the width. Write an expression in terms of *x* to represent the volume of the box.

Instructional Resources	
Tasks	**Additional Resources**
	FAL: Generating Polynomials from Patterns (Math Assessment Project) NEW

Snapshot Overview **Return to Main Menu**

NC.M1.A-APR.3

Understand the relationship between zeros and factors of polynomials.

Understand the relationships among the factors of a quadratic expression, the solutions of a quadratic equation, and the zeros of a quadratic function.

Concepts and Skills

Pre-requisite

- Understand that is the product is zero, at least one of the factors is zero (3.OA.7)

Connections

- Factor quadratic expressions to reveal zeros of functions and solutions to equations (NC.M1.A-SSE.3)
- Justify the steps in solving a quadratic equation (NC.M1.A-REI.1)
- Solving quadratic equations (NC.M1.A-REI.4)
- Factor quadratic functions to reveal key features (NC.M1.F-IF.8)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

2 – Reason abstractly and quantitatively

7 – Look for and make use of structure

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to compare solutions functions to solutions of equations.

New Vocabulary: quadratic expression, quadratic equation, quadratic function, zeroes, linear factors, roots

Mastering the Standard

Comprehending the Standard

The focus of this standard is for students to use the multiplicative property of zero to create linear factors given a quadratic equation, and to solve those linear factors to find a zero of a function or a solution of an equation.

This standard should be taught with NC.M1.A-SSE.3 and NC.M1.A-REI.1.

Students can find the solutions of a factorable quadratic equation and use the roots to sketch its x –intercepts on the graph.

Assessing for Understanding

Students should be able to explain how they go from factored form to identifying the zeros of the function.

Example: Given the function $y = 2x^2 + 6x - 3$, list the zeroes of the function and sketch its graph.

Example: Sketch the graph of the function $f(x) = (x + 5)^2$. How many zeros does this function have? Explain.

Note: It is a common error for students to assume that the solution or zero of linear factor, $(x - b)$, will always be the opposite of the constant term, b. If this is noticed, be sure to include examples in which $a \neq 1$.

Example: Which of the following are the solutions to the equation $x^2 - 13x = 30$?

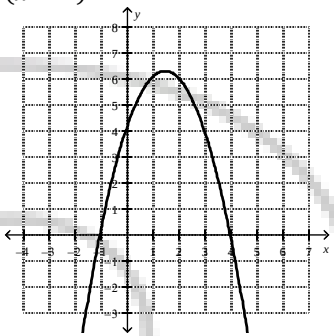
A) $x = -10 \,\&\, 3$
B) $x = 10 \,\&\, -3$
C) $x = -15 \,\&\, 2$
D) $x = 15 \,\&\, -2$

Snapshot Overview

Return to Main Menu

Example: Which of the following has the largest x-intercept?

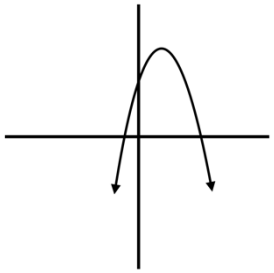
A) $x^2 + 4x - 12$
B) $(x + 2)(x - 5)$
C) $(x - 1)^2 - 4$
D)



Students should understand the relationship between zeros/solutions and the quadratic expression.

Example: If the zeros of a function are $x = 2$ and $x = 7$, what was the function? Could there be more than one answer?

Example: Based on the graph below, which of the following functions could have produced the graph?



A) $f(x) = (x + 2)(x + 6)$
B) $f(x) = (x - 2)(x + 6)$
C) $f(x) = (2 - x)(6 - x)$
D) $f(x) = (2 + x)(6 - x)$

Instructional Resources	
Tasks	**Additional Resources**
Quadratics Performance Task – 2006 (Inside Mathematics) NEW	Match My Parabola (Desmos) NEW
Snapshot Overview	Building Connections (Illuminations) NEW

Return to Main Menu

NC.M1.A-CED.1

Create equations that describe numbers or relationships.

Create equations and inequalities in one variable that represent linear, exponential, and quadratic relationships and use them to solve problems.

Concepts and Skills
Pre-requisite
• Create two-step linear equations and inequalities from a context (7.EE.4)
Connections
• Interpret parts of an expression in context (NC.M1.A-SSE.1a,b) • Justify a chosen solution method and each step of a that process (NC.M1.A-REI.1) • Solve linear and quadratic equations and linear inequalities (NC.M1.A-REI.3, NC.M1.A-REI.4) • Solve linear, exponential and quadratic equations using tables and graphs (NC.M1.A-REI.11) • Represent the solutions of linear inequalities on a graph (NC.M1.A-REI.12)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 7 – Look for and make use of structure
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to describe the origins of created equations and inequalities and demonstrate its relation to the context. New Vocabulary: exponential function, quadratic function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students create equations and inequalities in one-variable and use them to solve problems. In Math I, focus on linear, quadratic, and exponential contextual situations that students can use to create equations and inequalities in one variable and use them to solve problems. It is also important to note that equations can be created from an associated function when a given value is substituted in for either the independent or dependent variable. After the students have created an equation, they can use other representations to assist in	Students should be able to create an equation from a function and use the equation to solve problems. **Example:** A government buys x fighter planes at z dollars each, and y tons of wheat at w dollars each. It spends a total of B dollars, where $B = xz + yw$. In (a)–(c), write an equation whose solution is the given quantity. a) The number of tons of wheat the government can afford to buy if it spends a total of \$100 million, wheat costs \$300 per ton, and it must buy 5 fighter planes at \$15 million each. b) The price of fighter planes if the government bought 3 of them, in addition to 10,000 tons of wheat at \$500 a ton, for a total of \$50 million. c) The price of a ton of wheat, given that a fighter plane costs 100,000times as much as a ton of wheat, and that the government bought 20 fighter planes and 15,000 tons of wheat for a total cost of \$90 million. (https://www.illustrativemathematics.org/content-standards/HSA/CED/A/1/tasks/580) **Example:** A ball thrown vertically upward at an initial velocity of v_0 ft/sec rises a distance d feet in t seconds, given by $d = 6 + v_0 t - 16t^2$. Write an equation whose solution is:

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
solving problems, such as graphs and tables. For quadratic and exponential inequalities, the focus of this standard is to create the inequality and use that inequality to solve a problem. Solving these inequalities algebraically is *not* part of the standard. Once a student has the inequality, the student can use a table or graph to find a solution to the problem. Students in Math 1 are not responsible for using interval notation to represent a solution. They are to write answers to these inequalities using inequality notation.	a) The time it takes a ball thrown at a speed of 88 ft/sec to rise 20 feet. b) The speed with which the ball must be thrown to rise 20 feet in 2 seconds. (https://www.illustrativemathematics.org/content-standards/HSA/CED/A/2/tasks/437) Students should be able to create equations from various representations, such as verbal descriptions, and use them to solve problems. **Example:** Mary and Jeff both have jobs at a baseball park selling bags of peanuts. They get paid $12 per game and $1.75 for each bag of peanuts they sell. Create equations, that when solved, would answer the following questions: a. How many bags of peanuts does Jeff need to sell to earn $54? b. How much will Mary earn if she sells 70 bags of peanuts at a game? c. How many bags of peanuts does Jeff need to sell to earn at least $68? **Example:** Phil purchases a used truck for $11,500. The value of the truck is expected to decrease by 20% each year. When will the truck first be worth less than $1,000? **Example:** Suppose a friend tells you she paid a total of $16,368 for a car, and you'd like to know the car's list price (the price before taxes) so that you can compare prices at various dealers. Find the list price of the car if your friend bought the car in: a) Arizona, where the sales tax is 6.6%. b) New York, where the sales tax is 8.25%. c) A state where the sales tax is r. (https://www.illustrativemathematics.org/content-standards/HSA/CED/A/1/tasks/582) Students should be able to create inequalities and use those inequalities to solve problems. (Students are not expected to solve quadratic and exponential inequalities algebraically. Students should use technology, tables and graphs to solve problems.) **Example:** Stephen wants to create a landscaping feature in the shape of a parallelogram in his yard. Stephen has 200 square feet of mulch available for the project. To be most pleasing to the eye, he decides that he wants the length of the parallelogram to be 3 more than twice the width, measured in feet. If Stephen intends to cover the entire landscape feature in mulch, what can the width of the parallelogram be?

Instructional Resources	
Tasks	**Additional Resources**
Planes and Wheat (Illustrative Mathematics) Throwing a Ball (Illustrative Mathematics) Buying a Car (Illustrative Mathematics)	

NC.M1.A-CED.2

Create equations that describe numbers or relationships.

Create and graph equations in two variables to represent linear, exponential, and quadratic relationships between quantities.

Concepts and Skills
Pre-requisite
• Construct a linear function that models the relationship between two quantities (8.F.4) • Graph linear equations (8.EE.6) • The graph of a function is the set of ordered pairs consisting of input and a corresponding output (8.F.1) • Understand that the graph of a two-variable equation represents the set of all solutions to the equation (NC.M1.A-REI.10)
Connections
• Interpret parts of an expression in context (NC.M1.A-SSE.1a,b) • Creating linear equations for a system (NC.M1.A-CED.3) • Solving for a variable of interest in a formula (NC.M1.A-CED.4) • The graph a function f is the graph of the equation $y = f(x)$ (NC.M1.F-IF.1) • Interpret a function's domain and range in context (NC.M1.F-IF.5) • Identify key features of linear, exponential and quadratic functions (NC.M1.F-IF.7) • Building a function through patterns or by combining other functions (NC.M1.F-BF.1a , NC.M1.F-BF.1b)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 6 – Attend to precision 7 – Look for and make use of structure
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to describe the origins of created equations and demonstrate its relation to the context. New Vocabulary: exponential function, quadratic function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students create equations in two variables. Students graph equations on coordinate axes with labels and scales clearly labeling the axes defining what the values on the axes represent and the unit of measure. Students also select intervals for the scale that are appropriate for the context and display	Students should be able to create two variable equations from various representations, such as verbal descriptions, and use them to solve problems. **Example:** The larger leg of a right triangle is 3 cm longer than its smaller leg. The hypotenuse is 6 cm longer than the smaller leg. How many centimeters long is the smaller leg? (NCDPI Math 1 released EOC #13) **Example:** The floor of a rectangular cage has a length 4 feet greater than its width, w. James will increase both dimensions of the floor by 2 feet. Which equation represents the new area, N, of the floor of the cage?

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
adequate information about the relationship. Students interpret the context and choose appropriate minimum and maximum values for a graph. In Math I, focus on linear, exponential and quadratic **contextual** situations for students to create equations in two variables. While students will only be asked to rewrite expressions with integer exponents, in exponential functions, the domain is not restricted and students should use technology to understand the continuity of exponential functions.	a) $N = w^2 + 4w$ b) $N = w^2 + 6w$ c) $N = w^2 + 6w + 8$ d) $N = w^2 + 8w + 12$ (NCDPI Math I released EOC #5) Students should be able to create two variable equations, graph the relationship, and use graph to recognize key feature of the graph. **Example:** The FFA had a fundraiser by selling hot dogs for $1.50 and drinks for $2.00. Their total sales were $400. a. Write an equation to calculate the total of $400 based on the hot dog and drink sales. b. Graph the relationship between hot dog sales and drink sales. Note: This make a good connection to NC.M1.F-IF.5 **Example:** In a woman's professional tennis tournament, the money a player wins depends on her finishing place in the standings. The first-place finisher wins half of $1,500,000 in total prize money. The second-place finisher wins half of what is left; then the third-place finisher wins half of that, and so on. a. Write a rule to calculate the actual prize money in dollars won by the player finishing in nth place, for any positive integer n. b. Graph the relationship between the first 10 finishers and the prize money in dollars. What pattern is indicated in the graph? What type of relationship exists between the two variables?

Instructional Resources	
Tasks	**Additional Resources**
Hardwood Furniture (SBAC) NEW	Match My Line (DESMOS) Build a Bigger Field (DESMOS)

Snapshot Overview

Return to Main Menu

Algebra – Creating Equations

NC.M1.A-CED.3

Create equations that describe numbers or relationships.

Create systems of linear equations and inequalities to model situations in context.

Concepts and Skills

Pre-requisite

- Understanding a system of equations (8.EE.8)
- Creating linear equations in two variables (NC.M1.A-CED.2)

Connections

- Interpret parts of an expression in context (NC.M1.A-SSE.1a,b)
- Use tables, graphs and algebraic methods to solve systems of linear equations (NC.M1.A-REI.6)
- Represent the solution to a system of linear inequalities as a region of the plane (NC.M1.A-REI.12)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

4 – Model with mathematics

6 – Attend to precision

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to describe the origins of created equations and demonstrate its relation to the context.

Mastering the Standard

Comprehending the Standard

Students create a system of linear equations and inequalities that model real world situations.

The expectation for this standard is to create a system of linear equations or a system of linear inequalities that model a contextual situation. The system can include inequalities that limit the domain and range, if necessary.

Connect this standard to NC.M1.A-REI.11 & 12 for solving the system of linear equations algebraically and graphically and NC.M1.A-REI.12 for representing the solutions to a system of linear inequalities as a region of the plane.

Linear programming and optimization are not the intent of this standard. While it may be an extension of this standard and could be used as an application, it is not

Assessing for Understanding

Students should be able to write inequalities that describe the limitations from a context for a system of inequalities.

Example: A club is selling hats and jackets as a fundraiser. Their budget is $1500 and they want to order at least 250 items. They must buy at least as many hats as they buy jackets. Each hat costs $5 and each jacket costs $8.

a. Write a system of inequalities to represent the situation.
b. Graph the inequalities.
c. If the club buys 150 hats and 100 jackets, will the conditions be satisfied?
d. What is the maximum number of jackets they can buy and still meet the conditions?

Students should be able to write the system of equations based on context.

Example: The only coins that Alexis has are dimes and quarters.

- Her coins have a total value of $5.80.
- She has a total of 40 coins.

Which of the following systems of equations can be used to find the number of dimes, d, and the number of quarters, q, Alexis has?

(https://www.illustrativemathematics.org/content-standards/HSA/CED/A/3/tasks/220)

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
the expectation that students be fluent in maximizing or minimizing based on constraints.	

Instructional Resources	
Tasks	**Additional Resources**
Dimes and Quarters (Illustrative Mathematics)	Solutions to Systems of Equations (DESMOS) Solving Linear Equations in Two Variables (Mathematics Assessment Project)

Snapshot Overview

Return to Main Menu

Algebra – Creating Equations

NC.M1.A-CED.4

Create equations that describe numbers or relationships.

Solve for a quantity of interest in formulas used in science and mathematics using the same reasoning as in solving equations.

Concepts and Skills
Pre-requisite
• Solve linear equations in one variable (8.EE.7 and NC.M1.A-REI.3) • 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 (8.EE.2) • Justify a solution method and each step in the solving process (NC.M1.A-REI.1)
Connections
• Create an equation in two variables that represent a relationship between quantities (NC.M1.A-CED.2) • Justify a solving method and each step in the solving process (NC. M1.A-REI.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 7 – Look for and make use of structure
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to justify the steps in their solving process.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should be able to solve an equation for a given variable. In Math 1, focus on real mathematical and scientific formulas. This may be a good opportunity to collaborate with science teachers and ask them for formulas that they use often. This standard also covers solving for variables in mathematical forms as well as formulas. (Students are not expected to write linear equations into "proper" standard form.) This standard should be taught in conjunction with NC.M1.A-REI.1 in which students must justify each step of the solving process and justify a particular solving method.	Students should be able to solve for variables in mathematical forms as well as formulas. **Example:** Solve $(y - y_1) = m(x - x_1)$ for m. Students should be able to solve for variable in science and math formula. **Example:** Energy and mass are related by the formula $E = mc^2$. • m is the mass of the object • c is the speed of light Which equation finds m, given E and c? A) $m = E - c^2$ B) $m = Ec^2$ C) $m = \frac{c^2}{E}$ D) $m = \frac{E}{c^2}$ (NCDPI Math I released EOC #18)

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	Example: In each of the equations below, rewrite the equation, solving for the indicated variable. a) If F denotes a temperature in degrees Fahrenheit and C is the same temperature measured in degrees Celsius, then F and C are related by the equation $$F = 95C + 32.$$ Rewrite this expression to solve for C in terms of F. b) The surface area S of a sphere of radius r is given by $$S = 4\pi r^2.$$ Solve for r in terms of S. (https://www.illustrativemathematics.org/content-standards/HSA/CED/A/4/tasks/1828) **Example:** The equation for an object that is launched from the ground is given by $h(t) = -16t^2 + v_0 t$ where h is the height, t is the time, and v_0 is the initial velocity. What is the initial velocity of an object that is one-hundred feet off the ground four seconds after it is launched?

Instructional Resources	
Tasks	**Additional Resources**
Rewriting Equations (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.1

Understand solving equations as a process of reasoning and explain the reasoning.

Justify a chosen solution method and each step of the solving process for linear and quadratic equations using mathematical reasoning.

Concepts and Skills
Pre-requisite
• Students have been using properties of operations and equality throughout middle school. (6.EE.3, 7.EE.1, 7.EE.4). This is the first time that justification is required by a content standard. • Solve multi-step equations (8.EE.7)
Connections
• Understand the relationship between factors of a quadratic equation and the solution of the equation (NC.M1.A-APR.3) • Create and solve one variable linear and quadratic equations (NC.M1.A-CED.1) • Solve for a quantity of interest in a formula (NC.M1.A-CED.4) • Solve linear and quadratic equations and systems of linear equations (NC.M1.A-REI.3, NC.M1.A-REI.4, NC.M1.A-REI.5, NC.M1.A-REI.6)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct viable arguments and critique the reasoning of others
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to defend their method of solving an equation and each step of the solving process. New Vocabulary: quadratic equation

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
When solving equations, students will use the properties of equality to justify and explain each step obtained from the previous step, assuming the original equation has a solution, and develop an argument that justifies their method. Properties of operations can be used to change expressions on either side of the equation to equivalent expressions. In the properties of equality, adding the same term to both sides of an equation or multiplying	Students should be able to justify a chosen solution method and justify each step in the process. This would be a good opportunity to discuss efficiency.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**

both sides by a non-zero constant produces an equation with the same solutions.

Students do not have to name the property, but can describe the property using mathematical reasoning.

For example: Transforming $2x - 5 = 7$ to $2x = 12$ is possible because 5 = 5, so adding the same quantity to both sides of an equation makes the resulting equation true as well. *Knowing this is the Addition Property of Equality is not the point of this standard.*

Example: To the right are two methods to solve the same equation. Justify each step in the solving process. Which method do you prefer? Why?

Method 1:

$$5(x+3) - 3x = 55$$
$$5x + 15 - 3x = 55$$
$$2x + 15 = 55$$
$$2x + 15 - 15 = 55 - 15$$
$$2x = 40$$
$$\frac{2x}{2} = \frac{40}{2}$$
$$x = 20$$

Method 2:

$$5(x+3) - 3x = 55$$
$$\frac{5(x+3)}{5} - \frac{3x}{5} = \frac{55}{5}$$
$$x + 3 - \frac{3}{5}x = 11$$
$$\frac{2}{5}x + 3 = 11$$
$$\frac{2}{5}x + 3 - 3 = 11 - 3$$
$$\frac{2}{5}x = 8$$
$$\frac{5}{2}\left(\frac{2}{5}\right)x = \frac{5}{2}(8)$$
$$x = 20$$

Example: To the right are two methods for solving the equation $5x^2 + 10 = 90$. Select one of the solution methods and construct a viable argument for the use of the method.

$$5x^2 + 10 = 90$$
$$-10 = -10$$
$$5x^2 = 80$$
$$\frac{5x^2}{5} = \frac{80}{5}$$
$$x^2 = 16$$
$$x = \pm\sqrt{16}$$
$$x = 4 \text{ or } x = -4$$

$$5x^2 + 10 = 90$$
$$-90 = -90$$
$$5x^2 - 80 = 0$$
$$5(x^2 - 16) = 0$$
$$5(x+4)(x-4) = 0$$
$$x + 4 = 0 \text{ or } x - 4 = 0$$
$$x = 4 \text{ or } x = -4$$

Students should be able to critique the solving process of others, recognize incorrect steps and provide corrective action to the process.

Example: The following is a student solution to the inequality $\frac{5}{18} - \frac{x-2}{9} \leq \frac{x-4}{6}$.

$$\frac{5}{18} - \frac{x-2}{9} \leq \frac{x-4}{6}$$
$$\frac{5}{18} - \left(\frac{2}{2}\right)\frac{x-2}{9} \leq \left(\frac{3}{3}\right)\frac{x-4}{6}$$
$$\frac{5}{18} - \frac{2x-2}{18} \leq \frac{3x-4}{18}$$
$$5 - (2x-2) \leq 3x - 4$$
$$5 - 2x + 2 \leq 3x - 4$$
$$7 - 2x \leq 3x - 4$$
$$-5x \leq -11$$

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	$x \leq \frac{11}{5}$ a) There are two mathematical errors in this work. Identify at what step each mathematical error occurred and explain why it is mathematically incorrect. b) How would you help the student understand his mistakes? c) Solve the inequality correctly. (https://www.illustrativemathematics.org/content-standards/HSA/REI/A/1/tasks/807) Note: While this standard does not cover inequalities, this could be a good extension.

Instructional Resources	
Tasks	**Additional Resources**
Reasoning with Linear Inequalities (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.3

Solve equations and inequalities in one variable.

Solve linear equations and inequalities in one variable.

Concepts and Skills
Pre-requisite
• Solving multi-step equations (8.EE.7) • Solving two-step inequalities (7.EE.4)
Connections
• Create one variable linear equations and inequalities (NC.M1.A-CED.1) • Justify a solution methods and the steps in the solving process (NC.M3.A-REI.1) • Solve systems of linear equations (NC.M1.A-REI.6)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 1 – Make sense of problems and persevere in problem solving. 5 – Use appropriate tools strategically. 6 – Attend to precision. 7 – Look for and make use of structure. 8 – Look for and express regularity in repeated reasoning.
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to discuss their solution method and the steps in the solving process and should be able to interpret the solutions in context, when applicable.

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students are taught to solve multi-step equations in 8th grade. Students should become fluent solving multi-step equations in Math 1. Students were taught to solve two-step inequalities in 7th grade. In Math 1 students extend this skill to multi-step inequalities. This should be taught with the mathematical reasoning found in NC.M1.A-REI.1. Students should not be presented with a list of steps to solve a linear equation/inequality. Like many purely procedural practices, such steps are only effective for linear equations. It is more effective for students to be taught the mathematical reasoning for the solving process as these concepts can be applied to all types of equations. Teaching the process of solving linear equations and inequalities in conjunction with NC.M1.A-CED.1 (where students learn how to create linear equations in context) deepens students' knowledge of the purpose for solving.	Students should be able to solve multistep linear equations and inequalities. **Example:** Solve: • $\frac{7}{3}y - 8 = 111$ • $3x - 2 > 9 + 5x$ • $\frac{3+x}{7} = \frac{x-9}{4}$ • $\frac{2}{3}x + 9 < 8\left(\frac{1}{3}x - 2\right)$ • $\frac{1}{5}(10 - 20x) \leq -14$ **Example:** Jackson observed a graph with a y-intercept of 7 that passes through the point $(2, 3)$. What is the slope of the line of Jackson's graph?

Instructional Resources	
Tasks	**Additional Resources**
	Building and Solving Complex Equations (MAP FAL)

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.4

Solve equations and inequalities in one variable.

Solve for the real solutions of quadratic equations in one variable by taking square roots and factoring.

Concepts and Skills

Pre-requisite

- Factor linear expressions with rational coefficients (7.EE.1)
- Use square root to represent solutions to equations of the form $x^2 = p$, where p is a positive rational number; evaluate square roots of perfect squares (8.EE.2)
- Factor a quadratic expression to reveal the solution of a quadratic equation (NC.M1.A-SSE.3)
- Understand the relationship between linear factors and solutions (NC.M1.A-APR.3)

Connections

- Create one variable quadratic equations and inequalities and solve (NC.M1.A-CED.1)
- Justify a solution method and each step in the solution process (NC.M1.A-REI.1)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

6 – Attend to precision

7 – Look for a make use of structure

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to discuss their solution method and the steps in the solving process and should be able to interpret the solutions in context.

New Vocabulary: quadratic equation

Mastering the Standard

Comprehending the Standard

Students should focus on quadratics with one or two real solutions that can be solved by factoring or taking the square root.

This standard gives the algebraic reasoning of how to solve a quadratic equation to find the x –intercepts and zeroes that exist on the graph of the associated quadratic function.

This standard gives the "how" to solve a quadratic equation while NC.M1.A-APR.3 gives the "why". Therefore, these two standards should be taught together.

Students should be able to use the structure of the quadratic equation to determine whether to solve by using the square root as an inverse operation or by factoring.

Assessing for Understanding

Students should be able to solve quadratic equations using square root as the inverse operation.

Example: Solve:

- $x^2 = 49$
- $3x^2 + 9 = 72$

Students should be able to solve quadratic equations using factoring.

Example: Solve:

- $6x^2 + 13x = 5$

Students should be able to discuss their chosen solution method.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
When solving using the square root, students are only expected to evaluate perfect squares. All other square root solutions should either be left in square root form or estimated appropriately based on the context. Therefore, solving using the quadratic formula is not expected at this level.	**Example:** Stephen and Brianna are solving the quadratic equation, $(x-4)^2-25=0$, in a classroom activity. Stephen believes that the equation can be solving using a square root. Brianna disagrees, saying that it can be solve using by factoring. Who is correct? Be prepared to defend your position.

Instructional Resources	
Tasks	**Additional Resources**

Snapshot Overview

Return to Main Menu

Algebra – Reasoning with Equations and Inequalities

NC.M1.A-REI.5

Solve systems of equations.

Explain why replacing one equation in a system of linear equations by the sum of that equation and a multiple of the other produces a system with the same solutions.

Concepts and Skills

Pre-requisite

- Analyze and solve pairs of simultaneous linear equations by graphing and substitution (8.EE.8)
- Operations with polynomials (NC.M1.A-APR.1)
- Justify steps in a solving process (NC.M1.A-REI.1)

Connections

- Solving systems of equations and inequalities (NC.M1.A-REI.6)
- Understand that all points on the graph of an equation is a solution to that equation (NC.M1.A-REI.10)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

2 – Reason abstractly and quantitatively
3 – Construct a viable argument and critique the reasoning of others
7 – Look for and make use of structure

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.
Students should be able to explain why the process of elimination works.

New Vocabulary: elimination

Mastering the Standard

Comprehending the Standard

The focus of this standard is to explain a mathematical justification for the addition (elimination) method of solving systems of equations which ultimately transforms a given system of two equations into a simpler equivalent system that has the same solutions as the original system.

Students should use the properties of equality to discuss why the process of elimination maintains the same solutions.

- When an equation is multiplied by a constant the set of solutions remains the same. Graphically it is the same line.
- When two linear equations are added together, a third linear equation is formed that shares a common solution as the original equations. Graphically this means the three linear equations all intersect at the same point.
- The goal for process of elimination is to obtain the value for one of the coordinates of intersection. Graphically, it is to get

Assessing for Understanding

Students should be able to understand the process of elimination through simple intuitive problems.

Example: Given that the sum of two numbers is 10 and their difference is 4, what are the numbers? Explain how your answer can be deduced from the fact that the two numbers, x and y, satisfy the equations $x + y = 10$ and $x - y = 4$.

Students should be able to identify systems composed of equivalent equations.

Example: Which of the following systems is equivalent to $\begin{cases} x - 2y = 4 \\ 3x + y = 9 \end{cases}$?

A) $\begin{cases} x - 2y = 4 \\ 6x + 2y = 9 \end{cases}$

B) $\begin{cases} -3x + 6y = 4 \\ 3x + y = 9 \end{cases}$

C) $\begin{cases} x - 2y = 4 \\ 6x - 2y = 18 \end{cases}$

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
either a horizontal or vertical line that goes through the point of intersection.	D) $\begin{cases} \frac{1}{2}x - y = 2 \\ 3x + y = 9 \end{cases}$

Instructional Resources	
Tasks	**Additional Resources**
	Wafers and Crème (DESMOS)

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.6

Solve systems of equations.

Use tables, graphs, or algebraic methods (substitution and elimination) to find approximate or exact solutions to systems of linear equations and interpret solutions in terms of a context.

Concepts and Skills
Pre-requisite
• Analyze and solve pairs of simultaneous linear equations by graphing and substitution (8.EE.8) • Create equations for systems of equations (NC.M1.A-CED.3) • Justify the steps in a solving process (NC.M1.A-REI.1) • Solve linear equations in one variable (NC.M1.A-REI.3) • Understand the mathematical reasoning behind the process of elimination (NC.M1.A-REI.5) • Understand every point on a graph is a solution to its associated equation (NC.M1.A-REI.10)
Connections
• Understand the mathematical reasoning behind the methods of graphing, using tables and technology to solve systems and equations (NC.M1.A-REI.11) • Analyze linear functions (NC.M1.F-IF.7)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct a viable argument and critique the reasoning of others 6 – Attend to precision
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to discuss their solution method and the steps in the solving process and should be able to interpret the solutions in context. New Vocabulary: elimination

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students solve a system of equations and then interpret its solution for the given context. Students should be able to create and solve a system from a contextual situation. Therefore, this standard should be taught in conjunction to NC.M1.A-CED.3 Students should not be required to use one	Students should be able to create equations for system (NC.M1.A-CED.3), select an appropriate solution method, solve that system, and interpret the solution in context. **Example:** José had 4 times as many trading cards as Philippe. After José gave away 50 cards to his little brother and Philippe gave 5 cards to his friend for his birthday, they each had an equal number of cards. Write a system to describe the situation and solve the system.

Mastering the Standard

Comprehending the Standard	Assessing for Understanding
method over another when solving a system of equations, but should be allowed to choose the best option for the given scenario and justify their chosen solution method. The focus of this standards should also not be limited to the algebraic methods. Student were taught substitution and graphing methods in 8th grade. This is a capstone standard supported by several standards in this course. In order to have a complete understanding of this standard, these standards must be incorporated. • The ability to create equations for a system from a contextual situation is addressed in NC.M1.A-CED.3. • The understanding of the elimination method is addressed NC.M1.A-REI.5. • The understanding of solving a system by graphing and how to recognize a solution to a system in tables is taught in NC.M1.A-REI.11. Include cases where the two equations describe the same line (yielding infinitely many solutions) and cases where two equations describe parallel lines (yielding no solution); connect to NC.M1.G-GPE.5, which requires students to prove the slope criteria for parallel lines.	**Example:** A restaurant serves a vegetarian and a chicken lunch special each day. Each vegetarian special is the same price. Each chicken special is the same price. However, the price of the vegetarian special is different from the price of the chicken special. • On Thursday, the restaurant collected $467 selling 21 vegetarian specials and 40 chicken specials. • On Friday, the restaurant collected $484 selling 28 vegetarian specials and 36 chicken specials. What is the cost of each lunch special? **Example:** The math club sells candy bars and drinks during football games. • 60 candy bars and 110 drinks will sell for $265. • 120 candy bars and 90 drinks will sell for $270. How much does each candy bar sell for? (NCDPI Math 1 released EOC #7) **Example:** Two times Antonio's age plus three times Sarah's age equals 34. Sarah's age is also five times Antonio's age. How old is Sarah? (NCDPI Math 1 released EOC #10) **Example:** Lucy and Barbara began saving money the same week. The table below shows the models for the amount of money Lucy and Barbara had saved after x weeks. Lucy's Savings: $f(x) = 10x + 5$ Barbara's Savings: $g(x) = 7.5x + 25$ After how many weeks will Lucy and Barbara have the same amount of money saved? (NCDPI Math 1 released EOC #36) **Example:** A streaming movie service has three monthly plans to rent movies online. Graph the equation of each plan and analyze the change as the number of rentals increase. When is it beneficial to enroll in each of the plans? • Basic Plan: $3 per movie rental • Watchers Plan: $7 fee + $2 per movie with the first two movies included with the fee • Home Theater Plan: $12 fee + $1 per movie with the first four movies included with the fee

Instructional Resources

Tasks	Additional Resources
	Card Sort: Linear Systems (DESMOS)

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.10

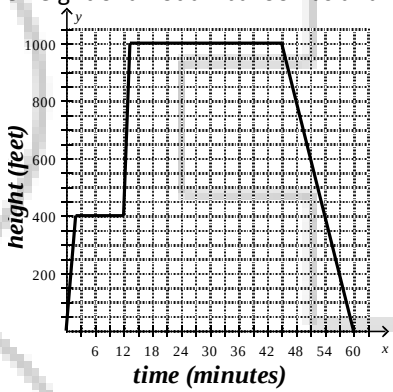
Represent and solve equations and inequalities graphically

Understand that the graph of a two-variable equation represents the set of all solutions to the equation.

Concepts and Skills
Pre-requisite
• Use substitution to determine if a number if a solution (6.EE.5) • Graphing lines (8.EE.5, 8.EE.6, 8.F.3) • Analyze and solve pairs of simultaneous linear equations by graphing and substitution (8.EE.8) • Understanding functions as a rule that assigns each input with exactly one output (8.F.1)
Connections
• Creating and graphing two-variable equations (NC.M1.A-CED.2) • Solutions to systems of equations (NC.M1.A-REI.5, NC.M1.A-REI.6) • Understanding that the relationship between the solution of system of equations and the associated equation (NC.M1.A-REI.11) • Representing the solutions to linear inequalities (NC.M1.A-REI.12) • Relating a function to its graph, domain and range of a function (NC.M1.F-IF.1, NC.M1.F-IF.2, NC.M1.F-IF.5)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct a viable argument and critique the reasoning of others
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to discuss the solutions to a two-variable equation and the link to a function.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students understand that the graph of an equation is the set of all ordered pairs that make that equation a true statement. This standard contains no limitation and so applies to all function types, including those functions that a student cannot yet algebraically manipulate. Students can explain and verify that every point (*x*, *y*) on the graph of an equation represents all values for *x* and *y* that make the equation true.	Students should be able to assess if a point is a solution to an equation. **Example:** Consider three points in the plane, $P = (-4,0), Q = (-1,12)$ and $R = (4,32)$. a) Find the equation of the line through P and Q. b) Use your equation in (a) to show that R is on the same line as P and Q. (https://www.illustrativemathematics.org/content-standards/HSA/REI/D/10/tasks/1066) **Example:** Which of the following points are on the graph of the equation $-5x + 2y = 20$? Which of the following points are of the graph of the equation? How do you know? a. (4, 0) b. (0, 10) c. (-1, 7.5)

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
In connection with NC.M1.F-IF.1, NC.M1.F-IF.2, NC.M1.F-IF.5, students can begin to understand how the context of a problem determines whether the solutions should be graphed discretely or continuously.	d. (2.3, 5) **Example:** Verify that $(-1, 60)$ is a solution to the equation $y = 15\left(\frac{1}{4}\right)^x$. Explain what this means for the graph of the function. **Example:** Without graphing, determine if the ordered pair $(2, -15)$ is on the graph of $y = 3x^2 + 2x - 1$. Explain. **Example:** The graph below shows the height of a hot air balloon as a function of time.  Use the graph to answer the following: a) What is the height of the hot air balloon 10 minutes after it has left the ground? b) Approximately, when will the hot air balloon reach a height of 600 feet? c) Explain what the point $(48, 800)$ on this graph represents.

Instructional Resources	
Tasks	**Additional Resources**
Collinear Points (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.11

Represent and solve equations and inequalities graphically

Build an understanding of why the *x*-coordinates of the points where the graphs of two linear, exponential, or quadratic equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$ and approximate solutions using a graphing technology or successive approximations with a table of values.

Concepts and Skills

Pre-requisite

- Solving multi-step linear equations (8.EE.7)
- Analyze and solve pairs of simultaneous linear equations by graphing and substitution (8.EE.8)
- Understand every point on a graph is a solution to its associated equation (NC.M1.A-REI.10)

Connections

- Creating and solving one variable equations and systems of equations (NC.M1.A-CED.1, NC.M1.A-CED.3)
- Solving systems of equations (NC.M1.A-REI.6)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

4 – Model with mathematics

6 – Attend to precision

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

New Vocabulary: exponential function, quadratic function

Mastering the Standard

Comprehending the Standard

For a complete understanding, students will need exposure to both parts of this standard.

First, students should be able to see the connection between graphs and tables of two functions, the points they have in common and the truthfulness of the equation.

For example:

x	$f(x) = 2x - 4$
0	-4
1	-2
2	0
3	2
4	4

x	$g(x) = \frac{1}{2}x + \frac{1}{2}$
0	.5
1	1
2	1.5
3	2
4	2.5

Assessing for Understanding

Example: The functions $f(m) = 18 + 0.4m$ and $g(m) = 11.2 + 0.54m$ give the lengths of two different springs in centimeters, as mass is added in grams, *m*, to each separately.

a) Graph each equation on the same set of axes.
b) What mass makes the springs the same length?
c) What is the length at that mass?
d) Write a sentence comparing the two springs.

Example: Solve the following equations by graphing. Give your answer to the nearest tenth.

a. $3(2^x) = 6x - 7$
b. $10x + 5 = -x + 8$

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Because $f(x) = g(x)$ when $x = 3$, 3 is the solution to the equation $2x - 4 = \frac{1}{2}x + \frac{1}{2}$ (As an extension, students could write an inequality to describe the relationship between the functions when $x < 3$ and when $x > 3$.) In Math 1, students are expected to solve linear systems of equations algebraically. All other systems should be solved with technology, tables, and graphs. Second, students should be able to use a system of equations to solve systems of equations. *For example:* Solve: $3x^2 - 2x + 1 = \frac{1}{2}x + 5$ Rewrite the equations as a system of equations $\begin{cases} f(x) = 3x^2 - 2x + 1 \\ g(x) = \frac{1}{2}x + 5 \end{cases}$ Using technology, graph the equations and look for points of intersection, where the same x produces $f(x) = g(x)$. In Math 1, students are expected to solve linear equations using inverse operations and quadratic equations with square roots and factoring. In all other equations, such as exponential equations, solutions should be approximated with technology, tables and graphs.	**Example:** The population of a country is initially 2 million people and is increasing at 4% per year. The country's annual food supply is initially adequate for 4 million people and is increasing at a constant rate adequate for an additional 0.5 million people per year. a) Based on these assumptions, in approximately what year will this country first experience shortages of food? b) If the country doubled its initial food supply and maintained a constant rate of increase in the supply adequate for an additional 0.5 million people per year, would shortages still occur? In approximately which year? c) If the country doubled the rate at which its food supply increases, in addition to doubling its initial food supply, would shortages still occur? (https://www.illustrativemathematics.org/content-standards/HSA/REI/D/11/tasks/645)

Instructional Resources	
Tasks	**Additional Resources**
Population and Food Supply (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

NC.M1.A-REI.12

Represent and solve equations and inequalities graphically

Represent the solutions of a linear inequality or a system of linear inequalities graphically as a region of the plane.

Concepts and Skills
Pre-requisite
• Solve two-step linear inequalities (7.EE.4b) • Solve linear inequalities in one variable (NC.M1.A-REI.3) • Understand every point on a graph is a solution to its associated equation (NC.M1.A-REI.10)
Connections
• Create one variable linear inequalities and use the inequality to solve problems (NC.M1.A-CED.1) • Create a system of linear inequalities to model a situation in context (NC.M1.A-CED.3)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 5 – Use appropriate tools strategically 6 – Attend to precision
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to explain the reasoning behind their graphical representation of an inequality or system of inequalities.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should understand that since there is no way to list every solution to a linear inequality in two variables, the solutions must be represented graphically. Similarly, we recognize linear inequalities to have infinitely many solutions. It is an American tradition to shade the region that represent the solutions of the inequality. In other countries, they shade regions of the plane that do <u>not</u> contain solutions, marking that region out. This results in an unmarked solution region making it easier to identify and work with points in the solution region. This means that it is important for students to understand	Students should be able to represent solutions to linear inequalities and systems of linear inequalities as a region of a plane. **Example:** Graph the solution set for the following system of inequalities: $3x + 5y \leq 10$ $y > -4$ **Example:** Graph the system of linear inequalities below and determine if (3, 2) is a solution to the system. $x - 3y > 0$ $x + y \leq 2$ $x + 3y > -3$ **Example:** Graph the following inequalities: $3x - 4y \leq 7$ $y > -2x + 6$ $-9x + 4y \geq 1$

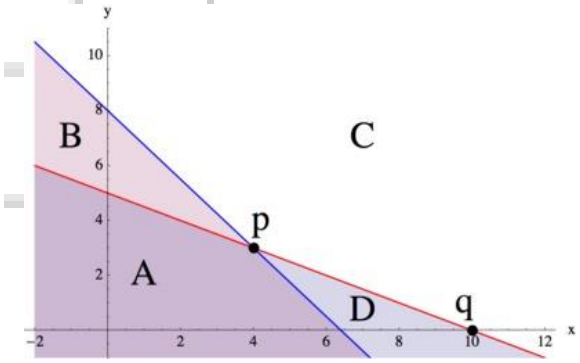
Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
what the shaded region represents according to the context of the problem.	

Example: Given below are the graphs of two lines, $y = -0.5x + 5$ and $y = -1.25x + 8$, and several regions and points are shown. Note that C is the region that appears completely white in the graph.

a. For each region and each point, write a system of equations or inequalities, using the given two lines, that has the region or point as its solution set and explain the choice of $\leq, \geq, or\ =$ in each case. (You may assume that the line is part of each region.)

b. The coordinates of a point within a region have to satisfy the corresponding system of inequalities. Verify this by picking a specific point in each region and showing that the coordinates of this point satisfy the corresponding system of inequalities for that region.

c. In the previous part, we checked that specific coordinate points satisfied our inequalities for each region. Without picking any specific numbers, use the same idea to explain how you know that all points in the 3rd quadrant must satisfy the inequalities for region A.



(https://www.illustrativemathematics.org/content-standards/HSA/REI/D/12/tasks/1205)

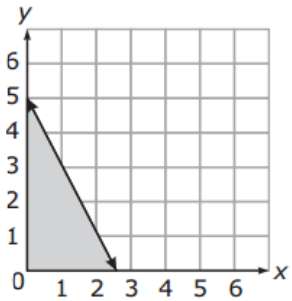
Example: What scenario could be modeled by the graph below? (multiple choice)

a) The number of pounds of apples, y, minus two times the number of pounds of oranges, x, is at most 5.

b) The number of pounds of apples, y, minus half the number of pounds of oranges, x, is at most 5.

c) The number of pounds of apples, y, plus two times the number of pounds of oranges, x, is at most 5.

d) The number of pounds of apples, y, plus half the number of pounds of oranges, x, is at most 5.



(NCDPI Math 1 released EOC #2)

Instructional Resources	
Tasks	**Additional Resources**
Solution Sets (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

Algebra, Functions & Function Families

NC Math 1	NC Math 2	NC Math 3
Functions represented as graphs, tables or verbal descriptions in context		
Focus on comparing properties of linear function to *specific* non-linear functions and rate of change. • Linear • Exponential • Quadratic	**Focus on properties of quadratic functions and an introduction to inverse functions through the inverse relationship between quadratic and square root functions.** • Quadratic • Square Root • Inverse Variation	**A focus on more complex functions** • Exponential • Logarithm • Rational functions w/ linear denominator • Polynomial w/ degree $\leq$ three • Absolute Value and Piecewise • Intro to Trigonometric Functions
A Progression of Learning of Functions through Algebraic Reasoning		
The conceptual categories of Algebra and Functions are inter-related. Functions describe situations in which one quantity varies with another. The difference between the Function standards and the Algebra standards is that the Function standards focus more on the characteristics of functions (e.g. domain/range or max/min points), function definition, etc. whereas the Algebra standards provide the computational tools and understandings that students need to explore specific instances of functions. As students progress through high school, the coursework with specific families of functions and algebraic manipulation evolve. Rewriting algebraic expressions to create equivalent expressions relates to how the symbolic representation can be manipulated to reveal features of the graphical representation of a function. **Note:** The Numbers conceptual category also relates to the Algebra and Functions conceptual categories. As students become more fluent with their work within particular function families, they explore more of the number system. For example, as students continue the study of quadratic equations and functions in Math 2, they begin to explore the complex solutions. Additionally, algebraic manipulation within the real number system is an important skill to creating equivalent expressions from existing functions.		

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.1

Understand the concept of a function and use function notation.

Build an understanding that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range by recognizing that:

- if f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x.
- the graph of f is the graph of the equation $y = f(x)$.

Concepts and Skills
Pre-requisite
• Understand that a function is a rule that assigns to each input exactly one output (8.F.1) • Every point on the graph of an equation is a solution to the equation (NC.M1.A-REI.10)
Connections
• Create and graph two variable equations (NC.M1.A-CED.2) • All other function standards

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 1 – Make sense of problems and persevere in solving them
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to accurate describe a function in their own terms. New Vocabulary: function notation

Mastering the Standard

Comprehending the Standard

Students should understand the definition of a function. It is deeper than just "x" cannot repeat or the vertical line test. Students should understand what it takes to be a function in categorical, numerical, and graphical scenarios.

In 8th grade, students studied the definition of a function. In Math 1, function notation is introduced. While this standard places a focus of the definition of a function on the correspondence of input and output values, a function can also be defined by how one

Assessing for Understanding

Students should be able to understand functions in categorical scenarios.

Example: A certain business keeps a database of information about its customers.

a. Let C be the rule which assigns to each customer shown in the table his or her home phone number. Is C a function? Explain your reasoning.
b. Let P be the rule which assigns to each phone number in the table above, the customer name(s) associated with it. Is P a function? Explain your reasoning.
c. Explain why a business would want to use a person's social security number as a way to identify a particular customer instead of their phone number.

Customer Name	Home Phone Number
Heather Baker	3105100091
Mike London	3105200256
Sue Green	3234132598
Bruce Swift	3234132598
Michelle Metz	2138061124

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
variable changes in relation to another variable. This view of a function is highlighted in other standards throughout Math 1 when students are asked to identify, interpret, and use the rate of change.	(https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/624) Students should be able to understand functions as a correspondence between inputs and outputs. **Example:** A pack of pencils cost \$0.75. If n number of packs are purchased, then the total purchase price is represented by the function $t(n) = 0.75n$. a. Explain why t is a function. b. What is a reasonable domain and range for the function t? **Example:** Suppose f is a function. a) If $10 = f(-4)$, give the coordinates of a point on the graph of f. b) If 6 is a solution of the equation $f(w) = 1$, give a point on the graph of f. (https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/630)

Instructional Resources	
Tasks	**Additional Resources**
The Customers (Illustrative Mathematics) Points on a Graph (Illustrative Mathematics)	Card Sort: Functions (DESMOS) Understanding Range (DESMOS)

Snapshot Overview **Return to Main Menu**

NC.M1.F-IF.2

Understand the concept of a function and use function notation.

Use function notation to evaluate linear, quadratic, and exponential functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Concepts and Skills
Pre-requisite
• Use substitution to determine if a number if a solution (6.EE.5) • Interpret parts of expressions in context (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b) • Every point on the graph of an equation is a solution to the equation (NC.M1.A-REI.10) • Define a function and use functions notation (NC.M1.F-IF.1)
Connections
• Creating and solving one variable equations (NC.M1.A-CED.1) • Creating and graphing two variable equations (NC.M1.A-CED.2) • Every point on the graph of an equation is a solution to the equation (NC.M1.A-REI.10) • Function standards that relate domain and range (NC.M1.F-IF.3, NC.M1.F-IF.4, NC.M1.F-IF.5, NC.M1.F-IF.7) • Comparing the end behavior of functions (NC.M1.F-LE.3)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 1 – Make sense of problems and persevere in solving them
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to discuss the domain, range, input, output and the relationship between the variables of a function in context. New Vocabulary: exponential function, quadratic function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should be fluent in using function notation to evaluate a linear, quadratic, and exponential function. Students should be able to interpret statements in function notation in contextual situations.	Students should be able to use evaluate functions written in function notation. **Example:** Evaluate $f(2)$ for the function $f(x) = 5(x-3)+17$. Evaluate $f(2)$ for the function $f(x) = 1200(1+.04)^x$. Evaluate $f(2)$ for the function $f(x) = 3x^2+2x-5$. Students should be able to evaluate functions and interpret the result in a context. **Example:** You placed a yam in the oven and, after 45 minutes, you take it out. Let f be the function that assigns to each minute after you placed the yam in the oven, its temperature in degrees Fahrenheit. Write a sentence for each of the following to explain what it means in everyday language. a) $f(0) = 65$

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	b) $f(5) < f(10)$ c) $f(40) = f(45)$ d) $f(45) > f(60)$ (https://www.illustrativemathematics.org/content-standards/HSF/IF/A/2/tasks/625) **Example:** The rule $f(x) = 50(0.85)^x$ represents the amount of a drug in milligrams, $f(x)$, which remains in the bloodstream after *x* hours. Evaluate and interpret each of the following: a) $f(0)$ b) $f(2) = k \cdot f(1)$. What is the value of k? c) $f(x) < 6$ ***Example:*** Suppose that the function $f(x) = 2x + 12$ represents the cost to rent x movies a month from an internet movie club. Makayla now has $10. How many more dollars does Makayla need to rent 7 movies next month? (NCDPI Math 1 released EOC #12) **Example:** Let $f(t)$ be the number of people, in millions, who own cell phones t years after 1990. Explain the meaning of the following statements. a) $f(10) = 100.3$ b) $f(a) = 20$ c) $f(20) = b$ d) $n = f(t)$ (https://www.illustrativemathematics.org/content-standards/HSF/IF/A/2/tasks/634)

Instructional Resources	
Tasks	**Additional Resources**
Yam in the Oven (Illustrative Mathematics) Cellphones (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.3

Understand the concept of a function and use function notation.

Recognize that recursively and explicitly defined sequences are functions whose domain is a subset of the integers, the terms of an arithmetic sequence are a subset of the range of a linear function, and the terms of a geometric sequence are a subset of the range of an exponential function.

Concepts and Skills
Pre-requisite
• Interpret the equation $y = mx + b$ as being from a linear function and compare to nonlinear functions (8.F.3) • Define a function and use functions notation (NC.M1.F-IF.1) • Evaluating functions (NC.M1.F-IF.2)
Connections
• Relating the domain and range to a context (NC.M1.F-IF.5) • Analyzing linear and exponential functions (NC.M1.F-IF.7) • Build linear and exponential functions (NC.M1.F-BF.1) • Translate between explicit and recursive forms (NC.M1.F-BF.2) • Identify situations that can be modeled with linear and exponential functions (NC.M1.F-LE.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 8 – Look for and express regularity in repeated reasoning
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to explain a function written in recursive form using subset notation. New Vocabulary: arithmetic sequence, geometric sequence, explicit form, recursive form, exponential function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should recognize that sequences are functions. A sequence can be described as a function, with the domain consisting of a subset of the integers, and the range being the terms of the sequence. This standard connects to arithmetic and geometric sequences and should be taught with NC.M1.F-BF.2. Emphasize that arithmetic and geometric sequences are examples of linear and exponential functions, respectively.	**Example:** A theater has 60 seats in the first row, 68 seats in the second row, 76 seats in the third row, and so on in the same increasing pattern. a) If the theater has 20 rows of seats, how many seats are in the twentieth row? b) Explain why the sequence is considered a function. c) What is the domain of the sequence? Explain what the domain represents in context. d) What is the range of the sequence? Explain what the range represents in context. **Example:** A geometric sequence can be represented by the exponential function $f(x) = 400\left(\frac{1}{2}\right)^x$. In terms of the geometric sequence, explain what $f(3) = 50$ represents.

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
It is important to note that sequences are not limited to arithmetic and geometric. It is expected that recursive form should be written in subset notation. Students should be familiar with writing and interpreting subset notation. Now-Next can be used a tool for introduce the concepts of recursive form, but the expectation is that students will move to the more formal representations of recursive form.	**Example:** Represent the following sequence in explicit form: 1, 4, 9, 16, 25 **Example:** The Fibonacci numbers are sequence that are often found in nature. This sequence is defined by $a_n = a_{n-1} + a_{n-2}$ where $a_0 = 0$ and $a_1 = 1$. What are the first 10 terms of the Fibonacci sequence? Could you easily represent this pattern in explicit form?

Instructional Resources	
Tasks	**Additional Resources**

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.4

Interpret functions that arise in applications in terms of the context.

Interpret key features of graphs, tables, and verbal descriptions in context to describe functions that arise in applications relating two quantities, including: intercepts; intervals where the function is increasing, decreasing, positive, or negative; and maximums and minimums.

Concepts and Skills
Pre-requisite
• Describe quantitatively the functional relationship between two quantities by analyzing a graph (8.F.5) • Define a function and use functions notation (NC.M1.F-IF.1) • Evaluating functions (NC.M1.F-IF.2)
Connections
• Interpret parts of expressions in context (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b) • Relate domain and range of a function to its graph (NC.M1.F-IF.5) • Calculate the average rate of change (NC.M1.F-IF.6) • Use equivalent forms of quadratic and exponential function to reveal key features (NC.M1.F-IF.8a, NC.M1.F-IF.8b) • Compare key features of two functions in different representations (NC.M1.F-IF.9) • Identify situations that can be modeled with linear and exponential functions (NC.M1.F-LE.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 1 – Make sense of problems and persevere in solving them 4 – Model with mathematics
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to justify their identification of key features and interpret those key features in context. New Vocabulary: maximum, minimum

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should understand the key features of any contextual situation. For example, plots over time represent functions as do some scatterplots. These are often functions that "tell a story" hence the portion of the standard that has students sketching graphs given a verbal description. Students should have experience with a wide variety of these types of functions and be flexible in thinking about functions	Students should be able to identify and interpret key features of functions. **Example:** An epidemic of influenza spreads through a city. The figure below is the graph of $I = f(w)$, where I is the number of individuals (in thousands) infected w weeks after the epidemic begins.

Mastering the Standard

Comprehending the Standard

and key features using tables, graphs, and verbal descriptions.
Students should understand the concept behind the key features (intercepts, increasing/decreasing, positive/negative, and maximum/minimum) for any given graph, not just "function families". This means that students should be asked to work with graphical and tabular representations of functions that the student could not solve or manipulate algebraically.

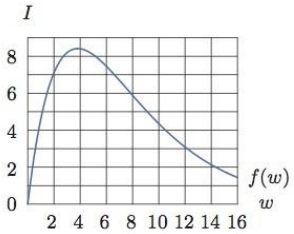
Given a problem that asks students to identify a region, students are expected to write answers using inequality notation. Students in Math 1 are not responsible for using interval notation to represent a solution.

It is important for students to begin developing an understanding of end behavior and interpreting mathematical notation (such as $x \to \infty$). As students study intervals of increasing and decreasing, connect their mathematical thinking from "as we keep going out" or "as *x* gets really big" to "as *x* goes to infinity".

By contrast, NC.M1.F-IF.7, has students work with specific functions in which students have the ability to use algebraic manipulation to identify additional key features.

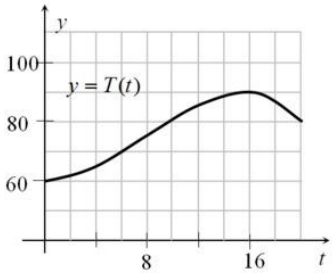
Assessing for Understanding

a. Estimate $f(2)$ and explain its meaning in terms of the epidemic.
b. Approximately how many people were infected at the height of the epidemic? When did that occur? Write your answer in the form $f(a) = b$.
c. For approximately which w is $f(w) = 4.5$; explain what the estimates mean in terms of the epidemic.
d. An equation for the function used to plot the image above is $f(w) = 6w(1.3)^{-w}$. Use the graph to estimate the solution of the inequality $6w(1.3)^{-w} \geq 6$. Explain what the solution means in terms of the epidemic. *(This would make a great Honors level extension to this standard)*



(https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/637)

Example: The figure shows the graph of T, the temperature (in degrees Fahrenheit) over one 20-hour period in Santa Elena as a function of time t.



a. Estimate $T(14)$.
b. If $t = 0$ corresponds to midnight, interpret what we mean by $T(14)$ in words.
c. Estimate the highest temperature during this period from the graph.
d. When was the temperature decreasing?
e. If Anya wants to go for a two-hour hike and return before the temperature gets over 80 degrees, when should she leave?

(https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/639)

Time (minutes)	Distance (feet)
0	0
1	5
2	30
3	15
4	25
5	50

Example: Eliana observed her dog, Lola, running around the yard and recorded the time and distance that Lola was away from her dog house in the table below.

a) Sketch a graph of Lola's play time away from her dog house.
b) Describe what is happening between minutes 2 & 3.

Instructional Resources

Tasks

Influenza Epidemic (Illustrative Mathematics)

Warming and Cooling (Illustrative Mathematics)

Additional Resources

There are a number of videos on this site http://graphingstories.com Some are aligned to Math I while others are more appropriate for Math 2 or 3. The following are suggested videos for Math I:

- Water Volume

Snapshot Overview

Return to Main Menu

Instructional Resources	
Tasks	**Additional Resources**
	• Weight • Bum Height Off Ground • Air Pressure • Height of Stack Function Carnival (DESMOS) Function Carnival, Part 2 (DESMOS) Representing Functions of Everyday Situations (Mathematics Assessment Project)

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.5

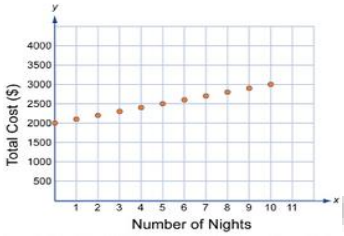
Interpret functions that arise in applications in terms of the context.

Interpret a function in terms of the context by relating its domain and range to its graph and, where applicable, to the quantitative relationship it describes.

Concepts and Skills
Pre-requisite
• In middle school, students only informally considered restrictions to the domain and range based on context, such as understanding that measurements cannot be negative. • Interpret parts of expressions in context (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b) • Every point on the graph of an equation is a solution to the equation (NC.M1.A-REI.10) • Formally define a function (NC.M1.F-IF.1) • Evaluating functions and interpret in context (NC.M1.F-IF.2)
Connections
• Recognize the domain of sequences (NC.M1.F-IF.3) • Identify key feature of graphs and tables of functions (NC.M1.F-IF.4) • Analyze linear, quadratic, and exponential functions to identify key features (NC.M1.F-IF.7)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should be able to associate a reasonable domain and range to a graph as well as to a contextual situation. The domain of a graph should be taught in the context of the situation it represents. Graphs represented should be both discrete and continuous forms. Students do not need to know the terminology discrete and continuous, but they should be able to identify which is appropriate for each contextual situation.	Students should be able to identify a reasonable domain and range to its graph as well as to a contextual situation. **Example:** Collin noticed that various combinations of nickels and dimes could add up to \$0.65. • Let x equal the number of nickels. • Let y equal the number of dimes. What is the domain where y is a function of x and the total value is \$0.65? (NCDPI Math 1 released EOC #37) A. $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$ B. $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$ C. $\{0, 1, 3, 5, 7, 9, 11, 13\}$ D. $\{1, 3, 5, 7, 9, 11, 13\}$

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	Example: Jennifer purchased a cell phone and the plan she decided upon charged her $50 for the phone and $0.10 for each minute she is on the phone. (The wireless carrier rounds up to the half minute.) She has budgeted $100 for her phone bill. What would be the appropriate domain for the cost as a function of the total minutes she used the phone? Describe what the point $(10, 51)$ represents in the problem. **Example:** Maggie tosses a coin off of a bridge into a stream below. The distance the coin is above the water is modeled by the equation $y = -16x^2 + 96x + 112$, where x represents time in seconds. What is a reasonable domain for the function? **Example:** Oakland Coliseum, home of the Oakland Raiders, is capable of seating 63,026 fans. For each game, the amount of money that the Raiders' organization brings in as revenue is a function of the number of people, *n*, in attendance. If each ticket costs $30, find the domain of this function. At a game, the Raiders has decided to honor fans who served in the military. For this event, the Raiders will be giving away 1,500 tickets to military families. How does this effect the domain and range of the function? What does this mean for the Raiders and their fans?  **Example:** An all-inclusive resort in Los Cabos, Mexico provides everything for their customers during their stay including food, lodging, and transportation. Use the graph at the right to describe the domain of the total cost function.

Instructional Resources	
Tasks	**Additional Resources**

Snapshot Overview **Return to Main Menu**

NC.M1.F-IF.6

Interpret functions that arise in applications in terms of the context.

Calculate and interpret the average rate of change over a specified interval for a function presented numerically, graphically, and/or symbolically.

Concepts and Skills
Pre-requisite
• Determine and interpret the rate of change of a linear function (8.F.4) • Describe qualitatively the functional relationship between two quantities and sketch a graph from a verbal description (8.F.5)
Connections
• Interpret key features of graphs and tables (NC.M1.F-IF.4) • Analyze linear, quadratic and exponential functions by generating different representations (NC.M1.F-IF.7)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. New Vocabulary: average rate of change

Mastering the Standard

Comprehending the Standard	Assessing for Understanding
Students calculate the average rate of change of a function given a graph, table, and/or equation. The average rate of change of a function $y = f(x)$ over an interval $a \le x \le b$ is $\frac{\text{change in } y}{\text{change in } x} = \frac{\Delta y}{\Delta x} = \frac{f(b)-f(a)}{b-a}$. This standard is more than just slope. It is asking students to find the average rate of change of any function over any given interval. Be sure to include multiple representations (numerically, graphically, or symbolically) of functions for students to work with. It is an important connection for further courses that students recognize that linear functions have consistent average rate of change over any	**Example:** Find the average rate of change of each of the following functions over the interval $1 \le x \le 5$. • $f(x) = 3x - 7$ • $g(x) = x^2 + 2x - 5$ • $h(x) = 3(2)^x$ **Example:** The table below shows the average weight of a type of plankton after several weeks. Time(weeks) / Weight (ounces) 8 / 0.04 9 / 0.07 10 / 0.14 11 / 0.25 12 / 0.49 (NCDPI Math 1 released EOC #21) What is the average rate of change in weight of the plankton from week 8 to week 12? A) 0.0265 ounce per week

Comprehending the Standard

interval, while functions like quadratics and exponentials do not have constant rates of change due to their curvature.

Assessing for Understanding

B) 0.0375 ounce per week
C) 0.055 ounce per week
D) 0.1125 ounce per week

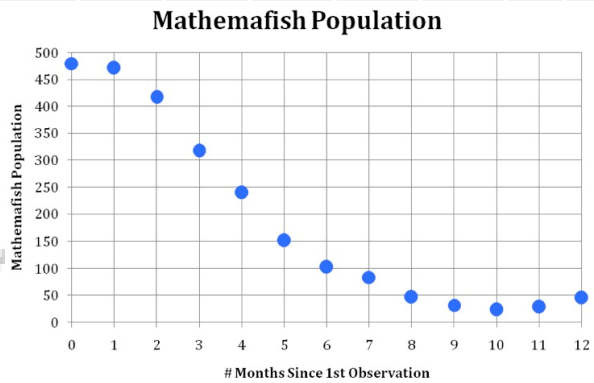
Example: The table below shows the temperature, T, in Tucson, Arizona t hours after midnight.
When does the temperature decrease the fastest: between midnight and 3 a.m. or between 3 a.m. and 4 a.m.?

t (hours after midnight)	0	3	4
T (temp. in ∘F)	85	76	70

(https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/1500)

Example: You are a marine biologist working for the Environmental Protection Agency (EPA). You are concerned that the rare coral mathemafish population is being threatened by an invasive species known as the fluted dropout shark. The fluted dropout shark is known for decimating whole schools of fish. Using a catch-tag-release method, you collected the following population data over the last year.

# months since 1st measurement	0	1	2	3	4	5	6	7	8	9	10	11	12
Mathemafish population	480	472	417	318	240	152	103	84	47	32	24	29	46



Through intervention, the EPA was able to reduce the dropout population and slow the decimation of the mathemafish population. Your boss asks you to summarize the effects of the EPA's intervention plan in order to validate funding for your project.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	What to include in your summary report: • Calculate the average rate of change of the mathemafish population over specific intervals. Indicate how and why you chose the intervals you chose. • When was the population decreasing the fastest? • During what month did you notice the largest effects of the EPA intervention? • Explain the overall effects of the intervention. • Remember to justify all your conclusions using supporting evidence. (https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/686)

Instructional Resources	
Tasks	**Additional Resources**
Temperature Change (Illustrative Mathematics) Mathemafish Population (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.7

Analyze functions using different representations.

Analyze linear, exponential, and quadratic functions by generating different representations, by hand in simple cases and using technology for more complicated cases, to show key features, including: domain and range; rate of change; intercepts; intervals where the function is increasing, decreasing, positive, or negative; maximums and minimums; and end behavior.

Concepts and Skills

Pre-requisite

- Interpret $y = mx + b$ as being linear (8.F.3)
- Determine rate of change and initial value of linear functions from tables and graphs (8.F.4)
- Interpret parts of expressions in context (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b)
- Formally define a function (NC.M1.F-IF.1)
- Evaluating functions and interpret in context (NC.M1.F-IF.2)
- Identify key feature of graphs and tables of functions (NC.M1.F-IF.4)

Connections

- Creating and graphing two variable equations (NC.M1.A-CED.2)
- Solving systems of equations (NC.M1.A-REI.6)
- Recognize the domain of sequences as integers (NC.M1.F-IF.3)
- Relate domain and range of a function to its graph (NC.M1.F-IF.5)
- Calculate the average rate of change (NC.M1.F-IF.6)
- Use equivalent forms of quadratic and exponential function to reveal key features (NC.M1.F-IF.8a, NC.M1.F-IF.8b)
- Compare key features of two functions in different representations (NC.M1.F-IF.9)
- Build functions that describe a relationship between two quantities (NC.M1.F-BF.1a, NC.M1.F-BF.1b)
- Identify situations that can be modeled with linear and exponential functions (NC.M1.F-LE.1)
- Interpret the parameters of a linear and exponential function in context (NC.M1.F-LE.5)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

4 – Model with mathematics

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to justify their use of a representation.

New Vocabulary: exponential function, quadratic function

Snapshot Overview

Return to Main Menu

Mastering the Standard

Comprehending the Standard

Students should identify the key features of the three function families covered in Math 1: linear, quadratic, and exponential.

Students should be aware of the key functions typically associated with each function type.
Linear functions – domain & range, rate of change, intercepts, increasing/decreasing
Quadratic functions – domain & range, y-intercept, x-intercepts (zeros), intervals of increasing and decreasing, intervals of positive and negative values, maximums and minimums, and end behavior
Exponential functions – domain & range, rate of change, increasing or decreasing (growth and decay), intervals of positive and negative values, and end behavior

It is important for students to begin developing an understanding of end behavior and interpreting mathematical notation (such as $x \to \infty$). As students study end behavior of these function families, connect their mathematical thinking from "as we keep going out" or "as *x* gets really big" to "as *x* goes to infinity".

At the Math 1 level, students should **not** be exposed to finding the line of symmetry of a quadratic function using the formula $x = \frac{-b}{2a}$, unless it is developed conceptually.
This concept should be developed with a study of the quadratic formula, which will be done in Math 2.
If the students need to find the line of symmetry (not a requirement of Math 1), they can find the midpoint of the zeros of the function.

Assessing for Understanding

Students should be able to identify key feature of linear, quadratic and exponential functions from the symbolic representation.

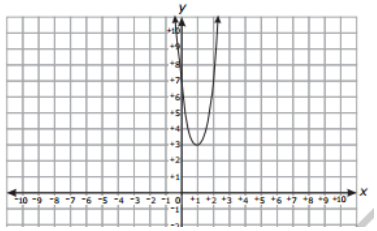
Example: Describe the key features of the graph $f(x) = \frac{-2}{3}x + 8$ and use the key features to create a sketch of the function.

Example: Without using the graphing capabilities of a calculator, sketch the graph of $f(x) = x^2 + 7x + 10$ and identify the *x*-intercepts, *y*-intercept, and the maximum or minimum point.

Example: The function $f(x) = 300(0.70)^x - 25$ models the amount of aspirin left in the bloodstream after x hours. Graph the function showing the key features of the graph. Interpret the key features in context of the problem.

Students should be able to identify key feature of linear, quadratic and exponential functions from the graphical representation.

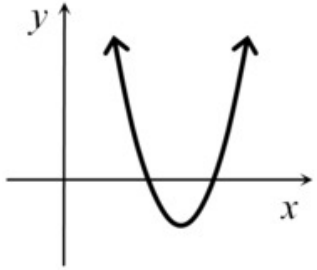
Example: Which of the following is the function graphed below?



A) $f(x) = 4x^2 - 8x + 7$
B) $f(x) = x^2 + 7x + 3$
C) $f(x) = 7x^2 - 4x + 3$
D) $f(x) = 3x^2 + x + 7$

(NCDPI Math 1 released EOC #4 modified)

Example: Which of the following could be the function of a real variable x whose graph is shown below? Explain.



$f_1(x) = (x+12)^2 + 4$	$f_5(x) = -4(x+2)(x+3)$
$f_2(x) = -(x-2)^2 - 1$	$f_6(x) = (x+4)(x-6)$
$f_3(x) = (x+18)^2 - 40$	$f_7(x) = (x-12)(-x+18)$
$f_4(x) = (x-12)^2 - 9$	$f_8(x) = (24-x)(40-x)$

*This task could be modified for a Math 1 classroom to not use vertex form.
(https://www.illustrativemathematics.org/content-standards/HSF/IF/C/8/tasks/640)

Snapshot Overview

Return to Main Menu

Instructional Resources	
Tasks	**Additional Resources**
Which Function? (Illustrative Mathematics)	Polygraph: Lines (DESMOS) Polygraph: Lines, Part 2 (DESMOS) Polygraph: Quadratics (DESMOS)

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.8a

Analyze functions using different representations.

Use equivalent expressions to reveal and explain different properties of a function.

a. Rewrite a quadratic function to reveal and explain different key features of the function

Concepts and Skills
Pre-requisite
• Interpret parts of expressions in context (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b) • Factor to reveal key features (NC.M1.A-SSE.3) • Operations with polynomials (NC.M1.A-APR.1) • Understand the relationship between linear factors and zeros (NC.M1.A-APR.3) • Formally define a function (NC.M1.F-IF.1)
Connections
• Identify key feature of graphs and tables of functions (NC.M1.F-IF.4) • Identify and interpret key features of functions from different representations (NC.M1.F-IF.7) • Compare key features of two functions in different representations (NC.M1.F-IF.9)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 5 – Use appropriate tools strategically
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. New Vocabulary: quadratic function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
This set of standards requires that students rewrite expressions of quadratic and exponential functions to reveal key features of their graphs. This is the "why" behind rewriting an expression where NC.M1.A-SSE.1 is the "how". Therefore, these two standards should be taught together. This standard should also tie to the key features of graphs in NC.M1.F.IF.7 At the Math 1 level, students only know two forms of quadratics; standard and factored. Students SHOULD NOT complete the square or write a quadratic in vertex form. Therefore, other methods for finding the vertex should be used, such as calculating the midpoint between two zeros to find the x-value of the	Students should be able to factor quadratic expressions to find key features of the quadratic function. **Example:** Suppose $h(t) = -5t^2 + 10t + 15$ is the height of a diver above the water (in meters), t seconds after the diver leaves the springboard. a) How high above the water is the springboard? Explain how you know. b) When does the diver hit the water? c) At what time on the diver's descent toward the water is the diver again at the same height as the springboard? d) When does the diver reach the peak of the dive? (https://www.illustrativemathematics.org/content-standards/HSF/IF/C/8/tasks/375)

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
vertex and using function notation to determine the y-value of the vertex. Using a graphing utility to analyze key features of a quadratic function may be necessary. At the Math 1 level, students should **not** be exposed to finding the line of symmetry of a quadratic function using the formula $x = \frac{-b}{2a}$, unless it is developed conceptually. This concept can be developed with a study of the quadratic formula in Math 2. If the students need to find the line of symmetry (not a requirement of Math 1), they can find the midpoint of the zeros of the function. The typical key features of a quadratic functions are: domain and range, y-intercept, x-intercepts (zeros), intervals of increasing and decreasing, intervals of positive and negative values, maximums and minimums, and end behavior	**Example:** The function $f(t) = -5t^2 + 20t + 60$ models the approximate height of an object t seconds after it is launched. How many seconds does it take the object to hit the ground? (NCDPI Math 1 released EOC #9) **Example:** Suppose that the equation $V = 20.8x^2 - 458.3x + 3500$ represents the value of a car from 1964 to 2002. What year did the car have the least value? ($x = 0$ in 1964) A) 1965 B) 1970 C) 1975 D) 1980 (NCDPI Math 1 released EOC #19)

Instructional Resources	
Tasks	**Additional Resources**
Springboard Dive (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

Functions – Interpreting Functions

NC.M1.F-IF.8b

Analyze functions using different representations.

Use equivalent expressions to reveal and explain different properties of a function.

b. Interpret and explain growth and decay rates for an exponential function.

Snapshot Overview

Concepts and Skills	The Standards for Mathematical Practices
Pre-requisite • Identify and interpret parts of expression (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b) • Formally define a function (NC.M1.F-IF.1)	**Connections** *Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.* 4 – Model with mathematics 5 – Use appropriate tools strategically
Connections • Identify key feature of graphs and tables of functions (NC.M1.F-IF.4) • Identify and interpret key features of functions from different representations (NC.M1.F-IF.7) • Compare key features of two functions in different representations (NC.M1.F-IF.9)	**Disciplinary Literacy** *As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.* New Vocabulary: exponential function, growth rate, decay rate

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
This set of standards requires that students rewrite expressions of quadratic and exponential functions to reveal key features of their graphs. This is the "why" behind rewriting an expression where NC.M1.A-SSE.1 interprets the rate in context. Therefore, these two standards should be taught together. This standard should also tie to the key features of graphs in NC.M1.F.IF.7 Students should know the key features of an exponential function and how they relate to a contextual situation. Students should be able to find the initial value as well as the growth/decay rate for the interval based on the given context.	Students should know the key features of an exponential function and how they relate to a contextual situation. **Example:** The expression $50(0.85)^x$ represents the amount of a drug in milligrams that remains in the bloodstream after x hours. a) Describe how the amount of drug in milligrams changes over time. b) What as the initial value of the drug in the bloodstream? c) What would the expression $50(0.80)^x$ represent? d) What new or different information is revealed by the changed expression?

Instructional Resources	
Tasks	**Additional Resources**

Snapshot Overview

Return to Main Menu

NC.M1.F-IF.9

Analyze functions using different representations.

Compare key features of two functions (linear, quadratic, or exponential) each with a different representation (symbolically, graphically, numerically in tables, or by verbal descriptions).

Concepts and Skills

Pre-requisite

- Compare properties of two functions each represented in different ways (8.F.2)
- Formally define a function (NC.M1.F-IF.1)
- Identify key feature of graphs and tables of functions (NC.M1.F-IF.4)
- Identify and interpret key features of functions from different representations (NC.M1.F-IF.7)
- Rewrite quadratic functions to identify key features (NC.M1.F-IF.8a)
- Interpret and explain growth and decay rates for an exponential function (NC.M1.F-IF.8b)

Connections

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

4 – Model with mathematics

5 – Use appropriate tools strategically

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to justify their use of a representation to make the comparison.

New Vocabulary: exponential function, quadratic function

Mastering the Standard

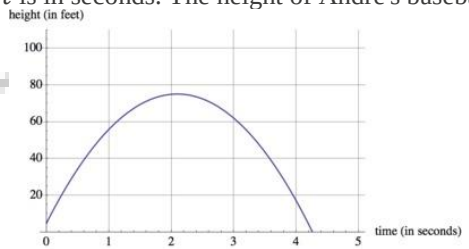
Comprehending the Standard

Students should compare two functions in two different forms. The function types may be the same (linear & linear) or different (linear & exponential), but the representations should be different (e.g. numerical & graphical).

It is important to note that the point of this standard is not to have students simply translate one function into the

Assessing for Understanding

Example: Suppose Brett and Andre each throws a baseball into the air. The height of Brett's baseball is given by $h(t) = -16t^2 + 79t + 6$, where h is in feet and t is in seconds. The height of Andre's baseball is given by the graph below:



Brett claims that his baseball went higher than Andre's, and Andre says that his baseball went higher.

a) Who is right?

Mastering the Standard

Comprehending the Standard	Assessing for Understanding
same form as the other function when given in different forms. Students should be able to use appropriate tools to compare the key features of functions.	

b) How long is each baseball airborne?

c) Construct a graph of the height of Brett's throw as a function of time on the same set of axes as the graph of Andre's throw (if not done already), and explain how this can confirm your claims to parts (a) and (b).

Example: Dennis compared the y-intercept of the graph of the function $f(x) = 3x + 5$ to the y-intercept of the graph of the linear function that includes the points in the table below.

x	$g(x)$
-7	2
-5	3
-3	4
-1	5

What is the difference when the y-intercept of $f(x)$ is subtracted from the y-intercept of $g(x)$?

A) -11.0
B) -9.3
C) 0.5
D) 5.5

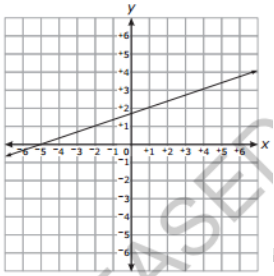
(NCDPI Math 1 released EOC #22)

Example: Joe is trying to decide which job would allow him to earn the most money after a few years.

- His first job offer agrees to pay him $500 per week. If he does a good job, they will give him a 2% raise each year.
- His other job offer agrees to pay him according to the following equation $f(x) = 20{,}800(1.03)^x$, where x represents the number of years and $f(x)$ his salary.

Which job would you suggest Joe take? Justify your reasoning.

Example: Mario compared the slope of the function graphed below to the slope of the linear function that has an x-intercept of $\frac{4}{3}$ and a y-intercept of -2.



What is the slope of the function with the smaller slope?

A) $\frac{1}{5}$
B) $\frac{1}{3}$
C) 3
D) 5

(NCDPI Math 1 EOC released #25)

Instructional Resources

Tasks	Additional Resources
	Card Sort: Linear Functions (DESMOS)

NC.M1.F-BF.1a

Build a function that models a relationship between two quantities.

Write a function that describes a relationship between two quantities.

a. Build linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (include reading these from a table).

Concepts and Skills

Pre-requisite

- Construct a function to model a linear relationship (8.F.4)
- Formally define a function (NC.M1.F-IF.1)
- Recognize arithmetic and geometric sequences as linear and exponential functions (NC.M1.F-IF.3)
- Identify situations that can be modeled with linear and exponential functions (NC.M1.F-LE.1)

Connections

- Create and graph two variable equations (NC.M1.A-CED.2)
- Identify key feature of graphs and tables of functions (NC.M1.F-IF.4)
- Identify and interpret key features of functions from different representations (NC.M1.F-IF.7)
- Translate between explicit and recursive forms (NC.M1.F-BF.2)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

4 – Model with mathematics

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

Students should be able to justify claims that a sequence defines a linear or exponential relationship.

New Vocabulary: arithmetic sequence, geometric sequence, exponential function

Mastering the Standard

Comprehending the Standard

This standard is about building a function from different representations. In this part of the standard, the different representations include: sequences, graphs, verbal descriptions, tables, and ordered pairs.

This standard pairs well with Interpreting Functions standards, in that the purpose behind building a function is to then use that function

Assessing for Understanding

Students should write functions from verbal descriptions as well as a table of values

Example: Suppose a single bacterium lands on one of your teeth and starts reproducing by a factor of 2 every hour. If nothing is done to stop the growth of the bacteria, write a function for the number of bacteria as a function of the number of days.

Example: The table below shows the cost of a pizza based on the number of toppings.

Number of Toppings (n)	Cost (C)
1	\$12.00

Mastering the Standard

Comprehending the Standard

to solve a problem.

These functions can be written in function notation (linear or exponential) or as a sequence in explicit or recursive form. Students should recognize explicit form of an arithmetic sequence as an equivalent structure to slope-intercept form of a linear function and explicit form of a geometric sequence as an equivalent structure to standard form of an exponential function. Using the concepts of rate of change, students should recognize that the forms of these sequences are one iteration forward from the y-intercept, which gives meaning to the $n-1$ notation.

Assessing for Understanding

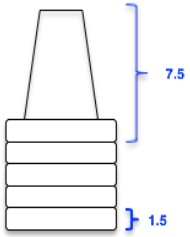
2	\$13.50
3	\$15.00
4	\$16.50

Which function represents the cost of a pizza with n toppings?

A) $C(n) = 12 + 1.5(n-1)$
B) $C(n) = 1.5n + 12$
C) $C(n) = 12 + n$
D) $C(n) = 12n$

(NCDPI Math 1 released EOC #39)

Example: The height of a stack of cups is a function of the number of cups in the stack. If a 7.5" cup with a 1.5" lip is stacked vertically, determine a function that would provide you with the height based on any number of cups.
Hint: Start with height of one cup and create a table, list, graph or description that describes the pattern of the stack as an additional cup is added.



Example: There were originally 4 trees in an orchard. Each year the owner planted the same number of trees. In the 29th year, there were 178 trees in the orchard. Which function, $t(n)$, can be used to determine the number of trees in the orchard in any year, n?

A) $t(n) = \frac{178}{29}n + 4$
B) $t(n) = \frac{178}{29}n - 4$
C) $t(n) = 6n + 4$
D) $t(n) = 29n - 4$

(NCDPI Math 1 released EOC #42)

Students should write linear or exponential relationships as a sequence in explicit or recursive form.

Example: The price of a new computer decreases with age. Examine the table by analyzing the outputs.

a) Describe the recursive relationship.
b) Analyze the input and the output pairs to determine an explicit function that represents the value of the computer when the age is known.

Age	Value
1	\$1575
2	\$1200
3	\$900
4	\$650
5	\$500
6	\$400
7	\$300

Snapshot Overview

Return to Main Menu

Instructional Resources	
Tasks	**Additional Resources**
	Put the Point on the Line (DESMOS) Modeling Population Growth: Having Kittens (Mathematics Assessment Project)

Snapshot Overview

Return to Main Menu

NC.M1.F-BF.1b

Build a function that models a relationship between two quantities.

Write a function that describes a relationship between two quantities.

b. Build a function that models a relationship between two quantities by combining linear, exponential, or quadratic functions with addition and subtraction or two linear functions with multiplication.

Concepts and Skills
Pre-requisite
• Construct a function to model a linear relationship (8.F.4) • Operations with polynomials (NC.M1.A-APR.1) • Formally define a function (NC.M1.F-IF.1)
Connections
• Create and graph two variable equations (NC.M1.A-CED.2) • Identify and interpret key features of functions from different representations (NC.M1.F-IF.7)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to justify their process of building a new function. New Vocabulary: exponential function, quadratic function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
This standard is about building functions. In this part of the standard students should combine functions to represent a contextual situation. This standard pairs well with Interpreting Functions standards, in that the purpose behind building a function is to then use that function to solve a problem. The algebraic skills behind this standard occur in NC.M1.A-APR.1. This standard should be taught throughout the year as each new function family is added to the course.	Students should combine functions to represent a contextual situation. **Example:** Cell phone Company Y charges a \$10 start-up fee plus \$0.10 per minute, x. Cell phone Company Z charges \$0.20 per minute, x, with no start-up fee. Which function represents the difference in cost between Company Y and Company Z? A) $f(x) = -0.10x - 10$ B) $f(x) = -0.10x + 10$ C) $f(x) = 10x - 0.10$ D) $f(x) = 10x + 0.10$ (NCDPI Math 1 released EOC #23) **Example:** A retail store has two options for discounting items to go on clearance. • Option 1: Decrease the price of the item by 15% each week. • Option 2: Decrease the price of the item by \$5 each week. If the cost of an item is \$45, write a function rule for the difference in price between the two options.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	Example: Blake has a monthly car payment of $225. He has estimated an average cost of $0.32 per mile for gas and maintenance. He plans to budget for the car payment the minimal he needs with an additional 3% of his total budget for incidentals that may occur. Build a function that gives the amount Blake needs to budget as a function of the number of miles driven.

Instructional Resources	
Tasks	**Additional Resources**
	Will it Hit the Hoop? (DESMOS: Quadratic specifically)

Snapshot Overview

Return to Main Menu

NC.M1.F-BF.2

Build a function that models a relationship between two quantities.

Translate between explicit and recursive forms of arithmetic and geometric sequences and use both to model situations.

Concepts and Skills
Pre-requisite
• Construct a function to model a linear relationship (8.F.4) • Formally define a function (NC.M1.F-IF.1) • Recognize sequences as function and link arithmetic sequences to linear functions and geometric sequences to exponential functions (NC.M1.F-IF.3) • Build functions from arithmetic and geometric sequences (NC.M1.F-BF.1a)
Connections

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to explain their model in context. New Vocabulary: arithmetic sequence, geometric sequence, explicit form, recursive form

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should be able to use both the explicit and recursive forms of arithmetic and geometric sequences where the explicit form is a linear or exponential function, respectively. Students are expected to use formal notation: ○ a_n (NOW) ○ a_{n-1} (PREVIOUS) ○ a_{n+1} (NEXT) (Students can use NEXT-NOW notation as they learn to create recursive functions but will need to move to formal notation.) This standard should be tied to NC.M1.F-IF.3,	Students should be able to build explicit and recursive forms of arithmetic and geometric sequences. **Example:** The sequence below shows the number of trees that a nursery plants each year. $2, 8, 32, 128 \ldots$ Let a_n represent the current term in the sequence and a_{n-1} represent the previous term in the sequence. Which formula could be used to determine the number of trees the nursery will plant in year n? A) $a_n = 4a_{n-1}$ B) $a_n = \frac{1}{4}a_{n-1}$ C) $a_n = 2a_{n-1} + 4$ D) $a_n = a_{n-1} + 6$ **Example:** A single bacterium is placed in a test tube and splits in two after one minute. After two minutes, the resulting two bacteria split in two, creating four bacteria. This process continues. a) How many bacteria are in the test tube after 5 minutes? 15 minutes? b) Write a recursive rule to find the number of bacteria in the test tube from one minute to the next.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
recognizing patterns and linking to function types. Students should recognize explicit form of an arithmetic sequence as an equivalent structure to slope-intercept form of a linear function and explicit form of a geometric sequence as an equivalent structure to standard form of an exponential function. Using the concepts of rate of change, students should recognize that the forms of these sequences are one iteration forward from the y-intercept, which gives meaning to the $n-1$ notation.	c) Convert this rule into explicit form. How many bacteria are in the test tube after one hour? **Example:** A concert hall has 58 seats in Row 1, 62 seats in Row 2, 66 seats in Row 3, and so on. The concert hall has 34 rows of seats. a) Write a recursive formula to find the number of seats in each row. How many seats are in row 5? b) Write the explicit formula to determine which row has 94 seats? **Example:** Given the sequence defined by the function $a_{n+1} = a_n + 12$ with $a_1 = 4$. Write an explicit function rule. Note: Student may interpret 4 as the y-intercept since it is the first value; however, attending to the notation when $x = 1, y = 4$. Thus, the y-intercept for the explicit form is -8. **Example:** Given the sequence defined by the function $a_{n+1} = \frac{3}{4}a_n$ with $a_1 = 424$. Write an explicit function rule.

Instructional Resources	
Tasks	**Additional Resources**

Snapshot Overview

Return to Main Menu

NC.M1.F-LE.1

Construct and compare linear and exponential models and solve problems.

Identify situations that can be modeled with linear and exponential functions, and justify the most appropriate model for a situation based on the rate of change over equal intervals.

Concepts and Skills
Pre-requisite
• Construct a function to model a linear relationship (8.F.4) • Describe qualitatively the functional relationship between two quantities by analyzing a graph (8.F.5) • Formally define a function (NC.M1.F-IF.1) • Recognize sequences as function and link arithmetic sequences to linear functions and geometric sequences to exponential functions (NC.M1.F-IF.3)
Connections
• Build explicit and recursive forms of arithmetic and geometric sequences (NC.M1.F-BF.1a) • Identify key feature of graphs and tables of functions (NC.M1.F-IF.4) • Identify and interpret key features of functions from different representations (NC.M1.F-IF.7)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct a viable argument and critique the reasoning of others 4 – Model with mathematics 7 – Look for and make use of structure
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. New Vocabulary: exponential function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should differentiate whether a situation (contextual, graphical, or numerical) can be represented best by a linear or exponential model. Students should be able to identify whether a situation is linear or exponential based on the context in relation to the rate of change.	Students should be able to identify whether a situation is linear or exponential based on the context of the scenario and justify their decision. **Example:** Town A adds 10 people per year to its population, and town B grows by 10% each year. In 2006, each town has 145 residents. For each town, determine whether the population growth is linear or exponential. Explain. **Example:** In (a)–(e), say whether the quantity is changing in a linear or exponential fashion. a) A savings account, which earns no interest, receives a deposit of $723 per month. b) The value of a machine depreciates by 17% per year. c) Every week, 9/10 of a radioactive substance remains from the beginning of the week.

Mastering the Standard

Comprehending the Standard

This standard can be taught with NC.MI.F-IF.3 and NC.MI.F-BF.2.

Assessing for Understanding

d) A liter of water evaporates from a swimming pool every day.

e) Every 124 minutes, ½ of a drug dosage remains in the body.

(https://www.illustrativemathematics.org/content-standards/HSF/LE/A/1/tasks/629)

Example: Monica did an experiment to compare two methods of warming an object. The results are shown in the table below.

Time (hours)	Temperature (°F) Method 1	Temperature (°F) Method 2
0	0	1.5
1	5	3
2	11	6
3	15	12
4	19	24
5	25	48

(NCDPI Math 1 released EOC #24)

Which statement best describes her results?

a. The temperature using both methods changed at a constant rate.
b. The temperature using both methods changed exponentially.
c. The temperature using Method 2 changed at a constant rate.
d. The temperature using Method 2 changed exponentially.

Example: According to Wikipedia, the International Basketball Federation (FIBA) requires that a basketball bounce to a height of 1300 mm when dropped from a height of 1800 mm.

a) Suppose you drop a basketball and the ratio of each rebound height to the previous rebound height is 1300:1800. Let h be the function that assigns to n the rebound height of the ball (in mm) on the nth bounce. Complete the chart below, rounding to the nearest mm.

n	$h(n)$
0	1800
1	
2	
3	

b) Write an expression for $h(n)$.

c) Solve an equation to determine on which bounce the basketball will first have a height of less than 100 mm.
(Note: Students are not expected to solve part c algebraically but are expected to take a table or graphical approach.)

(https://www.illustrativemathematics.org/content-standards/HSF/LE/A/1/tasks/347)

Example: For each or the scenarios below, decide whether the situation can be modeled by a linear function, an exponential function, or neither. For those with a linear or exponential model, create a function which accurately describes the situation.

a) From 1910 until 2010 the growth rate of the United States has been steady at about 1.5% per year. The population in 1910 was about 92,000,000.

b) The circumference of a circle as a function of the radius.

c) According to an old legend, an Indian King played a game of chess with a traveling sage on a beautiful, hand-made chessboard. The sage requested, as reward for winning the game, one grain of rice for the first square, two grains for the second, four grains for the third, and so on for the whole chess board. How many grains of rice would the sage win for the nth square?

d) The volume of a cube as a function of its side length.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	(https://www.illustrativemathematics.org/content-standards/HSF/LE/A/1/tasks/1910)

Instructional Resources	
Tasks	**Additional Resources**
Basketball Rebound (Illustrative Mathematics) Linear or Exponential? (Illustrative Mathematics) Finding Linear and Exponential Models (Illustrative Mathematics)	Penny Circle (DESMOS)

Snapshot Overview

Return to Main Menu

NC.M1.F-LE.3

Construct and compare linear and exponential models and solve problems.

Compare the end behavior of linear, exponential, and quadratic functions using graphs and tables to show that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.

Concepts and Skills

Pre-requisite

- Construct a function to model a linear relationship and interpret rate of change (8.F.4)
- Formally define a function (NC.M1.F-IF.1)
- Evaluate functions (NC.M1.F-IF.2)

Connections

- Calculate the average rate of change of an interval (NC.M1.F-IF.6)
- Identify and interpret key features, like rate of change, of functions from different representations (NC.M1.F-IF.7)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

4 – Model with mathematics

Disciplinary Literacy

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication.

New Vocabulary: exponential function, quadratic function

Mastering the Standard

Comprehending the Standard

Students experiment with the function types to build an understanding that the average rate of change over an interval for an exponential function will eventually surpass the rate of change of a linear or quadratic function over the same interval.

Students should be able to demonstrate this using various representations.

It is important for students to begin developing an understanding of end behavior and interpreting mathematical notation (such as $x \to \infty$). As students study end behavior of these function families, connect their mathematical thinking from "as we keep going out" or "as *x* gets really big" to "as *x* goes to infinity".

Assessing for Understanding

Students should realize that an exponential function is eventually always bigger than a linear or quadratic function.

Example: Kevin and Joseph each decide to invest $100. Kevin decides to invest in an account that will earn $5 every month. Joseph decided to invest in an account that will earn 3% interest every month.

a. Whose account will have more money in it after two years?
b. After how many months will the accounts have the same amount of money in them?
c. Describe what happens as the money is left in the accounts for longer periods of time.

Example: Using technology, determine the average rate of change of the following functions for intervals of their domains in the table.

Functions	Average rate of change $0 \le x \le 10$	Average rate of change $10 \le x \le 20$	Average rate of change $20 \le x \le 30$	Average rate of change $30 \le x \le 40$	Average rate of change $40 \le x \le 50$
$f(x) = x^2$					
$f(x) = 1.17^x$					

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
	a) When does the average rate of change of the exponential function exceed the average rate of change of the quadratic function? b) Using a graphing technology, graph both functions. How do the average rates of change in your table relate to what you see on the graph? Note: You can use the information in your table to determine how to change the setting to see where the functions intersect. c) In your graphing technology, change the first function to $f(x) = 10x^2$ and adjust the settings to see where the functions intersect. What do you notice about the rates of change interpreted from the graph? d) Make a hypothesis about the rates of change about polynomial and exponential function. Try other values for the coefficient of the quadratic function to support your hypothesis.

Instructional Resources	
Tasks	**Additional Resources**

Snapshot Overview

Return to Main Menu

NC.M1.F-LE.5

Interpret expressions for functions in terms of the situation they model.

Interpret the parameters a and b in a linear function $f(x) = ax + b$ or an exponential function $g(x) = ab^x$ in terms of a context.

Concepts and Skills
Pre-requisite
• Construct a function to model a linear relationship and interpret rate of change and initial value (8.F.4) • Compare the coefficients and constants of linear equations in similar form (8.EEb) • Identify and interpret parts of expression (NC.M1.A-SSE.1a, NC.M1.A-SSE.1b)
Connections
• Identify and interpret key features of functions from different representations (NC.M1.F-IF.7)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. New Vocabulary: exponential function

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students should know the meaning of the parameters in both linear and exponential functions in the context of the situation. Use real-world situations to help students understand how the parameters of linear and exponential functions depend on the context. In a linear function $y = ax + b$ the value of "a" represents the slope (constant rate of change) while "b" represents the y intercept (initial value). In an exponential function $y = a(b)^x$ the value of "a" represents the y intercept (initial value)	Students should be able to describe the effects of changes to the parameters of a linear and exponential functions. **Example:** A plumber who charges \$50 for a house call and \$85 per hour can be expressed as the function $y = 85x + 50$. If the rate were raised to \$90 per hour, how would the function change? **Example:** The equation $y = 8{,}000(1.04)^x$ models the rising population of a city with 8,000 residents when the annual growth rate is 4%. a. What would be the effect on the equation if the city's population were 12,000 instead of 8,000? b. What would happen to the population over 25 years if the growth rate were 6% instead of 4%? Students should be able to interpret the parameters of a linear and exponential function. **Example:** A function of the form $f(n) = P(1 + r)^n$ is used to model the amount of money in a savings account that earns 8% interest, compounded annually, where n is the number of years since the initial deposit. a. What is the value of r? Interpret what r means in terms of the savings account? b. What is the meaning of the constant P in terms of the savings account? Explain your reasoning. c. Will n or $f(n)$ ever take on the value 0? Why or why not?

Mastering the Standard

Comprehending the Standard	Assessing for Understanding
and "b" represents the growth or decay factor. When $b > 1$ the function models growth. When $0 < b < 1$ the function models decay. Be cautious when interpreting the growth or decay rate. If the factor is 0.85 this means that it is decreasing by 15%. If the factor is 1.05, this means that is increasing by 5%	**Example:** Lauren keeps records of the distances she travels in a taxi and what it costs: **Distance *d* in miles** / **Fare *f* in dollars** 3 / 8.25 5 / 12.75 11 / 26.25 a. If you graph the ordered pairs (d, f) from the table, they lie on a line. How can this be determined without graphing them? b. Show that the linear function in part a. has equation $f = 2.25d + 1.5$. c. What do the 2.25 and the 1.5 in the equation represent in terms of taxi rides

Instructional Resources

Tasks	Additional Resources
	Representing Linear and Exponential Growth (Mathematics Assessment Project)

Snapshot Overview

Return to Main Menu

Geometry

NC Math 1	NC Math 2	NC Math 3
Analytic & Euclidean		
Focus on coordinate geometry • Distance on the coordinate plane • Midpoint of line segments • Slopes of parallel and perpendicular lines • Prove geometric theorems algebraically	**Focus on triangles** • Congruence • Similarity • Right triangle trigonometry ○ Special right triangles	**Focus on circles and continuing the work with triangles** • Introduce the concept of radian • Angles and segments in circles • Centers of triangles • Parallelograms
A Progression of Learning		
Integration of Algebra and Geometry • Building off what students know from 5th – 8th grade with work in the coordinate plane, the Pythagorean theorem and functions. • Students will integrate the work of algebra and functions to prove geometric theorems algebraically. • Algebraic reasoning as a means of proof will help students to build a foundation to prepare them for further work with geometric proofs. **Snapshot Overview**	**Geometric proof and SMP3** • An extension of transformational geometry concepts, lines, angles, and triangles from 7th and 8th grade mathematics. • Connecting proportional reasoning from 7th grade to work with right triangle trigonometry. • Students should use geometric reasoning to prove theorems related to lines, angles, and triangles. *It is important to note that proofs here are not limited to the traditional two-column proof. Paragraph, flow proofs and other forms of argumentation should be encouraged.*	**Geometric Modeling** • Connecting analytic geometry, algebra, functions, and geometric measurement to modeling. • Building from the study of triangles in Math 2, students will verify the properties of the centers of triangles and parallelograms. **Return to Main Menu**

Expressing Geometric Properties with Equations

NC.M1.G-GPE.4

Use coordinates to prove simple geometric theorems algebraically.

Use coordinates to solve geometric problems involving polygons algebraically

- Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
- Use coordinates to verify algebraically that a given set of points produces a particular type of triangle or quadrilateral.

Concepts and Skills
Pre-requisite
• Finding the distance between points in the coordinate plane (8.G.8) • Calculating rate of change from two points (8.F.4) • Using slope to determine parallelism and perpendicularity (NC.M1.G-GPE.5) • Finding midpoint/endpoint of a line segment, given either (NC.M1.G-GPE.6)
Connections
• Experiment with transformations in the plane (NC.M2.G-CO.2, NC.M2.G-CO.3, NC.M2.G-CO.3, NC.M2.G-CO.4) • Geometric transformations as functions (NC.M2.F-IF.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct viable arguments and critique the reasoning of others. • Students must use algebraic reasoning as they solve geometric problems. 8 – Look for and express regularity in repeated reasoning • The distance formula is a generalization where students notice general methods and/or shortcuts for performing mathematical calculations.
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. Students should be able to justify their claim that a set of points forms a particular shape using mathematical reasoning.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
In upper elementary and middle grades, students calculated the area of triangles and special quadrilaterals using all four quadrants of the coordinate plane. Students also applied geometric measurement to real-world and mathematical problems and made use of properties of	Given coordinates of a polygon in the coordinate plane, students should be able to compute the lengths of segments and side lengths of polygons by finding the distance between points in the coordinate plane to: • calculate the perimeter of polygons • calculate the area of triangles and rectangles

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
two-dimensional figures in order to calculate or estimate their lengths and areas. This standard emphasizes the use of coordinates to solve geometric problems algebraically and continues with geometric measurement. Students will begin to demonstrate and analyze properties of geometric shapes using equations and graphs. This includes: • Using previously learned formulas to find the perimeter of polygons and the area of triangles and rectangles. • Applying the <u>slope</u> to determine right angles in triangles and rectangles (perpendicular lines), to verify parallel sides in geometric figures; and to determine intersecting lines. • Finding the perimeter of figures by computing the <u>distance</u> between points on the coordinate plane. The <u>distance formula</u> ($d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$) is an appropriate generalization and should be ***developed*** through SMP 8 where students notice general methods and/or shortcuts for performing mathematical calculations. This is based on what students know about finding the length of line segments in the coordinate plane (Pythagorean Theorem) from MS mathematics.	**Example**: Find the perimeter and area of a polygon with vertices at $C\ (-1,1)$, $D(3,4)$, $E(6,0)$, $F\ (2,-3)$ and $G\ (-4,-4)$. Round your answer to the nearest hundredth. Given coordinates of a polygon in the coordinate plane, students should be able to verify the properties of any triangle or quadrilateral using the slopes of lines and lengths of segments that comprise the figure. **Example:** Given ΔABC with altitude $\overline{CD}$, given $A\ (-4,-2)$, $B(8,7)$, $C(1,8)$ and $D(4,4)$. a. Calculate the area of ΔABC. b. The altitude of a triangle is defined as is a line that extends from one vertex of a **triangle** perpendicular to the opposite side. Verify that $\overline{CD}$ is an altitude of ΔABC. **Example:** The coordinates for the vertices of quadrilateral $MNPQ$ are $M\ (3,0)$, $N\ (1,3)$, $P\ (-2,1)$, and $Q\ (0,-2)$. a. Classify quadrilateral $MNPQ$. b. Identify the properties used to determine your classification. Given the properties of a rectangle or triangle, students can determine the missing coordinate(s). **Example*:*** If quadrilateral $ABCD$ is a rectangle, where $A\ (1,2)$, $B\ (6,0)$, $C\ (10,10)$ and $D\ (x,y)$ is unknown. a. Find the coordinates of the fourth vertex Point D. b. Verify that $ABCD$ is a rectangle providing evidence related to the sides and angles.

Snapshot Overview **Return to Main Menu**

Instructional Resources	
Tasks	**Additional Resources**
Squares on a coordinate grid (Illustrative Mathematics) Is this a rectangle? (Illustrative Mathematics) Unit Squares and Triangles (Illustrative Mathematics) Triangle Perimeters (Illustrative Mathematics) Mathematics Diagnostic Testing Project Area Problem (Regents of University of CA)	Dividing a Town into Pizza Delivery Regions (Illuminations) Classifying Equations of Parallel and Perpendicular Lines (Mathematics Assessment Project)

Snapshot Overview

Return to Main Menu

Expressing Geometric Properties with Equations

NC.M1.G-GPE.5

Use coordinates to prove simple geometric theorems algebraically.

Use coordinates to prove the slope criteria for parallel and perpendicular lines and use them to solve problems.

- Determine if two lines are parallel, perpendicular, or neither.
- Find the equation of a line parallel or perpendicular to a given line that passes through a given point.

Concepts and Skills
Pre-requisite
• Calculating rate of change given two points, a table or a graph (8.F.4) • Derive the equation for a line in the coordinate plane (8.EE.6)
Connections
• Calculating and interpreting rate of change for a function (NC.M1.F-IF.6) • Using coordinates to solve geometric problems algebraically (NC.M1.G-GPE.4) • Analyze functions using different representations (NC.M1.F-IF.7, NC.M1.F-IF.9) • Using concepts of points lines and planes to develop definitions of rigid motions in the plane (NC.M2.G-CO.2, NC.M2.G-CO.3, NC.M2.G-CO.4) • Prove theorems about lines (NC.M2.G-CO.9)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct viable arguments and critique the reasoning of others. 8 – Look for and express regularity in repeated reasoning. • The slope formula is a generalization where students notice general methods and/or shortcuts for performing mathematical calculations.
Disciplinary Literacy
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard: • Compare and contrast the equations of parallel and perpendicular lines. What similarities/differences must be present for parallel lines? Perpendicular lines? Intersecting lines?

Snapshot Overview

Return to Main Menu

Mastering the Standard

Comprehending the Standard

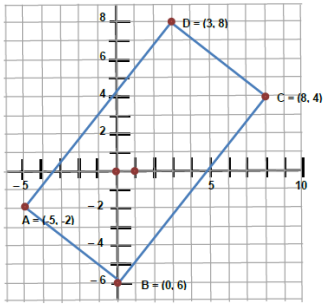
Students in 8th grade determine the slope and write the equation of non-vertical lines given two points, a table or graph. This standard is an extension and an application of this work as it asks students to compare two or more lines based on the characteristics of the lines presented.

- Parallelism – same slope
  $m_1 = m_2$, where $m = \frac{\Delta y}{\Delta x}$
- Perpendicularity – slopes are opposite reciprocals OR slopes have a product of (-1).
  $m_1 \cdot m_2 = -1$, where $m = \frac{\Delta y}{\Delta x}$
- Intersecting – have completely different rates of change. It is useful to note that perpendicular lines are a subset of intersecting lines on coordinate plane.
  $m_1 \neq m_2$, where $m = \frac{\Delta y}{\Delta x}$

The slope formula ($m = \frac{y_2 - y_1}{x_2 - x_1}$) is an appropriate generalization and should be ***developed*** through SMP 8 where students notice general methods and/or shortcuts for performing mathematical calculations. This is based on what students know about rate of change (slope) from MS mathematics.

Assessing for Understanding

Given coordinates, students can compare the characteristics, slopes and intercepts, of two or more lines. Student should be able to determine if two lines are parallel, perpendicular or intersecting based on the slopes of the two lines.



Example: Investigate the slopes of each of the sides of the rectangle ABCD (pictured on the right). What do you notice about the slopes of the sides that meet at a right angle? What do you notice about the slopes of the opposite sides that are parallel? Can you generalize what happens when you multiply the slopes of perpendicular lines?

Students should be able to find the slope and/or endpoint(s) of a line given the graph or coordinates of a line parallel or perpendicular to the given line.

Example: Suppose a line *k* in a coordinate plane has slope $\frac{c}{d}$.

a. What is the slope of a line parallel to *k*? Why must this be the case?
b. What is the slope of a line perpendicular to *k*? Why does this seem reasonable?

Students should be able to write the equation of line parallel or perpendicular to a given line.

Example: Two points $A(0, -4)$, $B(2, -1)$ determines a line, $\overleftrightarrow{AB}$.

a. What is the equation of the line AB?
b. What is the equation of the line perpendicular to $\overleftrightarrow{AB}$. passing through the point $(2, -1)$?

Instructional Resources

Tasks	Additional Resources
Midpoint Miracle (Illustrative Mathematics)	Classifying Equations of Parallel and Perpendicular Lines (MAP FAL)
Slope Criterion for Parallel and Perpendicular Lines (Illustrative Mathematics)	Graphing resource: https://www.geogebra.org/

Snapshot Overview

Return to Main Menu

Expressing Geometric Properties with Equations

NC.M1.G-GPE.6

Use coordinates to prove simple geometric theorems algebraically.

Use coordinates to find the midpoint or endpoint of a line segment.

Concepts and Skills
Pre-requisite
• Finding the distance between points in the coordinate plane (8.G.8) • (7.RP.2d)
Connections
• Use coordinates to solve geometric problems involving polygons (NC.M1.G-GPE.4) • Prove theorems about lines (NC.M2.G-CO.9)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct viable arguments and critique the reasoning of others. 8 – Look for and express regularity in repeated reasoning. • The <u>midpoint formula</u> is a generalization where students notice general methods and/or shortcuts for performing mathematical calculations.
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard:

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
The midpoint partitions the ratio of two distinct points on the same line segment into 1:1; thus from either direction the point is the same. The midpoint is always halfway between the two endpoints. The *x*-coordinate of the midpoint will be the mean of the *x*-coordinates of the endpoints and the *y*-coordinate will be the mean of the *y*-coordinates of the endpoints as indicated through the use of the midpoint formula.	Given two points on a line, students can find the point that divides the segment into an equal number of parts. ***Example:*** Jennifer and Jane are best friends. They placed a map of their town on a coordinate grid and found the point at which each of their house lies. If Jennifer's house lies at (9, 7) and Jane's house is at (15, 9) and they wanted to meet in the middle, what are the coordinates of the place they should meet? Given the midpoint and an endpoint, students can use what they know about the midpoint to locate the other endpoint.

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
This should derived from what students understand about distance. The midpoint formula $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$ is an appropriate generalization and should be ***developed*** through SMP 8 where students notice general methods and/or shortcuts for performing mathematical calculations.	***Example:*** If you are given the midpoint of a segment and one endpoint. Find the other endpoint. a. midpoint: $(6, 2)$ endpoint: $(1, 3)$ b. midpoint: $(-1, -2)$ endpoint: $(3.5, -7)$

Instructional Resources	
Tasks	**Additional Resources**
Midpoint Miracle (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

Statistics & Probability

A statistical process is a problem-solving process consisting of four steps:

1. Formulating a statistical question that anticipates variability and can be answered by data.
2. Designing and implementing a plan that collects appropriate data.
3. Analyzing the data by graphical and/or numerical methods.
4. Interpreting the analysis in the context of the original question.

NC Math 1	NC Math 2	NC Math 3
Focus on analysis of univariate and bivariate data • Use of technology to represent, analyze and interpret data • Shape, center and spread of univariate numerical data • Scatter plots of bivariate data • Linear and exponential regression • Interpreting linear models in context.	**Focus on probability** • Categorical data and two-way tables • Understanding and application of the Addition and Multiplication Rules of Probability • Conditional Probabilities • Independent Events • Experimental vs. theoretical probability	**Focus on the use of sample data to represent a population** • Random sampling • Simulation as it relates to sampling and randomization • Sample statistics • Introduction to inference
A Progression of Learning		
• A continuation of the work from middle grades mathematics on summarizing and describing quantitative data distributions of univariate (6th grade) and bivariate (8th grade) data. **Snapshot Overview**	• A continuation of the work from 7th grade where students are introduced to the concept of probability models, chance processes and sample space; and 8th grade where students create and interpret relative frequency tables. • The work of MS probability is extended to develop understanding of conditional probability, independence and rules of	• Bringing it all back together • Sampling and variability • Collecting unbiased samples • Decision making based on analysis of data **Return to Main Menu**

	probability to determine probabilities of compound events.	

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.1

Summarize, represent, and interpret data on a single count or measurement variable.

Use technology to represent data with plots on the real number line (histograms and box plots).

Concepts and Skills

Pre-requisite

- Displaying numerical data on line plots, dot plots, histograms and dot plots (6.SP.4)

Connections

- Comparing two or more data distributions using shape and summary statistics (NC.M1.S-ID.2)
- Examining the effects of outliers on the shape, center, and/or spread of data (NC.M1.S-ID.3)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.
4 – Model with mathematics

Vocabulary

As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard:

New Vocabulary: outlier, standard deviation

Mastering the Standard

Comprehending the Standard

This standard is an extension of 6th grade where students display numerical data using dot plots, histograms and box plots.

The standard involves representing data from contextual situations with histograms and box plots ***using technology***. Students should now be able to see that dot plots (line plots) are no longer appropriate for larger data sets. They should see that technology can quickly perform calculations and create graphs so that more emphasis can be placed on interpretation of the data.

Summary statistics include:

Assessing for Understanding

Students can use appropriate technology to calculate summary statistics and graph a given set of data. Appropriate technology includes graphing calculators, software or online applications (e.g. http://technology.cpm.org/general/stats/).

Example: The table below shows the length of a class period for each of the schools listed in a NC school district. Choose and create an appropriate plot to represent the data. Explain your choice of plot.

School	Class period (minutes)	School	Class period (minutes)
Lincoln Middle	45	New Hope Middle	55
Central Middle	65	Sunnyside Middle	50
Oak Grove Middle	70	Pine Grove Middle	60
Fairview Middle	55	Green Middle	65
Jefferson Middle	60	Hope Middle	55

Mastering the Standard

Comprehending the Standard

- 5-Number summary: minimum value (minX), maximum value (maxX), median (Med), lower quartile (Q_1) and upper quartile (Q_3)
- mean ($\bar{x}$)
- Sum ($\sum x$)
- standard deviation (Sx)*

Graphs include:

- Histograms
- *Modified* Box plots – plots outliers as individual points. A point is determined to be an outlier if:
  - Lower outlier(s) $< 1.5 \cdot IQR$
  - Upper outlier(s) $> 1.5 \cdot IQR$

*While technology gives values for the population standard deviation (σx), students will not use this measurement at this level.

Assessing for Understanding

Roosevelt Middle	60		

Example: The following data set shows the number of songs downloaded in one week by each student in Mrs. Jones class: 10, 20, 12, 14, 12, 27, 88, 2, 7, 30, 16, 16, 32, 25, 15, 4, 0, 15, 6, 1, 0, 15, 12, 10, and 7.

a. What are the summary statistics for the data?
b. Construct two different graphs of the data.
c. Describe the distribution of the data, citing both of the plots and the numerical summary statistics.
d. What are the advantages to each data display? Explain.

Instructional Resources

Tasks

Speed Trap (Illustrative Mathematics)

S-ID Haircut Costs (Illustrative Mathematics)

Random Walk III (Illustrative Mathematics)

Additional Resources

Statistics on Basketball Team (Smarter Balanced CAT Sample Questions)

Interactive Box Plot Activity (Shodor)

Representing Data with Boxplots (Mathematics Assessment Project)

Representing Data with Frequency Graphs (Mathematics Assessment Project)

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.2

Summarize, represent, and interpret data on a single count or measurement variable.

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 sets. Interpret differences in shape, center, and spread in the context of the data sets.

Concepts and Skills
Pre-requisite
• Relating the choice of center and variability to shape of data (6.SP.5d) • Informally compare graphical displays of two distributions to make inferences about two populations (7.SP.3) • Informally compare numerical summaries of two distributions to make inferences about two populations (7.SP.4) • Use technology to represent data (NC.M1.S-ID.1)
Connections
• Effects of outliers on shape, center, and/or spread (NC.M1.S-ID.3)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 5 – Use appropriate tools strategically 6 – Attend to precision
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard: New Vocabulary: standard deviation, outlier

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
In middle school, students related the measure of center and variability to the shape and context of the data. Students know that symmetrical displays are more appropriate for the mean as a measure of center and mean absolute deviation (M.A.D) as a measure of variability. Likewise, they understand that skewed distributions or distributions with outliers are better described using median as a measure of center due to the fact that it is a *resistant* measure of center; and the	Given two or more sets of data, students compare datasets and identify similarities and differences in shape, center and spread within the context of the data. **Example:** Ms. Williams wants to analyze the scores for the first unit test of her 1st period and 4th period NC Math 1 classes. The scores for each class are below. 1st Period: 82, 100, 94, 68, 34, 72, 70, 96, 99, 92, 90, 85, 70, 46, 71, 71, 77, 78, 95, 82, 80, 100, 99, 72, 69, 74, 84, 87 4th Period: 100, 95, 72, 80, 97, 78, 89, 100, 93, 95, 66, 87, 85, 98, 89, 86, 80, 79, 94, 90, 92, 87, 88 81, 82 a. Calculate the mean, median, standard deviation, and interquartile range for each class.

Mastering the Standard

Comprehending the Standard

interquartile range (IQR) as a measure of variability.

Context also plays an important role in the choice of summary statistic utilized. Students can examine the context to rationalize why particular measures are more appropriate than others.

The standard deviation is a new summary statistic for students. Its *development* should be based on the M.A.D (Mean Absolute Deviation) learned in the 6th grade. Essentially, students need to understand that SD like M.A.D is a measure of variability in the data. The larger SD, the more variable the data. Students should also know that standard deviation allows comparison of variability in multiple data sets regardless of the unit of measurement for the data sets.

An understanding of how the standard deviation is calculated can help students to conceptualize the value and why it's primarily used in association with mean as a measure of center.

$$S_x = \sqrt{\frac{1}{n-1}\sum(x_i - \bar{x})^2}$$

Using a relatively smaller data set and the list feature in the graphing calculator can make the calculations easier during development of the concept.

Assessing for Understanding

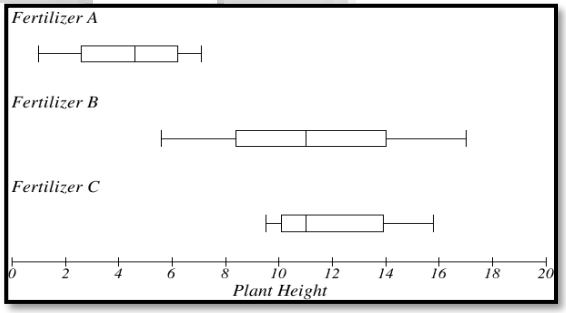
b. Construct an appropriate graph to compare the two classes.

c. Write several sentences to compare the class grades in context.

Given two or more graphs, students compare datasets and identify similarities and differences in shape, center and spread within the context of the data.

Example: Delia wanted to find the best type of fertilizer for her tomato plants. She purchased three types of fertilizer and used each on a set of seedlings. After 15 days, she measured the heights (in cm) of each set of seedlings. The data she collected and plots are shown below. Write a brief description comparing the three types of fertilizer. Which fertilizer do you recommend that Delia use? Explain your answer.

Fertilizer A			Fertilizer B			Fertilizer C		
7.1	6.3	1.0	11.0	9.2	5.6	10.5	11.8	15.5
5.0	4.5	5.2	8.4	7.2	12.1	14.7	11.0	10.8
3.2	4.6	2.4	10.5	14.0	15.3	13.9	12.7	9.9
5.5	3.8	1.5	6.3	8.7	11.3	10.3	10.1	15.8
6.2	6.9	2.6	17.0	13.5	14.2	9.5	13.2	9.7



Online Tools

Boxplot Grapher: http://www.imathas.com/stattools/boxplot.html

Snapshot Overview

Return to Main Menu

Instructional Resources

Tasks	Additional Resources

Measuring Variability in a Data Set (Illustrative Mathematics) Understanding the Standard Deviation (Illustrative Mathematics) Speed Trap (Illustrative Mathematics) Haircut Costs (Illustrative Mathematics)	Airline Arrival Times (Smarter Balanced CAT Sample Questions)

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.3

Summarize, represent, and interpret data on a single count or measurement variable.

Examine the effects of extreme data points (outliers) on shape, center, and/or spread.

Concepts and Skills
Pre-requisite
• Describing striking deviations from the overall pattern of a distribution (6.SP.5c) • Use technology to create boxplots and histograms (NC.M1.S-ID.1)
Connections
• Comparing two or more data distributions using shape and summary statistics (NC.M1.S-ID.2)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct a viable argument and critique the reasoning of others 4 – Model with mathematics 5 – Use appropriate tools strategically 6 – Attend to precision
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard: New Vocabulary: outlier, standard deviation

Snapshot Overview

Return to Main Menu

Mastering the Standard

Comprehending the Standard

An important part of data analysis includes examining data for values that represent abnormalities in the data. In MS, students *informally* addressed "striking deviations from the overall pattern" of a data distribution.

The identification of outliers is formalized in this standard. A value is mathematically determined to be an outlier if the value falls 1.5 IQRs below the 1st quartile or above the third quartile in a data set.

- Lower outlier(s) $< 1.5 \cdot IQR$
- Upper outlier(s) $> 1.5 \cdot IQR$

The mean and standard deviation are most commonly used to describe sets of data. However, if the distribution is extremely skewed and/or has outliers, it is best to use the median and the interquartile range to describe the distribution since these measures are not sensitive to outliers.

It is important to detect outliers within a distribution, because they can alter the results of the data analysis. The mean is more sensitive to the existence of outliers than other measures of center.

Assessing for Understanding

Students understand and use the context of the data to explain why its distribution takes on a particular shape (e.g. Why is the data skewed? Are there outliers?)

Example:
Why does the shape of the distribution of incomes for professional athletes tend to be skewed to the right?
Why does the shape of the distribution of test scores on a really easy test tend to be skewed to the left?
Why does the shape of the distribution of heights of the students at your school tend to be symmetrical?

Students should identify outliers of the data set and determine the effect outliers will have on the shape, center, and spread of a data set.

Example: The heights of players on the Washington High School's Girls basketball team are recorded below:

5' 10"	5' 4"	5' 7"	5' 6"	5' 5"	5' 3"	5' 7"	5' 7"	5' 8"

A student transfers to Washington High and joins the basketball team. Her height is 6' 2"

a. What is the mean height of the team before the new player transfers in? What is the median height?
b. What is the mean height after the new player transfers? What is the median height?
c. What affect does her height have on the team's height distribution and stats (center and spread)?
d. Which measure of center most accurately describes the team's average height? Explain.

Example: The table on the right shows the length of a class period for each of the school's listed. If Cherry Lane Middle School's class period length of 100 minutes is added to the data above, what effect will it have on the mean, median, interquartile range, standard deviation and on the graph of the data?

School	Length of class period (minutes)
Lincoln Middle	45
Central Middle	65
Oak Grove Middle	70
Fairview Middle	55
Jefferson Middle	60
Roosevelt Middle	60
New Hope Middle	55
Sunnyside Middle	50
Pine Grove Middle	60
Green Middle	65
Hope Middle	55

Instructional Resources	
Tasks	**Additional Resources**
Identifying Outliers (Illustrative Mathematics) Describing Data Sets with Outliers (Illustrative Mathematics)	Student Heights (PISA Sample) Test Scores (PISA Sample)

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.6a

Summarize, represent, and interpret data on two categorical and quantitative variables.

Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

a. Fit a least squares regression line to linear data using technology. Use the fitted function to solve problems.

Concepts and Skills
Pre-requisite
• Construct and interpret scatterplots for two-variable data and describe patterns of association (8.SP.1) • Informally fit a straight line assess the model fit judging the closeness of the data to line (8.SP.2) • Analyze patterns and describe relationships between variables in context. (NC.M1.S-ID.8)
Connections
• Assess linearity by analyzing residuals (NC.M1.S-ID.6b) • Fit a function to exponential data using technology and use the model to solve problems (NC.M1.S-ID.6c) • Use technology to analyze patterns and describe relationships between two variables in context. (NC.M1.S-ID.7) • Distinguish between association and causation (NC.M1.S-ID.9) • Write a function that describes a relationship between two quantities (NC.M1.F-BF.1) • Identify situations that can be modeled with linear and exponential functions and justify the appropriate model (NC.M1.F-LE.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 4 – Model with mathematics 5 – Use appropriate tools strategically 6 – Attend to precision
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard:

Snapshot Overview

Return to Main Menu

Mastering the Standard

Comprehending the Standard

In 8th grade, students created scatter plots and described patterns of association between two quantities. They also informally fit a straight line to data based on how closely the data points resembled a line. That knowledge is extended to fitting a linear regression equation to a set of data using technology. Technology includes graphing calculators, computer software/programs and web-based applets and tools.

The initial exploration with technology should include a discussion of domain and range and their relationship to the graphing window. Most technology tools include an automatic feature that graphs data within a window representative of the data, however understanding of the graphing window can lead to further discussions about domain, range, interpolation and extrapolation.

Assessing for Understanding

Students can represent data on a scatter plot using an appropriate scale and describe the relationship between two quantitative variables.

Example: Represent the data from the table below in a scatter plot. Determine if and what the relationship is between the population of each high school and the number of active band members.

HS Population	# of active band members
1200	150
1450	155
900	100
1500	125
1400	125
1005	120

Example: The data gives the number of miles driven and advertised price for 11 used models of a particular car.

a. Use a calculator or graphing technology to make a scatter plot of the data.
b. Find the correlation coefficient for the data above. Describe what the correlation coefficient means in regards to the data.
c. Fit a linear function to model the relationship between miles driven and the price of these cars.
d. How do you know that this is the best-fit model?
e. If a used car is driven 98,000 miles, what will the price be (to the nearest dollar)?
f. If the price of the car is $12,540, how many miles could have been driven (to the nearest thousand)?

Miles (thousands)	**Price**($)
22	17,998
29	16,450
35	14,998
39	13,998
45	14,599
49	14,988
55	13,599
56	14,599
69	11,998
70	14,450
86	10,998

Instructional Resources	
Tasks	**Additional Resources**
Olympic Men's 100-meter dash (Illustrative Mathematics) Laptop Battery Charge 2 (Illustrative Mathematics)	Lego Prices (DESMOS)

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.6b

Summarize, represent, and interpret data on two categorical and quantitative variables.

Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

b. Assess the fit of a linear function by analyzing residuals.

Concepts and Skills

Pre-requisite

- Fit a regression line to linear data using technology (NC.M1.S-ID.6a)

Connections

- Use technology to analyze patterns and describe relationships between two variables in context. (NC.M1.S-ID.7)
- Analyze patterns and describe relationships between variables in context. (NC.M1.S-ID.8)

The Standards for Mathematical Practices

Connections

Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.

3 – Construct a viable argument and critique the reasoning of others

Vocabulary

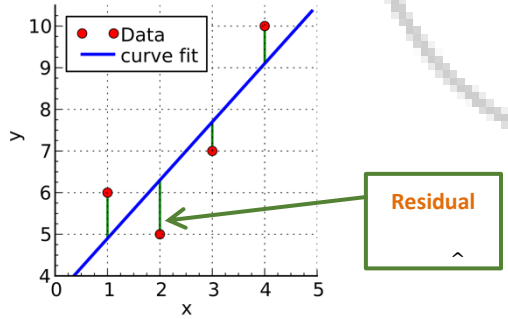
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard:

New Vocabulary: residual

Mastering the Standard

Comprehending the Standard

A ***residual***, a measure of the error in prediction, is the difference between the actual *y*-value (y) and the predicted *y*-value ($\hat{y}$). Residuals are represented on the graph by the vertical distance between a data point and the graph of the function.



Assessing for Understanding

Students can create a residual plot from a given set of data and interpret the appropriateness of a linear model for the data set.

Year (0 = 1990)	Tuition Rate	Predicted Rate	Residuals
0	6546		
1	6996		
2	6996		
3	7350		
4	7500		

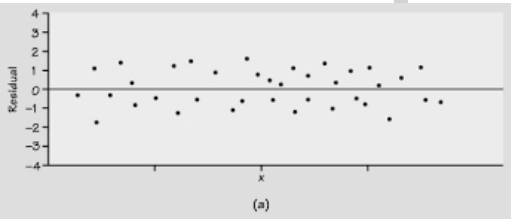
Snapshot Overview

Return to Main Menu

Mastering the Standard

Comprehending the Standard

A ***residual plot*** is a graph that shows the residuals on the vertical axis and the independent variable on the horizontal axis. If the points in a residual plot are randomly dispersed around the horizontal axis, a linear regression model is appropriate for the data; otherwise, a non-linear model is more appropriate.



Assessing for Understanding

Students can determine the residual for any value in a data set.

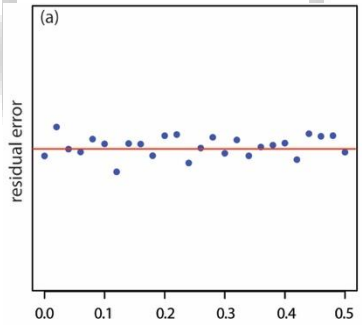
Example: The table to the left displays the annual tuition rates of a state college in the U.S. between 1990 and 2000, inclusively. The linear function $R(t) = 326x + 6440$ has been suggested as a good fit for the data.

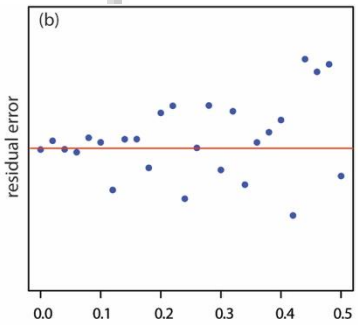
a. Extend the table to find the predicted rates based on the model and the residual values for each year.
b. Create the residual plot for the tuition rates.
c. Use the residual plot to determine the goodness of fit of the function for the data provided in the table.

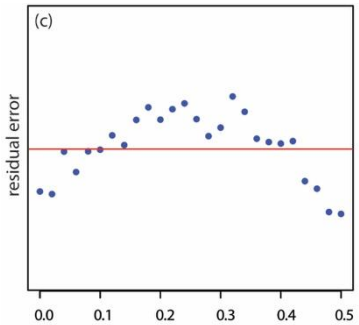
5	7978		
6	8377		
7	8710		
8	9110		
9	9411		
10	9800		

Students can use a residual plot to determine the appropriateness of a linear model for a set of data.

Example: What do the following residual plots tell you about the appropriateness of a linear model for the functions they represent? Explain your responses.







Snapshot Overview **Return to Main Menu**

Instructional Resources

Tasks	Additional Resources
Restaurant Bill and Party Size (Illustrative Mathematics)	

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.6c

Summarize, represent, and interpret data on two categorical and quantitative variables.

Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

c. Fit a function to exponential data using technology. Use the fitted function to solve problems.

Concepts and Skills	The Standards for Mathematical Practices
Pre-requisite • Fit a regression line to linear data using technology (NC.M1.S-ID.6a)	**Connections** *Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard.* 4 – Model with mathematics 5 – Use appropriate tools strategically 6 – Attend to precision
Connections • Create and graph equations that represent exponential relationships (NC.M1.A-CED.1) • Recognize a geometric sequence as a subset of the range of an exponential function (NC.M1.F-IF.3) • Exponential growth and decay (NC.M1.F-IF.8b) • Use technology to analyze patterns and describe relationships between two variables in context. (NC.M1.S-ID.7) • Identify situations that can be modeled with linear and exponential functions, and justify the most appropriate model (NC.M1.F-LE.1) • Interpret the parameters in linear or exponential functions in terms of a context (NC.M1.F-LE.5) • Interpret key features in context to describe functions relating two quantities (NC.M1.F-IF.4) • Interpret a function in terms of its domain and range in context (NC.M1.F-IF.5) • Calculate and interpret the avg. rate of change for a function (NC.M1.F-IF.6)	**Vocabulary** *As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard:*

Snapshot Overview **Return to Main Menu**

Mastering the Standard

Comprehending the Standard

Work with exponential functions is new to students. In 8th grade, students focused on identifying characteristics of linear functions and distinguishing them from non-linear functions. Students will use the same tools to explore exponential functions specifically.

This standard should be explored in context to help students make meaning of the behavior of exponential models. Technology can be used as a tool to make connections between symbolic, tabular and graphical representations of exponential functions. This will also help to build conceptual understanding of exponential growth and decay.

At this level, students should be able to support the use of an exponential model based on the graphical display and the understanding of the constant ratio between consecutive terms; a concept supported by the study of geometric sequences.

Students should be presented with exponential data and asked to fit the function to the data using technology. They should **NOT** have to *verify* the appropriateness of an exponential model; analysis at that level requires transformations for linearity, which is an advanced statistical concept.

Assessing for Understanding

Students can use graphing technology or a graphing calculator to determine the exponential model for a given data set or scatter plot.

Example: What is the exponential function that best models the number of gnats the scientists have gathered after the number of hours listed? How many hours will it take for 200 gnats to gather?

Hours	0	1	2	3	4
Number of gnats	12	20	35	60	80

Students can make connections between the graph, table, and symbolic representations of an exponential function.

Example: In an experiment, 300 pennies were shaken in a cup and poured onto a table. Any penny 'heads up' was removed. The remaining pennies were returned to the cup and the process was repeated. The results of the experiment are shown below. Write a function rule suggested by the context. Use the context to explain all values of the function. How are those values reflected in the table?

# of Rolls	0	1	2	3	4	5
# of Pennies	300	164	100	46	20	8

Instructional Resources

Tasks	Additional Resources
Stopping Distance vs. Speed (UCLA Curtis Center)	Income vs Literacy (Smarter Balanced CAT Sample Question)

Snapshot Overview

Return to Main Menu

NC.M1.S-ID.7

Interpret linear models.

Interpret in context the rate of change and the intercept of a linear model. Use the linear model to interpolate and extrapolate predicted values. Assess the validity of a predicted value.

Concepts and Skills
Pre-requisite
• Interpret the slope and *y*-intercept of a linear model in context (8.SP.3)
Connections
• Fit a regression line to linear data using technology (NC.M1.S-ID.6a) • Interpret the parameters in linear or exponential functions in terms of a context (NC.M1.F-LE.5) • Interpret key features in context to describe functions relating two quantities (NC.M1.F-IF.4) • Calculate and interpret the avg. rate of change for a function (NC.M1.F-IF.6)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct a viable argument and critique the reasoning of others 4 – Model with mathematics 5 – Use appropriate tools strategically 6 – Attend to precision
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard:

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Students have interpreted the slope and y-intercept of a linear model in 8th grade. This standard expands upon this notion to using the model to make **predictions**. **Interpolation** is using the function to predict the value of the dependent variable for an independent variable that is in the midst of the data.	Students can interpret the meaning of the rate of change and *y*-intercept in context. Students can interpolate and/or extrapolate predicted values using the linear model. **Example:** Data was collected of the weight of a male white laboratory rat for the first 25 weeks after its birth. A scatterplot of the rat's weight (in grams) and the time since birth (in weeks)

Snapshot Overview

Return to Main Menu

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Extrapolation is using the function to predict the value of the dependent variable for an independent variable that is outside the range of our data.	indicates a fairly strong, positive linear relationship. The linear regression equation $W = 100 + 40t$ (where W = weight in grams and t = number of weeks since birth) models the data fairly well. a. Explain the meaning of the slope of the linear regression equation in context. b. Explain the meaning of the *y*-intercept of the linear regression equation in context. c. Based on the linear regression model, what will be the weight of the rat 10 weeks after birth? d. Based on the linear regression model, at how many weeks will the rat be 760 grams?

Instructional Resources	
Tasks	**Additional Resources**
Texting and Grades II (Illustrative Mathematics) Used Subaru Foresters II (Illustrative Mathematics)	Charge! (DESMOS)

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.8

Interpret linear models.

Analyze patterns and describe relationships between two variables in context. Using technology, determine the correlation coefficient of bivariate data and interpret it as a measure of the strength and direction of a linear relationship. Use a scatter plot, correlation coefficient, and a residual plot to determine the appropriateness of using a linear function to model a relationship between two variables.

Concepts and Skills
Pre-requisite
• Construct and interpret scatterplots for two-variable data and describe patterns of association (8.SP.1) • Fit a regression line to linear data using technology (NC.M1.S-ID.6a) • Assess linearity by analyzing residuals (NC.M1.S-ID.6b)
Connections
• Identify situations that can be modeled with linear and exponential functions, and justify the most appropriate model (NC.M1.F-LE.1)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct viable arguments and critique the reasoning of others 4 – Model with mathematics 5 – Use appropriate tools strategically 6 – Attend to precision
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard: New Vocabulary: correlation, correlation coefficient

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
In working with bivariate data in MS, students have previously investigated patterns of association between two quantities (specifically, positive and negative associations and linear and non-linear associations). The correlation coefficient, *r*, is a measure of the strength and direction of a linear relationship between two quantities in a set of data.	Students can interpret the correlation coefficient. **Example:** The correlation coefficient of a given data set is 0.97. List three specific things this tells you about the data. Students recognize the strength of the association of two quantities based on the scatter plot. **Example:** Which correlation coefficient best matches each graph? Explain.

Snapshot Overview

Return to Main Menu

Mastering the Standard

Comprehending the Standard

The magnitude (absolute value) of *r* indicates how closely the data points fit a linear pattern.

If $r = \pm 1$, all points fall exactly on a line. The sign of *r* indicates the direction of the relationship. The closer $|r|$ is to 1, the stronger the correlation and the closer $|r|$ is to zero, the weaker the correlation.

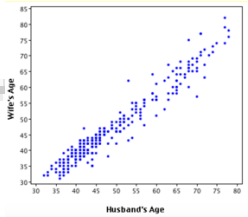
Instructions for TI-83 and TI-84 series calculators:

1: Go to the [catalog]. Click→ **2nd** then **0**.
2: Scroll down to → DiagnosticOn and press **enter** twice.

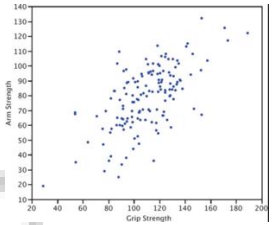
When '**Done**' appears on the screen the diagnostics are on and the calculator should now calculate the correlation coefficient (*r*) automatically when linear regression is performed.

Assessing for Understanding

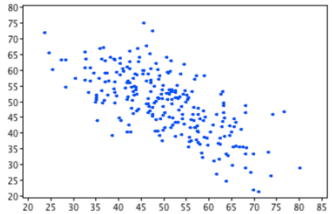
A. *r* = _____



B. *r* = _____



C. *r* = _____



r = –.48	*r* = .98	*r* = .88	*r* = –.17	*r* = 1	*r* = .31	*r* = –1

Students will be able to analyze patterns in context between two variables and use graphing technology to determine whether a linear model is appropriate for the data.

Example: The following data set indicates the average weekly temperature and the number of sno-cones sold by Sno-Show Sno-cones each week in May for the temperatures noted.

a. Using technology, sketch a scatter plot of the data above.
b. Determine a linear regression model that could represent the data shown.
c. Determine the correlation coefficient.
d. Determine the strength and direction of the linear relationship.
e. Create a residual plot.
Is a linear model appropriate for the data shown? Explain.

Average weekly temperature	# of Sno-cones sold
68	500
74	600
74	700
80	800
82	1200

NOTE: Remind students to turn the Diagnostics on in the graphing calculator so that the correlation coefficient (*r*) appears when the regression equation is calculated.

Instructional Resources

Tasks	Additional Resources
Used Subaru Foresters I (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

Interpreting Categorical and Quantitative Data

NC.M1.S-ID.9

Interpret linear models.

Distinguish between association and causation.

Concepts and Skills
Pre-requisite
• Construct and interpret scatterplots for two-variable data and describe patterns of association (8.SP.1) • Fit a regression line to linear data using technology (NC.M1.S-ID.6a) • Assess linearity by analyzing residuals (NC.M1.S-ID.6b)
Connections
• Fit a function to exponential data using technology (NC.M1.S-ID.6c)

The Standards for Mathematical Practices
Connections
Generally, all SMPs can be applied in every standard. The following SMPs can be highlighted for this standard. 3 – Construct viable arguments and critique the reasoning of others
Vocabulary
As stated in SMP 6, the precise use of mathematical vocabulary is the expectation in all oral and written communication. The following vocabulary is new to this course and supported by this standard: New Vocabulary: correlation, causation, association

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
In working with bivariate data in MS, students have previously investigated patterns of association between two quantities (specifically, positive and negative associations and linear and non-linear associations). This standard addresses an often made misconception in regard to association, correlation and causation. Association indicates a relationship between two or more variables and correlation indicates the degree of association between two quantities. Causation, on the other hand, implies a cause and effect relationship when a strong relationship is observed.	Students will recognize that association does not imply causation. **Example:** The following graph shows the correlation between *Letters in Winning Word of Scripps National Spelling Bee* and *Number of people killed by venomous spiders*. How does the graph support the phrase: <u>association does not imply causation</u>?

Mastering the Standard	
Comprehending the Standard	**Assessing for Understanding**
Determining causation goes beyond the idea of mere assocation or a high degree of correlation and requires the design and analysis of a randomized experimental process.	 For more examples, explore the site http://tylervigen.com/. Students will determine if statements of causation are reasonable or not and justify their opinion. **Example:** A study found a strong, positive correlation between the number of cars owned and the length of one's life. Larry concludes that owning more cars means you will live longer. Does this seem reasonable? Explain your answer. **Example:** Choose two variables that could be correlated because one is the cause of the other; defend and justify the selection of variables.

Instructional Resources	
Tasks	**Additional Resources**
Coffee vs. Crime (Illustrative Mathematics) Golf and Divorce (Illustrative Mathematics)	

Snapshot Overview

Return to Main Menu

Public Schools of North Carolina
State Board of Education | Department of Public Instruction

8th Grade Mathematics ● Unpacked Content

For the new Common Core standards that will be effective in all North Carolina schools in the 2012-13 School Year.

This document is designed to help North Carolina educators teach the Common Core (Standard Course of Study). NCDPI staff are continually updating and improving these tools to better serve teachers.

What is the purpose of this document?
To increase student achievement by ensuring educators understand specifically what the new standards mean a student must know, understand and be able to do.

What is in the document?
Descriptions of what each standard means a student will know, understand and be able to do. The "unpacking" of the standards done in this document is an effort to answer a simple question "What does this standard mean that a student must know and be able to do?" and to ensure the description is helpful, specific and comprehensive for educators.

How do I send Feedback?
We intend the explanations and examples in this document to be helpful and specific. That said, we believe that as this document is used, teachers and educators will find ways in which the unpacking can be improved and made ever more useful. Please send feedback to us at feedback@dpi.state.nc.us and we will use your input to refine our unpacking of the standards. Thank You!

Just want the standards alone?
You can find the standards alone at www.corestandards.org .

Return to Main Menu

Snapshot Overview

At A Glance

This page was added to give a snapshot of the mathematical concepts that are new or have been removed from this grade level as well as instructional considerations for the first year of implementation.

New to 8th Grade:

- Integer exponents with numerical bases (8.EE.1)
- Scientific notation, including multiplication and division (8.EE.3 and 8.EE.4)
- Unit rate as slope (8.EE.5)
- Qualitative graphing (8.F.5)
- Transformations (8.G.1 and 8.G.3)
- Congruent and similar figures (characterized through transformations) (8.G.2 and 8.G.4)
- Angles (exterior angles, parallel cut by transversal, angle-angle criterion) (8.G.5)
- Finding diagonal distances on a coordinate plane using the Pythagorean Theorem (8.G.8)
- Volume of cones, cylinders and spheres (8.G.9)
- Two-way tables (8.SP.4)

Moved from 8th Grade:

- Indirect measurement (embedded throughout)
- Linear inequalities (moved to high school)
- Effect of dimension changes (moved to high school)
- Misuses of data (embedded throughout)
- Function notation (moved to high school)
- Point-slope form (moved to high school) and standard form of a linear equation (not in CCSS)

Notes:

- Topics may appear to be similar between the CCSS and the 2003 NCSCOS; however, the CCSS may be presented at a higher cognitive demand.
- **For more detailed information, see the crosswalks (http://www.ncpublicschools.org/acre/standards/common-core-tools)**

Instructional considerations for CCSS implementation in 2012 – 2013:

- Solving proportions with tables, graphs, equations (7.RP.2a, 7.RP.2b, 7.RP.2c, 7.RP.2d) – prerequisite to 8.EE.5
- Identifying the conditions for lengths to make a triangle (7.G.2)
- Supplementary, complementary, vertical and adjacent angles (7.G.5) – prerequisite to 8.G.5
- Finding vertical and horizontal distances on the coordinate plane (6.NS.3) – foundational to 8.G.8
- Mean Absolute Deviation (6.SP.5c) – foundational to standard deviation in Math One standards so could be addressed at that time.

Snapshot Overview

Return to Main Menu

Standards for Mathematical Practice

The Common Core State Standards for Mathematical Practice are expected to be integrated into every mathematics lesson for all students Grades K-12. Below are a few examples of how these Practices may be integrated into tasks that students complete.

Standards for Mathematical Practice	Explanations and Examples
1. Make sense of problems and persevere in solving them.	In grade 8, students solve real world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"
2. Reason abstractly and quantitatively.	In grade 8, students represent a wide variety of real world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.
3. Construct viable arguments and critique the reasoning of others.	In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking.
4. Model with mathematics.	In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.
5. Use appropriate tools strategically.	Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.
6. Attend to precision.	In grade 8, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays.
7. Look for and make use of structure.	Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.

Snapshot Overview

Return to Main Menu

Standards for Mathematical Practice	Explanations and Examples
8. Look for and express regularity in repeated reasoning. **Snapshot Overview**	In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. They analyze patterns of repeating decimals to identify the corresponding fraction. During multiple opportunities to solve and model problems, they notice that the slope of a line and rate of change are the same value. Students flexibly make connections between covariance, rates, and representations showing the relationships between quantities. **Return to Main Menu**

Grade 8 Critical Areas (from CCSS pg. 52)

The Critical Areas are designed to bring focus to the standards at each grade by describing the big ideas that educators can use to build their curriculum and to guide instruction. The Critical Areas for eighth grade can be found on page 52 in the *Common Core State Standards for Mathematics.*

1. **Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations**
   Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m \cdot A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

   Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2. **Grasping the concept of a function and using functions to describe quantitative relationships**
   Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

3. **Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem**
   Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

Snapshot Overview **Return to Main Menu**

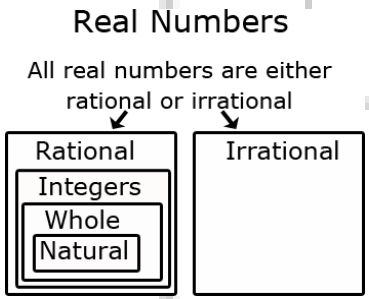
The Number System 8.NS

Common Core Cluster

Know that there are numbers that are not rational, and approximate them by rational numbers.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **Real Numbers, Irrational numbers, Rational numbers, Integers, Whole numbers, Natural numbers, radical, radicand, square roots, perfect squares, cube roots, terminating decimals, repeating decimals, truncate**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES 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.	**8.NS.1** Students understand that Real numbers are either rational or irrational. They distinguish between rational and irrational numbers, recognizing that any number that can be expressed as a fraction is a rational number. The diagram below illustrates the relationship between the subgroups of the real number system.



Students recognize that the decimal equivalent of a fraction will either terminate or repeat. Fractions that terminate will have denominators containing only prime factors of 2 and/or 5. This understanding builds on work in 7th grade when students used long division to distinguish between repeating and terminating decimals.

Students convert repeating decimals into their fraction equivalent using patterns or algebraic reasoning.

One method to find the fraction equivalent to a repeating decimal is shown below.

Example 1:

Change $0.\overline{4}$ to a fraction.

- Let $x = 0.444444\ldots$
- Multiply both sides so that the repeating digits will be in front of the decimal. In this example, one digit repeats so both sides are multiplied by 10, giving $10x = 4.4444444\ldots$
- Subtract the original equation from the new equation.

$$\begin{array}{r} 10x = 4.4444444\ldots \\ -\,x = 0.444444\ldots \\ \hline 9x = 4 \end{array}$$

Snapshot Overview

Return to Main Menu

- Solve the equation to determine the equivalent fraction.

$$\frac{9x}{9} = \frac{4}{9}$$

$$x = \frac{4}{9}$$

Additionally, students can investigate repeating patterns that occur when fractions have denominators of 9, 99, or 11.

Example 2:

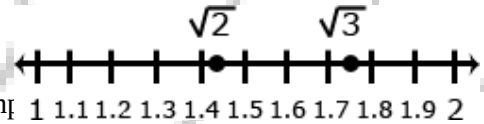
$\frac{4}{9}$ is equivalent to $0.\overline{4}$, $\frac{5}{9}$ is equivalent to $0.\overline{5}$, etc.

RESOURCES 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., π^2). *For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*

8.NS.2 Students locate rational and irrational numbers on the number line. Students compare and order rational and irrational numbers. Students also recognize that square roots may be negative and written as $-\sqrt{28}$.

Example 1:

Compare $\sqrt{2}$ and $\sqrt{3}$



Solution: Statements for the comp

$\sqrt{2}$ and $\sqrt{3}$ are between the whole numbers 1 and 2

$\sqrt{3}$ is between 1.7 and 1.8

$\sqrt{2}$ is less than $\sqrt{3}$

Additionally, students understand that the value of a square root can be approximated between integers and that non-perfect square roots are irrational.

Example 2:

Find an approximation of $\sqrt{28}$

- Determine the perfect squares $\sqrt{28}$ is between, which would be 25 and 36.
- The square roots of 25 and 36 are 5 and 6 respectively, so we know that $\sqrt{28}$ is between 5 and 6.
- Since 28 is closer to 25, an estimate of the square root would be closer to 5. One method to get an estimate is to divide 3 (the distance between 25 and 28) by 11 (the distance between the perfect squares of 25 and 36) to get 0.27.
- The estimate of $\sqrt{28}$ would be 5.27 (the actual is 5.29).

Snapshot Overview

Return to Main Menu

Expressions and Equations 8.EE

Common Core Cluster

Work with radicals and integer exponents.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **laws of exponents, power, perfect squares, perfect cubes, root, square root, cube root, scientific notation, standard form of a number.** Students should also be able to read and use the symbol: ±

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.	**8.EE.1** In 6th grade, students wrote and evaluated simple numerical expressions with whole number exponents (ie. $5^3 = 5 \cdot 5 \cdot 5 = 125$). Integer (positive and negative) exponents are further developed to generate equivalent numerical expressions when multiplying, dividing or raising a power to a power. Using numerical bases and the laws of exponents, students generate equivalent expressions. Students understand: • Bases must be the same before exponents can be added, subtracted or multiplied. (Example 1) • Exponents are subtracted when like bases are being divided (Example 2) • A number raised to the zero (0) power is equal to one. (Example 3) • Negative exponents occur when there are more factors in the denominator. These exponents can be expressed as a positive if left in the denominator. (Example 4) • Exponents are added when like bases are being multiplied (Example 5) • Exponents are multiplied when an exponents is raised to an exponent (Example 6) • Several properties may be used to simplify an expression (Example 7) Example 1: $\frac{2^3}{5^2} = \frac{8}{25}$ Example 2: $\frac{2^2}{2^6} = 2^{2-6} = 2^{-4} = \frac{1}{2^4} = \frac{1}{16}$ Example 3: $6^0 = 1$ Students understand this relationship from examples such as $\frac{6^2}{6^2}$. This expression could be simplified as $\frac{36}{36} = 1$. Using the laws of exponents this expression could also be written as $6^{2-2} = 6^0$. Combining these gives $6^0 = 1$. Example 4: $\frac{3^{-2}}{2^4} = 3^{-2} \times \frac{1}{2^4} = \frac{1}{3^2} \times \frac{1}{2^4} = \frac{1}{9} \times \frac{1}{16} = \frac{1}{144}$

Snapshot Overview

Return to Main Menu

Example 5:

$(3^2)(3^4) = (3^{2+4}) = 3^6 = 729$

Example 6:

$(4^3)^2 = 4^{3x2} = 4^6 = 4{,}096$

Example 7:

$$\frac{(3^2)^4}{(3^2)(3^3)} = \frac{3^{2x4}}{3^{2+3}} = \frac{3^8}{3^5} = 3^{8-5} = 3^3 = 27$$

RESOURCES 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.

8.EE.2

Students recognize perfect squares and cubes, understanding that non-perfect squares and non-perfect cubes are irrational.

Students recognize that squaring a number and taking the square root $\sqrt{\ }$ of a number are inverse operations; likewise, cubing a number and taking the cube root $\sqrt[3]{\ }$ are inverse operations.

Example 1:

$4^2 = 16$ and $\sqrt{16} = \pm 4$

NOTE: $(-4)^2 = 16$ while $-4^2 = -16$ since the negative is not being squared. This difference is often problematic for students, especially with calculator use.

Example 2:

$$\left(\frac{1}{3}\right)^3 = \left(\frac{1^3}{3^3}\right) = \frac{1}{27} \text{ and } \sqrt[3]{\frac{1}{27}} = \frac{\sqrt[3]{1}}{\sqrt[3]{27}} = \frac{1}{3}$$

NOTE: there is no negative cube root since multiplying 3 negatives would give a negative.

This understanding is used to solve equations containing square or cube numbers. Rational numbers would have perfect squares or perfect cubes for the numerator and denominator. In the standard, the value of p for square root and cube root equations must be positive.

Example 3:

Solve: $x^2 = 25$

Solution: $\sqrt{x^2} = \pm\sqrt{25}$

$x = \pm 5$

NOTE: There are two solutions because 5 • 5 and -5 • -5 will both equal 25.

Snapshot Overview

Return to Main Menu

	Example 4: Solve: $x^2 = \frac{4}{9}$ *Solution:* $\sqrt{x^2} = \pm\sqrt{\frac{4}{9}}$ $x = \pm\frac{2}{3}$ Example 5: Solve: $x^3 = 27$ *Solution:* $\sqrt[3]{x^3} = \sqrt[3]{27}$ $x = 3$ Example 6: Solve: $x^3 = \frac{1}{8}$ *Solution:* $\sqrt[3]{x^3} = \sqrt[3]{\frac{1}{8}}$ $x = \frac{1}{2}$ Students understand that in geometry the square root of the area is the length of the side of a square and a cube root of the volume is the length of the side of a cube. Students use this information to solve problems, such as finding the perimeter. Example 7: What is the side length of a square with an area of 49 ft^2? *Solution:* $\sqrt{49} = 7$ ft. The length of one side is 7 ft.
RESOURCES 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 × 10^8 and the population of the world as 7 × 10^9, and determine that the world population is more than 20 times larger.*	**8.EE.3** Students use scientific notation to express very large or very small numbers. Students compare and interpret scientific notation quantities in the context of the situation, recognizing that if the exponent increases by one, the value increases 10 times. Likewise, if the exponent decreases by one, the value decreases 10 times. Students solve problems using addition, subtraction or multiplication, expressing the answer in scientific notation. Example 1: Write 75,000,000,000 in scientific notation. *Solution:* 7.5×10^{10} Example 2: Write 0.0000429 in scientific notation. *Solution:* 4.29×10^{-5}

Return to Main Menu

Snapshot Overview

Example 3:
Express 2.45×10^5 in standard form.
Solution: 245,000

Example 4:
How much larger is 6×10^5 compared to 2×10^3
Solution: 300 times larger since 6 is 3 times larger than 2 and 10^5 is 100 times larger than 10^3.

Example 5:
Which is the larger value: 2×10^6 or 9×10^5?
Solution: 2×10^6 because the exponent is larger

RESOURCES 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.

8.EE.4 Students understand scientific notation as generated on various calculators or other technology. Students enter scientific notation using E or EE (scientific notation), * (multiplication), and ^ (exponent) symbols.
Example 1: 2.45E+23 is 2.45×10^{23} and 3.5E-4 is 3.5×10^{-4} (NOTE: There are other notations for scientific notation depending on the calculator being used.)
Students add and subtract with scientific notation.
Example 2: In July 2010 there were approximately 500 million Facebook users. In July 2011 there were approximately 750 million Facebook users. How many more users were there in 2011? Write your answer in scientific notation.
Solution: Subtract the two numbers: 750,000,000 - 500,000,000 = 250,000,000 → 2.5×10^8

Students use laws of exponents to multiply or divide numbers written in scientific notation, writing the product or quotient in proper scientific notation.
Example 3:
$(6.45 \times 10^{11})(3.2 \times 10^4) = (6.45 \times 3.2)(10^{11} \times 10^4)$ *Rearrange factors*
$= 20.64 \times 10^{15}$ *Add exponents when multiplying powers of 10*
$= 2.064 \times 10^{16}$ *Write in scientific notation*

Example 4:
$\frac{3.45 \times 10^5}{6.7 \times 10^{-2}} \quad \frac{6.3}{1.6} \quad 10^{5-(-2)}$ *Subtract exponents when dividing powers of 10*
$= 0.515 \times 10^7$ *Write in scientific notation*
$= 5.15 \times 10^6$

Example 5:
$(0.0025)(5.2 \times 10^4) = (2.5 \times 10^{-3})(5.2 \times 10^5)$ *Write factors in scientific notation*
$= (2.5 \times 5.2)(10^{-3} \times 10^5)$ *Rearrange factors*
$= 13 \times 10^2$ *Add exponents when multiplying powers of 10*
$= 1.3 \times 10^3$ *Write in scientific notation*
Example 6: The speed of light is 3×10^8 meters/second. If the sun is 1.5×10^{11} meters from earth, how many seconds does it take light to reach the earth? Express your answer in scientific notation.

Solution: 5×10^2
(light)(x) = sun, where x is the time in seconds

Snapshot Overview

Return to Main Menu

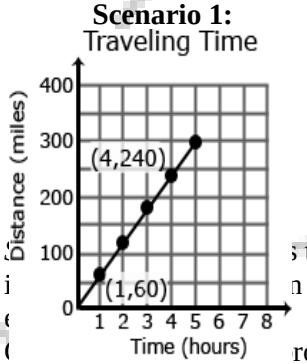
	$(3 \times 10^{8})x = 1.5 \times 10^{11}$ $\frac{1.5 \times 10^{11}}{3 \times 10^{8}}$ Students understand the magnitude of the number being expressed in scientific notation and choose an appropriate corresponding unit. Example 7: 3×10^{8} is equivalent to 300 million, which represents a large quantity. Therefore, this value will affect the unit chosen.

Expressions and Equations 8.EE

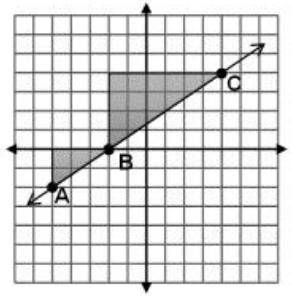
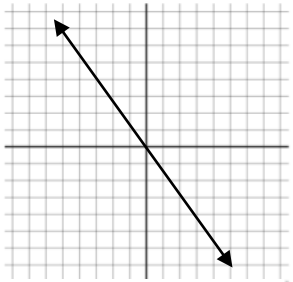
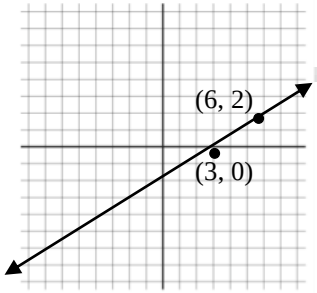
Common Core Cluster

Understand the connections between proportional relationships, lines, and linear equations.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **unit rate, proportional relationships, slope, vertical, horizontal, similar triangles, *y*-intercept**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES 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.* **Snapshot Overview**	**8.EE.5** Students build on their work with unit rates from 6th grade and proportional relationships in 7th grade to compare graphs, tables and equations of proportional relationships. Students identify the unit rate (or slope) in graphs, tables and equations to compare two proportional relationships represented in different ways. Example 1:Compare the scenarios to determine which represents a greater speed. Explain your choice including a written description of each scenario. Be sure to include the unit rates in your explanation. **Scenario 1:**  **Scenario 2:** $y = 55x$ x is time in hours y is distance in miles s the greater speed since the unit rate is 60 miles per hour. The graph shows this rate since 60 i n one hour. Scenario 2 has a unit rate of 55 miles per hour shown as the coefficient in the (roportional relationship, students draw a graph of the relationship. Students recognize that the unit rate is the coefficient of x and that this value is also the slope of the line.
RESOURCES Use similar triangles to explain why the slope m is the same between any 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	**8.EE.6** Triangles are similar when there is a constant rate of proportionality between them. Using a graph, students construct triangles between two points on a line and compare the sides to understand that the slope (ratio of rise to run) is the same between any two points on a line. Example 1: The triangle between A and B has a vertical height of 2 and a horizontal length of 3. The triangle between B and C has a vertical height of 4 and a horizontal length of 6.

Return to Main Menu

$y = mx + b$ for a line intercepting the vertical axis at b.	The simplified ratio of the vertical height to the horizontal length of both triangles is 2 to 3, which also represents a slope of $\frac{2}{3}$ for the line, indicating that the triangles are similar. Given an equation in slope-intercept form, students graph the line represented. Students write equations in the form $y = mx$ for lines going through the origin, recognizing that m represents the slope of the line.  <u>Example 2:</u>Write an equation to represent the graph to the right.  *Solution:* $y = -\frac{3}{2}x$ Students write equations in the form $y = mx + b$ for lines no n, recognizing that m represents the slope and b represents the y-intercept.  *Solution:* $y = \frac{2}{3}x - 2$

Expressions and Equations 8.EE

Common Core Cluster

Analyze and solve linear equations and pairs of simultaneous linear equations.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **intersecting, parallel lines, coefficient, distributive property, like terms, substitution, system of linear equations**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution,	**8.EE.7** Students solve one-variable equations including those with the variables being on both sides of the equals sign. Students recognize that the solution to the equation is the value(s) of the variable, which make a true equality when substituted back into the equation. Equations shall include rational numbers, distributive property and combining like terms.

Snapshot Overview **Return to Main Menu**

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.

Snapshot Overview

Example 1:

Equations have one solution when the variables do not cancel out. For example, $10x - 23 = 29 - 3x$ can be solved to $x = 4$. This means that when the value of x is 4, both sides will be equal. If each side of the equation were treated as a linear equation and graphed, the solution of the equation represents the coordinates of the point where the two lines would intersect. In this example, the ordered pair would be (4, 17).

$$10 \cdot 4 - 23 = 29 - 3 \cdot 4$$
$$40 - 23 = 29 - 12$$
$$17 = 17$$

Example 2:

Equations having no solution have variables that will cancel out and constants that are not equal. This means that there is not a value that can be substituted for x that will make the sides equal.

$-x + 7 - 6x = 19 - 7x$ *Combine like terms*

$-7x + 7 = 19 - 7x$ *Add 7x to each side*

$7 \neq 19$

This solution means that no matter what value is substituted for x the final result will never be equal to each other.

If each side of the equation were treated as a linear equation and graphed, the lines would be parallel.

Example 3:

An equation with infinitely many solutions occurs when both sides of the equation are the same. Any value of x will produce a valid equation. For example the following equation, when simplified will give the same values on both sides.

$$-\frac{1}{2}(36a - 6) = \frac{3}{4}(4 - 24a)$$

$-18a + 3 = 3 - 18a$

If each side of the equation were treated as a linear equation and graphed, the graph would be the same line.

Students write equations from verbal descriptions and solve.

Example 4:

Two more than a certain number is 15 less than twice the number. Find the number.

Solution:

$n + 2 = 2n - 15$

$17 = n$

Return to Main Menu

Expressions and Equations 8.EE

Common Core Cluster

Analyze and solve linear equations and pairs of simultaneous linear equations.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **intersecting, parallel lines, coefficient, distributive property, like terms, substitution, system of linear equations**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES Analyze and solve pairs of simultaneous linear equations. 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.	**8.EE.8** Systems of linear equations can also have one solution, infinitely many solutions or no solutions. Students will discover these cases as they graph systems of linear equations and solve them algebraically. Students graph a system of two linear equations, recognizing that the ordered pair for the point of intersection is the *x*-value that will generate the given *y*-value for both equations. Students recognize that graphed lines with one point of intersection (different slopes) will have one solution, parallel lines (same slope, different *y*-intercepts) have no solutions, and lines that are the same (same slope, same *y*-intercept) will have infinitely many solutions. By making connections between algebraic and graphical solutions and the context of the system of linear equations, students are able to make sense of their solutions. Students need opportunities to work with equations and context that include whole number and/or decimals/fractions. Students define variables and create a system of linear equations in two variables <u>Example 1:</u> 1. Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same. *Solution:* Let *W* = number of weeks Let *H* = height of the plant after *W* weeks

Plant A		
W	H	
0	4	(0, 4)
1	6	(1, 6)
2	8	(2, 8)
3	10	(3, 10)

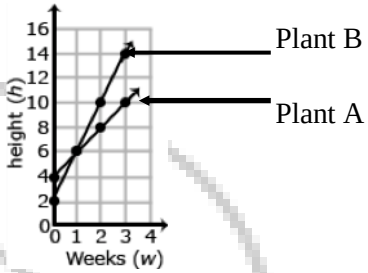
Plant B		
W	H	
0	2	(0, 2)
1	6	(1, 6)
2	10	(2, 10)
3	14	(3, 14)

Snapshot Overview

Return to Main Menu

2. Based on the coordinates from the table, graph lines to represent each plant.

Solution:



3. Write an equation that represents the growth rate of Plant A and Plant B.

Solution: Plant A $H = 2W + 4$

Plant B $H = 4W + 2$

4. At which week will the plants have the same height?

Solution:

$2W + 4 = 4W + 2$ *Set height of Plant A equal to height of Plant B*

$2W - 2W + 4 = 4W - 2W + 2$ *Solve for W*

$4 = 2W + 2$

$4 - 2 = 2W + 2 - 2$

$\frac{2}{2} = \frac{2W}{2}$

$1 = W$

After one week, the height of Plant A and Plant B are both 6 inches.

Check: $2(1) + 4 = 4(1) + 2$

$2 + 4 = 4 + 2$

$6 = 6$

Given two equations in slope-intercept form (Example 1) or one equation in standard form and one equation in slope-intercept form, students use substitution to solve the system.

Snapshot Overview

Return to Main Menu

Example 2:

Solve: Victor is half as old as Maria. The sum of their ages is 54. How old is Victor?

Solution: Let v = Victor's age
Let m = Maria's age

$$\begin{cases} v + m = 54 \\ v = \frac{1}{2} m \end{cases}$$

$\frac{1}{2} m + m = 54$ *Substitute ½m for v in the first equation*

$1\frac{1}{2} m = 54$

$m = 36$

If Maria is 36, then substitute 36 into $v + m = 54$ to find Victor's age of 18.

Note: Students are not expected to change linear equations written in standard form to slope-intercept form or solve systems using elimination.

For many real world contexts, equations may be written in standard form. Students are not expected to change the standard form to slope-intercept form. However, students may generate ordered pairs recognizing that the values of the ordered pairs would be solutions for the equation. For example, in the equation above, students could make a list of the possible ages of Victor and Maria that would add to 54. The graph of these ordered pairs would be a line with all the possible ages for Victor and Maria.

Victor	Maria
20	34
10	44
50	4
29	25

Snapshot Overview

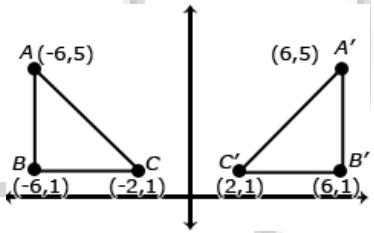
Return to Main Menu

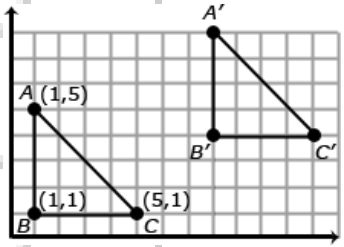
RESOURCES Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8.G.3 Students identify resulting coordinates from translations, reflections, and rotations (90º, 180º and 270º both clockwise and counterclockwise), recognizing the relationship between the coordinates and the transformation.

Translations

Translations move the object so that every point of the object moves in the same direction as well as the same distance. In a translation, the translated object is *congruent* to its pre-image. Triangle ABC has been translated 7 units to the right and 3 units up. To get from A (1,5) to A' (8,8), move A 7 units to the right (from $x = 1$ to $x = 8$) and 3 units up (from $y = 5$ to $y = 8$). Points B and C also move in the same direction (7 units to the right and 3 units up), resulting in the same changes to each coordinate.





Reflections

A reflection is the "flipping" of an object over a line, known as the "line of reflection". In the 8th grade, the line of reflection will be the *x*-axis and the *y*-axis. Students recognize that when an object is reflected across the *y*-axis, the reflected *x*-coordinate is the opposite of the pre-image x-coordinate (see figure below).

Likewise, a reflection across the *x*-axis would change a pre-image coordinate (3, -8) to the image coordinate of (3, 8) -- note that the reflected *y*-coordinate is opposite of the pre-image *y*-coordinate.

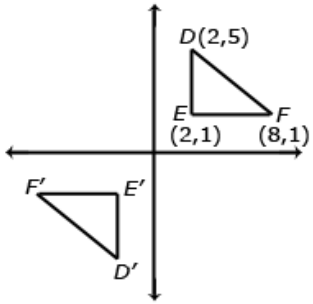
Rotations

A rotation is a transformation performed by "spinning" the figure around a fixed point known as the center of rotation. The figure may be rotated clockwise or counterclockwise up to 360º (at 8th grade, rotations will be around the origin and a multiple of 90º). In a rotation, the rotated object is *congruent* to its pre-image

Consider when triangle DEF is 180˚ clockwise about the origin. The coordinate of triangle DEF are D(2,5), E(2,1), and F(8,1). When rotated 180˚ about the origin, the new coordinates are D'(-2,-5), E'(-2,-1) and F'(-8,-1). In this case, each coordinate is the opposite of its pre-image (see figure below).

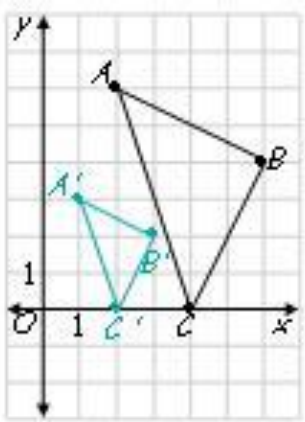
Snapshot Overview

Return to Main Menu



Dilations

A dilation is a non-rigid transformation that moves each point along a ray which starts from a fixed center, and multiplies distances from this center by a common scale factor. Dilations enlarge (scale factors greater than one) or reduce (scale factors less than one) the size of a figure by the scale factor. In 8th grade, dilations will be from the origin. The dilated figure is *similar* to its pre-image.



The coordinates of A are (2, 6); A' (1, 3). The coordinates of B are (6, 4) and B' are (3, 2). The coordinates of C are (4, 0) and C' are (2, 0). Each of the image coordinates is ½ the value of the pre-image coordinates indicating a scale factor of ½.

The scale factor would also be evident in the length of the line segments using the ratio: $\frac{\text{image length}}{\text{pre-image length}}$

Students recognize the relationship between the coordinates of the pre-image, the image and the scale factor for a dilation from the origin. Using the coordinates, students are able to identify the scale factor (image/pre-image).

Students identify the transformation based on given coordinates. For example, the pre-image coordinates of a triangle are A(4, 5), B(3, 7), and C(5, 7). The image coordinates are A(-4, 5), B(-3, 7), and C(-5, 7). What transformation occurred?

Snapshot Overview

Return to Main Menu

Geometry 8.G

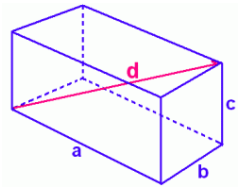
Common Core Cluster

Understand and apply the Pythagorean Theorem.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **right triangle, hypotenuse, legs, Pythagorean Theorem, Pythagorean triple**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES Explain a proof of the Pythagorean Theorem and its converse.	**8.G.6** Using models, students explain the Pythagorean Theorem, understanding that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Students also understand that given three side lengths with this relationship forms a right triangle. Example 1: The distance from Jonestown to Maryville is 180 miles, the distance from Maryville to Elm City is 300 miles, and the distance from Elm City to Jonestown is 240 miles. Do the three towns form a right triangle? Why or why not? *Solution*: If these three towns form a right triangle, then 300 would be the hypotenuse since it is the greatest distance. $180^2 + 240^2 = 300^2$ $32400 + 57600 = 90000$ $90000 = 90000$ These three towns form a right triangle.
RESOURCES Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	**8.G.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. Example 1: The Irrational Club wants to build a tree house. They have a 9-foot ladder that must be propped diagonally against the tree. If the base of the ladder is 5 feet from the bottom of the tree, how high will the tree house be off the ground? *Solution*: $a^2 + 5^2 = 9^2$ $a^2 + 25 = 81$ $a^2 = 56$ $\sqrt{a^2} = \sqrt{56}$ $a = \sqrt{56}$ or ~7.5
Snapshot Overview	Example 2: Find the length of d in the figure to the right if a = 8 in., b = 3 in. and c = 4in. **Return to Main Menu**

Solution:
First find the distance of the hypotenuse of the triangle formed with legs *a* and *b*.



$8^2 + 3^2 = c^2$
$64^2 + 9^2 = c^2$
$73 = c^2$
$\sqrt{73} = \sqrt{c^2}$
$\sqrt{73}$ in. $= c$

The $\sqrt{73}$ is the length of the base of a triangle with *c* as the other leg and *d* is the hypotenuse.
To find the length of *d*:
$\sqrt{73}^2 + 4^2 = d^2$
$73 + 16 = d^2$
$89 = d^2$
$\sqrt{89} = \sqrt{d^2}$
$\sqrt{89}$ in. $= d$

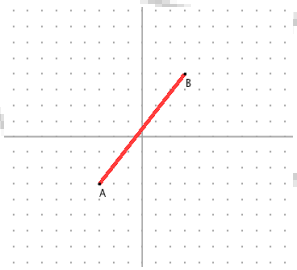
Based on this work, students could then find the volume or surface area.

RESOURCES Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

8.G.8 One application of the Pythagorean Theorem is finding the distance between two points on the coordinate plane. Students build on work from 6th grade (finding vertical and horizontal distances on the coordinate plane) to determine the lengths of the legs of the right triangle drawn connecting the points. Students understand that the line segment between the two points is the length of the hypotenuse.

NOTE: The use of the distance formula is not an expectation.

Example 1:
Find the length of $\overline{AB}$.



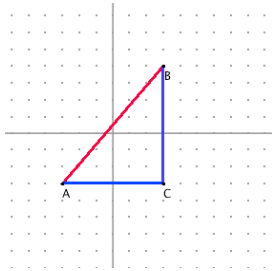
Solution:

1. Form a right triangle so that the given line segment is the hypotenuse.
2. Use Pythagorean Theorem to find the distance (length) between the two points.

$6^2 + 7^2 = c^2$

$36 + 49 = c^2$

$85 = c^2$



Example 2:
Find the distance between (-2, 4) and (-5, -6).

Snapshot Overview

Return to Main Menu

Solution:
The distance between -2 and -5 is the horizontal length; the distance between 4 and -6 is the vertical distance.
Horizontal length: 3
Vertical length: 10

$10^2 + 3^2 = c^2$
$100 + 9 = c^2$
$109 = c^2$
$\sqrt{109} = \sqrt{c^2}$
$\sqrt{109} = c$

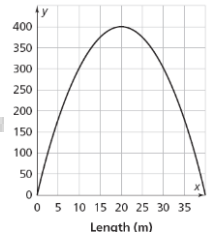
Students find area and perimeter of two-dimensional figures on the coordinate plane, finding the distance between each segment of the figure. (Limit one diagonal line, such as a right trapezoid or parallelogram)

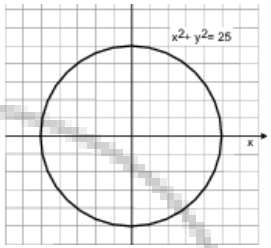
Functions 8.F

Common Core Cluster

Define, evaluate, and compare functions.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **functions, *y*-value, *x*-value, vertical line test, input, output, rate of change, linear function, non-linear function**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES 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.[1] [1]Function notation is not required in Grade 8. **Snapshot Overview**	**8.F.1** Students understand rules that take *x* as input and gives *y* as output is a function. Functions occur when there is exactly one *y*-value is associated with any *x*-value. Using *y* to represent the output we can represent this function with the equations $y = x^2 + 5x + 4$. Students are **not** expected to use the function notation *f(x)* at this level. Students identify functions from equations, graphs, and tables/ordered pairs. **Graphs** Students recognize graphs such as the one below is a function using the vertical line test, showing that each *x*-value has only one *y*-value;  whereas, graphs such as the following are not functions since there are 2 *y*-values for multiple *x*-value. **Return to Main Menu**



Tables or Ordered Pairs

Students read tables or look at a set of ordered pairs to determine functions and identify equations where there is only one output (*y*-value) for each input (*x*-value).

Functions

x	y
0	3
1	9
2	27

Not A Function

x	y
16	4
16	-4
25	5
25	-5

{(0, 2), (1, 3), (2, 5), (3, 6)}

Equations

Students recognize equations such as $y = x$ or $y = x^2 + 3x + 4$ as functions; whereas, equations such as $x^2 + y^2 = 25$ are not functions.

RESOURCES 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*

8.F.2 Students compare two functions from different representations.

Example 1:

Compare the following functions to determine which has the greater rate of change.

Snapshot Overview **Return to Main Menu**

has the greater rate of change.

Function 1: $y = 2x + 4$

Function 2:

x	y
-1	-6
0	-3
2	3

Solution: The rate of change for function 1 is 2; the rate of change for function 2 is 3. Function 2 has the greater rate of change.

Example 2:

Compare the two linear functions listed below and determine which has a negative slope.

Function 1: Gift Card

Samantha starts with $20 on a gift card for the bookstore. She spends $3.50 per week to buy a magazine. Let y be the amount remaining as a function of the number of weeks, *x*.

x	y
0	20
1	16.50
2	13.00
3	9.50

Function 2: Calculator rental

The school bookstore rents graphing calculators for $5 per month. It also collects a non-refundable fee of $10.00 for the school year. Write the rule for the total cost (c) of renting a calculator as a function of the number of months (*m*).

$c = 10 + 5m$

Solution: Function 1 is an example of a function whose graph has a negative slope. Both functions have a positive starting amount; however, in function 1, the amount decreases 3.50 each week, while in function 2, the amount increases 5.00 each month.

Snapshot Overview

Return to Main Menu

NOTE: Functions could be expressed in standard form. However, the intent is not to change from standard form to slope-intercept form but to use the standard form to generate ordered pairs. Substituting a zero (0) for x and y will generate two ordered pairs. From these ordered pairs, the slope could be determined.

Example 3:

$2x + 3y = 6$

Let $x = 0$:

$$2(0) + 3y = 6$$
$$3y = 6$$
$$\frac{3y}{3} = \frac{6}{3}$$
$$y = 2$$

Ordered pair: (0, 2)

Let $y = 0$:

$$2x + 3(0) = 6$$
$$2x = 6$$
$$\frac{2x}{2} = \frac{6}{2}$$
$$x = 3$$

Ordered pair: (3, 0)

Using (0, 2) and (3, 0) students could find the slope and make comparisons with another function.

RESOURCES 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.*

8.F.3 Students understand that linear functions have a constant rate of change between any two points. Students use equations, graphs and tables to categorize functions as linear or non-linear.

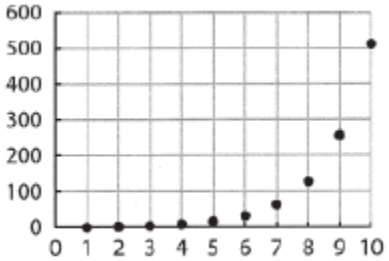
Example 1:

Determine if the functions listed below are linear or non-linear. Explain your reasoning.

1. $y = -2x^2 + 3$
2. $y = 0.25 + 0.5(x - 2)$
3. $A = \pi r^2$
4.

X	Y
1	12
2	7
3	4
4	3
5	4
6	7

5.



Solution:

1. Non-linear
2. Linear
3. Non-linear
4. Non-linear; there is not a constant rate of change
5. Non-linear; the graph curves indicating the rate of change is not constant.

Snapshot Overview

Return to Main Menu

Functions 8.F

Common Core Cluster

Use functions to model relationships between quantities.

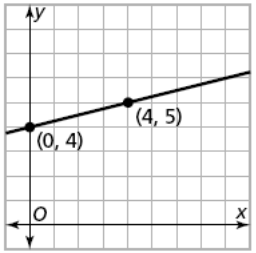
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **linear relationship, rate of change, slope, initial value, y-intercept**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES 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.	**8.F.4** Students identify the rate of change (slope) and initial value (y-intercept) from tables, graphs, equations or verbal descriptions to write a function (linear equation). Students understand that the equation represents the relationship between the x-value and the y-value; what math operations are performed with the x-value to give the y-value. Slopes could be undefined slopes or zero slopes. **Tables:** Students recognize that in a table the y-intercept is the y-value when x is equal to 0. The slope can be determined by finding the ratio $\frac{y}{x}$ between the change in two y-values and the change between the two corresponding x-values. Example 1: Write an equation that models the linear relationship in the table below. x: -2, 0, 1 y: 8, 2, -1 *Solution:* The y-intercept in the table below would be (0, 2). The distance between 8 and -1 is 9 in a negative direction → -9; the distance between -2 and 1 is 3 in a positive direction. The slope is the ratio of rise to run or $\frac{y}{x}$ or $\frac{-9}{3}$ = -3. The equation would be $y = -3x + 2$ **Graphs:** Using graphs, students identify the y-intercept as the point where the line crosses the y-axis and the slope as the rise. run

Snapshot Overview

Return to Main Menu

Example 2:
Write an equation that models the linear relationship in the graph below.



Solution: The y-intercept is 4. The slope is ¼ , found by moving up 1 and right 4 going from (0, 4) to (4, 5). The linear equation would be $y = \frac{1}{4}x + 4$.

Equations:
In a linear equation the coefficient of x is the slope and the constant is the y-intercept. Students need to be given the equations in formats other than $y = mx + b$, such as $y = ax + b$ (format from graphing calculator), $y = b + mx$ (often the format from contextual situations), etc.

Point and Slope:
Students write equations to model lines that pass through a given point with the given slope.
Example 2:
A line has a zero slope and passes through the point (-5, 4). What is the equation of the line?
Solution: $y = 4$

Example 3:
Write an equation for the line that has a slope of ½ and passes though the point (-2, 5)
Solution: $y = \frac{1}{2}x + 6$
Students could multiply the slope ½ by the x-coordinate -2 to get -1. Six (6) would need to be added to get to 5, which gives the linear equation.

Students also write equations given two ordered pairs. **Note that point-slope form is not an expectation at this level.** Students use the slope and y-intercepts to write a linear function in the form $y = mx + b$.

Contextual Situations:
In contextual situations, the y-intercept is generally the starting value or the value in the situation when the independent variable is 0. The slope is the rate of change that occurs in the problem. Rates of change can often occur over years. In these situations it is helpful for the years to be "converted" to 0, 1, 2, etc. For example, the years of 1960, 1970, and 1980 could be represented as 0 (for 1960), 10 (for 1970) and 20 (for 1980).

Snapshot Overview

Return to Main Menu

Example 4:
The company charges $45 a day for the car as well as charging a one-time $25 fee for the car's navigation system (GPS). Write an expression for the cost in dollars, *c*, as a function of the number of days, *d*, the car was rented.

Solution: $C = 45d + 25$

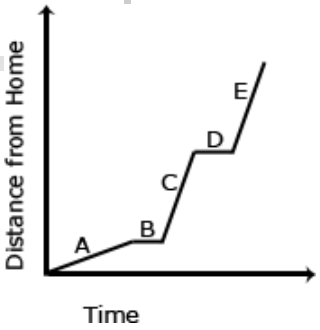
Students interpret the rate of change and the *y*-intercept in the context of the problem. In Example 4, the rate of change is 45 (the cost of renting the car) and that initial cost (the first day charge) also includes paying for the navigation system. Classroom discussion about one-time fees vs. recurrent fees will help students model contextual situations.

RESOURCES 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.

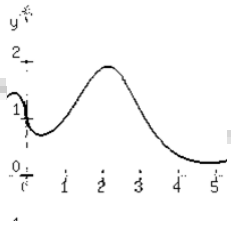
8.F.5 Given a verbal description of a situation, students sketch a graph to model that situation. Given a graph of a situation, students provide a verbal description of the situation.

Example 1:
The graph below shows a John's trip to school. He walks to his Sam's house and, together, they ride a bus to school. The bus stops once before arriving at school.

Describe how each part A – E of the graph relates to the story.
Solution:
A John is walking to Sam's house at a constant rate.
B John gets to Sam's house and is waiting for the bus.
C John and Sam are riding the bus to school. The bus is moving at a constant rate, faster than John's walking rate.
D The bus stops.
E The bus resumes at the same rate as in part C.



Example 2:
Describe the graph of the function between $x = 2$ and $x = 5$?



Solution:
The graph is non-linear and decreasing.

Snapshot Overview

Return to Main Menu

Statistics and Probability 8.SP

Common Core Cluster

Investigate patterns of association in bivariate data.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **bivariate data, scatter plot, linear model, clustering, linear association, non-linear association, outliers, positive association, negative association, categorical data, two-way table, relative frequency**

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
RESOURCES 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.	**8.SP.1** Bivariate data refers to two-variable data, one to be graphed on the *x*-axis and the other on the *y*-axis. Students represent numerical data on a scatter plot, to examine relationships between variables. They analyze scatter plots to determine if the relationship is linear (positive, negative association or no association) or non-linear. Students can use tools such as those at the National Center for Educational Statistics to create a graph or generate data sets. (http://nces.ed.gov/nceskids/createagraph/default.aspx) Data can be expressed in years. In these situations it is helpful for the years to be "converted" to 0, 1, 2, etc. For example, the years of 1960, 1970, and 1980 could be represented as 0 (for 1960), 10 (for 1970) and 20 (for 1980).

Example 1:
Data for 10 students' Math and Science scores are provided in the chart. Describe the association between the Math and Science scores.

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Science	68	70	83	33	60	27	74	63	40	96

Solution: This data has a positive association.

Example 2:
Data for 10 students' Math scores and the distance they live from school are provided in the table below. Describe the association between the Math scores and the distance they live from school.

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Distance from School (miles)	0.5	1.8	1	2.3	3.4	0.2	2.5	1.6	0.8	2.5

Solution: There is no association between the math score and the distance a student lives from school.

Return to Main Menu

Snapshot Overview

Example 3:
Data from a local fast food restaurant is provided showing the number of staff members and the average time for filling an order are provided in the table below. Describe the association between the number of staff and the average time for filling an order.

Number of Staff	3	4	5	6	7	8
Average time to fill order (seconds)	56	24	72	63	42	93

Solution: There is a positive association.

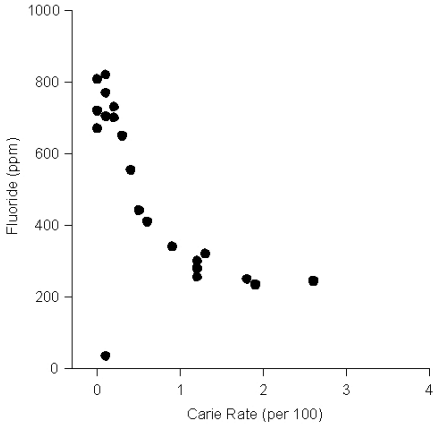
Example 4:
The chart below lists the life expectancy in years for people in the United States every five years from 1970 to 2005. What would you expect the life expectancy of a person in the United States to be in 2010, 2015, and 2020 based upon this data? Explain how you determined your values.

Date	1970	1975	1980	1985	1990	1995	2000	2005
Life Expectancy (in years)	70.8	72.6	73.7	74.7	75.4	75.8	76.8	77.4

Solution: There is a positive association.

Students recognize that points may be away from the other points (outliers) and have an effect on the linear model.
NOTE: Use of the formula to identify outliers is **not** expected at this level.

Students recognize that not all data will have a linear association. Some associations will be non-linear as in the example below:



Snapshot Overview

Return to Main Menu

RESOURCES 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

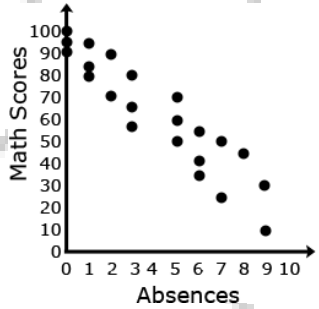
8.SP.2 Students understand that a straight line can represent a scatter plot with linear association. The most appropriate linear model is the line that comes closest to most data points. The use of linear regression is not expected. If there is a linear relationship, students draw a linear model. Given a linear model, students write an equation.

REOURCES Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

8.SP.3 Linear models can be represented with a linear equation. Students interpret the slope and *y*-intercept of the line in the context of the problem.

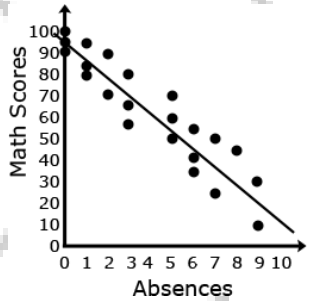
Example 1:

1. Given data from students' math scores and absences, make a scatterplot.



Absences	Math Scores
3	65
5	50
1	95
1	85
3	80
6	34
5	70
3	56
0	100
7	24
8	45
2	71
9	30
0	95
6	55
6	42
2	90
0	92
5	60
7	50
9	10
1	80

2. Draw a linear model paying attention to the closeness of the data points on either side of the line.



3. From the linear model, determine an approximate linear equation that models the given data (about $y = -\frac{25}{3}x + 95$)

4. Students should recognize that 95 represents the *y*-intercept and $-\frac{25}{3}$ represents the slope of the line. In the context of the problem, the *y*-intercept represents the math score a student with 0 absences could expect. The slope indicates that the math scores decreased 25 points for every 3 absences.

Snapshot Overview

Return to Main Menu

	5. Students can use this linear model to solve problems. For example, through substitution, they can use the equation to determine that a student with 4 absences should expect to receive a math score of about 62. They can then compare this value to their line.
RESOURCES 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 the 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?*	**8.SP.4** Students understand that a two-way table provides a way to organize data between two categorical variables. Data for both categories needs to be collected from each subject. Students calculate the relative frequencies to describe associations. Example 1: Twenty-five students were surveyed and asked if they received an allowance and if they did chores. The table below summarizes their responses. Of the students who do chores, what percent do not receive an allowance? *Solution:* 5 of the 20 students who do chores do not receive an allowance, which is 25%

	Receive Allowance	No Allowance
Do Chores	15	5
Do Not Do Chores	3	2

We would like to acknowledge the Arizona Department of Education for allowing us to use some of their examples and graphics

Return to Main Menu

EOC PERCENTAGES

Conceptual Category	Math I
Number and Quantity	5–10%
Algebra	25–31%
Functions	35–40%
Geometry	10–15%
Statistics and Probability	15–20%
Total	**100%**

Snapshot Overview

EOC Weighted Distribution

The following table shows the number of operational items for each standard. Note that future coverage of standards could vary within the constraints of the content category weights. Some standards not designated with tested items (i.e., "–") may be a prerequisite standard, may be tested within the context of another standard or may be included as an embedded field test item.

Math I		Number of Items Per Standard*
The Real Number System	N-RN.1	–
	N-RN.2	2
Quantities	N-Q.1	1
	N-Q.2	–
	N-Q.3	–
Seeing Structure in Expressions	A-SEE.1	–
	A-SEE.2	1
	A-SEE.3	0-1
Arithmetic with Polynomials & Rational Expressions	A-APR.1	1
Creating Equations	A-CED.1	4
	A-CED.2	2
	A-CED.3	2
	A-CED.4	1-2
Reasoning with Equations & Inequalities	A-REI.1	–
	A-REI.3	–
	A-REI.5	–
	A-REI.6	1
	A-REI.10	–
	A-REI.11	1
	A-REI.12	1

Return to Main Menu

Snapshot Overview

EOC Weighted Distribution (continued)

Interpreting Functions	F-IF.1	–
	F-IF.2	1-2
	F-IF.3	–
	F-IF.4	1-2
	F-IF.5	0-1
	F-IF.6	1-2
	F-IF.7	1
	F-IF.8	2-3
	F-IF.9	1
Building Functions	F-BF.1	2-3
	F-BF.2	0-1
	F-BF.3	1
Linear, Quadratic, & Exponential Models	F-LE.1	1-2
	F-LE.2	1
	F-LE.3	1
	F-LE.5	1
Congruence	G-CO.1	–
Expressing Geometric Properties with Equations	G-GPE.4	1
	G-GPE.5	1
	G-GPE.6	1
	G-GPE.7	1
Geometric Measurement & Dimension	G-GMD.1	–
	G-GMD.3	1
Interpreting Categorical & Quantitative Data	S-ID.1	–
	S-ID.2	1
	S-ID.3	1-2
	S-ID.5	2
	S-ID.6	1
	S-ID.7	1
	S-ID.8	1-2
	S-ID.9	–

Return to Main Menu

Snapshot Overview

2017-18 SAMPLE DAILY PACING CALENDAR – 8th grade Math I **FIRST SEMESTER** – Middle School

This pacing guide may be used to gauge the amount of time spent on and sequence of topics.

It is important in math to begin with hands on investigations & visual models when introducing a new concept – hence reminders to do so are included.

**"place holder" days are included to account for county benchmarking and other events that may throw off pacing.*

	Monday	Tuesday	Wednesday	Thursday	Friday
AUG 28 – SEPT.1 Weekly Warm Up Answer Key	Welcome Team building	Pre-Assmt Continue Team building	8.NS.1 Number Sets & review integer rules converting fractions/repeating dec.	8.EE.2 & 8.NS.2 Introduce square roots and cube roots	8.EE.2 & 8.NS.2 Estimating Radicals
SEPT. 4 – 8 Weekly Warm Up Answer Key	HOLIDAY	8.NS.1,2 &EE.2 Review	Test – 8.NS.1,2, & EE.2	8.EE.1 Laws of exponents (only integer laws)	8.EE.1 Application of Laws of Exponents
SEPT. 11 – 15 Weekly Warm Up Answer Key	*(place holder day)* *COUNTY LEVEL PRE-ASSMENT BENCHMARK*	8.EE.3 Scientific notation & standard form	8.EE.4 Operations with Scientific Notation	8.EE.1, 3, and 4 Application and word problems with Sci. Not.	8.EE.1, 3, and 4 Test on Laws of Exponents and Scientific Notation
SEPT 18 – 22 Weekly Warm Up Answer Key	CED.1/REI.1&3 Create equations and inequalities in one variable. Explain the reasoning	CED.1/REI.1&3/8.EE.7 Solve equations and inequalities in one variable	CED.4 Solve for a quantity of interest such as $E=mc^2$solve for M.	ERPD CED.4 – Continue to solve for specific variables.	CED.1/4REI.1&3 Review creating equations and inequalities and solving for one variable
SEPT. 25 – 29 Weekly Warm Up Answer Key	CED.1/4REI.1&3 Test	IF.1, F.1 Introduce Functions, Using function notation, evaluate inputs and interpret statements	IF.2/4, EE.5&6, F.4, 8.F.3 Interpret key features of graphs, tables, and verbal descriptions. Tell whether it is increasing or decreasing, identify the y-intercept	SSE.1a/b Identify and interpret parts of a linear function. Interpret a linear expression as multiple parts	IF.2/4, EE.5&6, F.4 Understand parts of a linear function and how to find slope and the y-intercept
OCT. 2 – 6 Weekly Warm Up Answer Key	IF.2/4, EE.5&6, F.4 Understand parts of a linear function and how to find slope and the y-intercept from a variety of scenarios.	IF.2/4/6, EE.5&6, F.4 Write linear functions by finding the rate of change and initial value.	IF.2/4/6, EE.6, F.4, BF.2 Write linear functions by finding the rate of change and initial value. Build linear functions when given a graph, table, or points.	Review Linear Functions	Quiz Linear Functions

Snapshot Overview **Return to Main Menu**

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
OCT. 9 – 13 Weekly Warm Up Answer Key	WORKDAY	CED.1/2/REI.10 Review creating equations and graph them to represent linear relationships.	CED.1/2/REI.10 Review creating equations and graph them to represent linear relationships. Understand that all points on a linear function graph represents all solutions to the equation.	IF.5, LE.5 Find the domain and range of a function and relate it to its graph. Interpret the parameters of a linear function.	CED.1/2/REI.10/IF.7 Analyze linear functions by generating different representations including technology. Identify domain, range, intercepts, increasing and decreasing, positive and negative.
OCT. 16 – 20 Weekly Warm Up Answer Key	IF.9/F.2 Compare key features of two functions each with a different representation (symbolically, graphically, tables, or verbal expression)	IF.9/F.2 Continue to compare two different functions and their features.	LE.5 Interpret the parameters of a linear function	ERPD IF.3 Identify arithmetic sequences as linear, express sequences with a linear function and how to write them.	IF.3/BF.1a/2 Build linear functions including arithmetic sequences when given a graph, table, or two ordered pairs.
OCT. 23 – 27 Weekly Warm Up Answer Key	BF.2 Translate between explicit and recursive arithmetic sequences.	Place holder day/catch up	Place holder day/catch up	Review parts of a linear functions, writing and graphing, understanding features of a function, and comparing two functions represented differently.	Test SSE.1/b, CED.1/2, REI.10, IF.7/9
OCT. 30 -NOV. 3 Weekly Warm Up Answer Key	LE.1, S-ID.6a/b, SP.1-3 Introduce scatter plots and how they can be represented with linear equations.	Grading Period Ends S-ID.6a/b SP.1-3 Understand that a regression line can be found with technology	S-ID.6/b, SP.1-3 Analyze residuals. Use the fitted function to solve problems.	Review Scatter Plots, how to graph, how to use fitted lines, and how to analyze residuals	Quiz Scatter Plots
NOV.6 – 10 Weekly Warm Up Answer Key	*Place holder day* *(COUNTY LEVEL BENCHMARK 1)*	S-ID7,8,9 Use linear models to interpolate and extrapolate predicted values. Assess validity	S-ID.7,8,9 Use technology to determine the correlation coefficient of bivariate data and determine its strength.	ERPD S-ID.7,8,9 Use a residual plot, correlation coefficient, and scatter plot to determine appropriateness.	HOLIDAY

Snapshot Overview **Return to Main Menu**

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
NOV. 13 – 17 Weekly Warm Up Answer Key	S-ID.7,8,9 Distinguish between causation and association	S-ID.6a/b, 7,8,9 Review on scatter plots and interpreting categorical and quantitative data.	S-ID.6a/b, 7,8,9 Test on scatter plots and interpreting categorical and quantitative data.	8.EE.8/CED.3/REI.5,6,11 Introduce systems of equations and solving by graphing	8.EE.8/CED.3/REI.5,6,11 Introduce systems of equations and solving by substitution. Use technology to show how ordered pairs match.
NOV. 20 – 24 Weekly Warm Up Answer Key	8.EE.8/CED.3/REI.5,6,11 Introduce systems of equations and solving by elimination.	8.EE.8/CED.3/REI.5,6,11 Introduce systems of equations and solving by any method word problems	LEAVE	HOLIDAY	HOLIDAY
NOV. 27 – DEC. 1 Weekly Warm Up Answer Key	GPE.5/8.EE.8/CED.3/REI.5,6,11 Discuss slopes of parallel and perpendicular lines and how they relate to solutions for systems	8.EE.8/CED.3/REI.5,6,11 Review systems of equations and solving by any method	8.EE.8/CED.3/REI.5,6,11 Test	CED.3/REI.12 Systems of Inequalities	CED.3/REI.12 Systems of Inequalities – word problems
DEC. 4 – 8 Weekly Warm Up Answer Key	CED.3/REI.12 Systems of Inequalities Review	CED.3/REI.12 Test	RN.2 Review laws of exponents and introduce rational exponents	RN.2 Rewrite algebraic expressions with rational exponents.	RN.2 Applications and investigations
DEC. 11 – 15 Weekly Warm Up Answer Key	Quiz RN.2	A-SSE.1a/b Identify parts of exponential function from $f(x) = a*b^x$	A-SSE.1a/b, CED.1/2, IF.2 Create exponential equations and graph. Use function notation to aid in graphing.	IF.2-9 Identify parts of an exponential function, how to graph, translate, and identify features including range/domain.	IF.2-9, LE. 1,3,5, SID.6c Analyze exponential functions using different representations and build exponential functions that model a relationship
Dec. 18 – 22 Weekly Warm Up Answer Key	IF.2-9, LE.1,3,5, SID.6c, BF.1a, BF.2 Construct and compare linear and exponential models and solve problems.	IF.2-9 Review Exponential Functions	IF.2-9 Quiz on Exponential Functions	HOLIDAY	HOLIDAY
DEC. 21 – DEC.31	HOLIDAY 12/17 – 1/1				

Snapshot Overview **Return to Main Menu**

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	**FRIDAY**
JAN. 1 – 5 Weekly Warm Up Answer Key	HOLIDAY	WORKDAY	Review Exponential Functions	IF.8b/LE.1,3,5 Interpret growth and decay with exponential functions.	IF.2-9/LE.1,3,5 Word problems with Exponential functions and Review. Practice with growth and decay
JAN. 8 – 12 Weekly Warm Up Answer Key	BF.1a/2 Geometric Sequences Explicit and Recursive	BF.1a/2 Geometric Sequences Explicit and Recursive	IF.2-9, BF.1a/2, LE.1,3,5 Review Growth and Decay, features, and sequences	IF.2-9, BF.1a/2, LE.1,3,5 Test Growth and Decay, features, and sequences	*(place holder/ catch up day)*
JAN. 15 – 19 Weekly Warm Up Answer Key	HOLIDAY	Extension Activities/Rich Tasks/Cumulative Review	Extension Activities/Rich Tasks/Cumulative Review	Extension Activities/Rich Tasks/Cumulative Review	**GRADING PERIOD ENDS** Extension Activities/Rich Tasks/Cumulative Review

2017-18 SAMPLE DAILY PACING CALENDAR 8th Grade Math **SECOND SEMESTER** – Middle School

This pacing guide may be used to gauge the amount of time spent on and sequence of topics.

It is important in math to begin with hands on investigations & visual models when introducing a new concept – hence reminders to do so are included.

**"place holder" days are included to account for county benchmarking and other events that may throw off pacing.*

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	**FRIDAY**
JAN. 22 – 26 Weekly Warm Up Answer Key	WORKDAY	WORKDAY	2ND SEM. BEGINS *Place holder day (COUNTY LEVEL BENCHMARK 2)*	A-SSE.1a/b, APR.1 Introduce terms, factors, coefficients, and exponents and how they relate to polynomial expressions.	A-SSE.1a/b, APR.1 Introduce terms, factors, coefficients, and exponents and how they relate to polynomial expressions. Add and subtract polynomials
JAN. 29 - FEB. 2 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.1 Multiply binomials Punnet Square or FOIL	A-SSE.1a/b, APR.1 Special cases with multiplication	A-SSE.1a/b, APR.1 Review operations with polynomials	A-SSE.1a/b, APR.1 Review operations with polynomials	A-SSE.1a/b, APR.1 Quiz operations with polynomials
FEB. 5 – 9 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.1 Introduce factoring with a common monomial	A-SSE.1a/b, APR.1 More practice with factoring	A-SSE.1a/b, APR.1 Introduce factoring with binomial	A-SSE.1a/b, APR.1 Factoring with binomials	A-SSE.1a/b, APR.1 Special Cases

Snapshot Overview **Return to Main Menu**

	Monday	Tuesday	Wednesday	Thursday	Friday
FEB. 12 – 16 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.1 Special Cases	A-SSE.1a/b, APR.1 Finding solutions when factoring	A-SSE.1a/b, APR.1 Finding solutions when factoring	ERPD A-SSE.1a/b, APR.1 Review operations with polynomials and factoring	A-SSE.1a/b, APR.1 Test
FEB. 19 – 23 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.3, IF.2-9 Introduce the quadratic formula and how it is used to find solutions.	A-SSE.1a/b, APR.3, IF.2-9 Create quadratic equations that describe numbers or relationships	A-SSE.1a/b, APR.3, IF.2-9 Represent and solve quadratic equations graphically and with technology	A-SSE.1a/b, APR.3, IF.2-9 Represent and solve quadratic equations graphically and with technology	A-SSE.1a/b, APR.3, IF.2-9, Analyze quadratics, create and compare models and solve problems.
FEB. 26 – MAR. 2 Weekly Warm Up Answer Key	A-SSE.1a/b/3, APR.1, IF.2-9 Introduce terms, factors, coefficients, and exponents and how they relate to polynomial expressions and parts of a quadratic function.	A-SSE.1a/b/3, APR.1, IF.2-9 Introduce terms, factors, coefficients, and exponents and how they relate to polynomial expressions and parts of a quadratic function.	A-SSE.1a/b/3, APR.3, IF.2-9, Relate finding solutions by factoring to finding zeros and roots for quadratics. How to find the y-intercept.	A-SSE.1a/b/3, APR.3, IF.2-9, Relate finding solutions by factoring to finding zeros and roots for quadratics. How to find the y-intercept.	A-SSE.1a/b, APR.3, IF.2-9, REI.1/4 Relate finding solutions by factoring to finding zeros and roots for quadratics. How to find the y-intercept. Discuss best methods to solve for real solutions
MAR. 5 – 9 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.3, IF.2-9, REI.1/4 Relate finding solutions by factoring to finding zeros and roots for quadratics. How to find the y-intercept. Discuss best methods to solve for real solutions	A-SSE.1a/b, APR.3, IF.2-9 Discuss the discriminant formula and how it aids in finding solutions.	A-SSE.1a/b, APR.3, IF.2-9 Discuss the discriminant formula and how it aids in finding solutions.	A-SSE.1a/b, APR.3, IF.2-9 Introduce the quadratic formula and how it is used to find solutions.	A-SSE.1a/b, APR.3, IF.2-9 Introduce the quadratic formula and how it is used to find solutions.
MAR. 12 – 16 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.3, IF.2-9 Introduce the quadratic formula and how it is used to find solutions.	A-SSE.1a/b, APR.3, IF.2-9, CED.1/2, BF.1b Create quadratic equations that describe numbers or relationships	A-SSE.1a/b, APR.3, IF.2-9, CED.1/2, BF.1b Create quadratic equations that describe numbers or relationships	ERPD A-SSE.1a/b, APR.3, IF.2-9 Represent and solve quadratic equations graphically and with technology	A-SSE.1a/b, APR.3, IF.2-9 Represent and solve quadratic equations graphically and with technology

Snapshot Overview **Return to Main Menu**

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
MAR. 19 – 23 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.3, IF.2-9 Represent and solve quadratic equations graphically and with technology	A-SSE.1a/b, APR.3, IF.2-9, Analyze quadratics, create and compare models and solve problems.	A-SSE.1a/b, APR.3, IF.2-9, Analyze quadratics, create and compare models and solve problems.	A-SSE.1a/b, APR.3, IF.2-9, LE.3 Discuss features of quadratics such as domain, range, y-intercept, solutions, minimum and maximum	A-SSE.1a/b, APR.3, IF.2-9, LE.3 Discuss features of quadratics such as domain, range, y-intercept, solutions, minimum and maximum
MAR. 26 – 30 Weekly Warm Up Answer Key	A-SSE.1a/b, APR.3, IF.2-9 Review quadratics	A-SSE.1a/b, APR.3, IF.2-9 Test on quadratics	GRADING PERIOD ENDS RICH TASK APPLICATION/ PROJECT EXTENSION	*Place holder day*	HOLIDAY
APR. 2 – 6	SPRING BREAK 4/2 – 8				
APR. 9 – 13 Weekly Warm Up Answer Key	*Place holder day (COUNTY LEVEL BENCHMARK 3)*	8.SP .4 Interpret data in two-way frequency tables *discuss categorical vs numerical data	8.SP.4 **Gather Categorical data** and create two-way frequency tables	8. SP.4 Interpret categorical data from two-way frequency tables created in previous lesson	8.SP.4 Quiz on Categorical Data
APR. 16 – 20 Weekly Warm Up Answer Key	S-ID.1-3 Use technology to represent data with plots on the real number line (histograms and box plots)	S-ID.1-3 Use technology to represent data with plots on the real number line (histograms and box plots)	S-ID.1-3 Use statistics appropriate to the data distribution to compare center and spread. (histograms and box plots)	S-ID.1-3 Use statistics appropriate to the data distribution to compare center and spread. (histograms and box plots)	S-ID.1-3 Examine the effects of extreme data points on shape, center, and/or spread. (histograms and box plots)
APR. 23 – 27 Weekly Warm Up Answer Key	S-ID.1-3 Examine the effects of extreme data points on shape, center, and/or spread. (histograms and box plots)	S-ID.1-3 Review Categorical and Quantitative Data	S-ID.1-3 Test Categorical and Quantitative Data	GPE.4-6 Use coordinates to prove simple geometric theorems algebraically with a focus on polygons.	GPE.4-6 Use coordinates to prove simple geometric theorems algebraically with a focus on polygons such as perimeter of triangles and rectangles

Snapshot Overview

Return to Main Menu

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
APR. 30 – MAY 4 Weekly Warm Up Answer Key	GPE.4-5,8.G.6-8 Use coordinates to prove simple slope criteria for parallel and perpendicular when a point is given	GPE.4-5,8.G.6-8 Use coordinates to prove simple slope criteria for parallel and perpendicular when a point is given	GPE.4-5,8.G.6-8 Use coordinates to find the midpoint and endpoint of a line segment	GPE.4-5,8.G.6-8 Use coordinates to find the midpoint and endpoint of a line segment	Rich task
MAY 7 – 11 Weekly Warm Up Answer Key	GPE.4-5,8.G.6-8 Review of Coordinates for proving geometric theorems.	GPE.4-5,8.G.6-8 Test of Coordinates for proving geometric theorems.	EOC REVIEW	EOC REVIEW	EOC REVIEW
MAY 14 – 18 Weekly Warm Up Answer Key	EOC REVIEW	EOC REVIEW	EOC REVIEW	EOC REVIEW	EOC REVIEW
MAY 21 – 25	EOC REVIEW	EOC REVIEW	EOC REVIEW	EOC REVIEW	EOC REVIEW
MAY 28 – JUN 1	HOLIDAY	EOC REVIEW	Closing Tasks	Closing Tasks	Closing Tasks
JUN 5 - 8	Closing Tasks	Closing Tasks	Closing Tasks	Closing Tasks	GRD. PD ENDS
JUN 12 - 14	THREE WORKDAYS: 6/12 – 6/14				

Snapshot Overview **Return to Main Menu**

YEAR-AT-A-GLANCE SAMPLE PACING FOR 8th GRADE MATH I

DAYS	TOPICS/STANDARDS
1 & 2	Welcome, Pre-Assmt, Team Building, Etc.
3 – 7	8.NS.1, 8.NS.2 & 8.EE.2 Distinguish between rational and irrational numbers, recognizing that any number that can be expressed as a fraction is a rational number. Locate rational and irrational numbers on the number line. Compare and order rational and irrational numbers. Understand that the value of a square root and cube roots.
8 – 14	8.EE.1, 3 & 4 Properties of integer exponents, scientific notation.
15 – 20	CED.1&4/REI.1&3 8.EE.7 Solve linear equations in one variable. Create and solve equations and inequalities in one variable. Solve for a variable in formulas.
21 – 29	8.EE.5&6/8.F.1,3,4/IF.1,2,4,5,6/BF.2/A-SSE.1 Interpreting the unit rate as the slope of the graph and 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. Understand rules that take x as input and gives y as output is a function, constant rate of change, Sketch a graph that exhibits the qualitative features of a function. Interpret the equation $y = mx + b$ as defining a linear function. Interpret the structure of linear functions.
30 – 37	8.F.2,5/CED.1,2/REI.10/IF.5,7,9/LE.5 Identify parts of a linear function, create equations and graphs, know that all points are on a graph, interpret features of a linear function, compare functions and their features when represented differently. Compare properties of two functions.
38 – 43	IF.3/BF.1 Arithmetic sequences as linear expressions, including explicit and recursive.
44 – 55	SP.1-3/S-ID7-9, S-ID6a,b/LE.1 Scatter plots, lines of best fit, linear and non-linear relationships, outliers, causation and association, residual plots, and correlation coefficients.
56 – 66	8.EE.8/CED.3/REI.5,6,11,12 Solutions to systems of equations and inequalities, parallel and perpendicular lines.
67 – 70	8.EE.1/RN.2 – Rational exponents
71 – 89	A-SSE.1a,b/CED.1,2/IF.2-9/LE.1,3,5/SID.6c/BF.1a,2 Exponential functions, growth and decay, and geometric sequences
90 – 107	A-SSE.1 a,b/APR.1 Polynomials, factoring, operations, and solutions
108 – 136	A-SSE.1 a,b/A-SSE.3/APR.3/IF.2-9/REI.1,4/CED.1,2/LE.3/BF.1b Quadratic functions – finding zeroes, vertex, solutions, y-intercept, and comparing
137 – 149	8.SP.4, S-ID.1-3 Categorical and Quantitative Data
150 – 158	GPE.4-6, 8.G.3,6-8 Use coordinates to prove geometric theorems
159 – 172 (+)	Focused Review for EOC
173 - 180	EOC & closing tasks for year

Return to Main Menu

1st Nine Weeks

Linear Equations / Inequalities /*Expressions and Equations / *Functions & graphing

ESSENTIAL QUESTIONS

- How are laws of exponents used with operations with scientific notation?
- How do you graph inequalities?
- How do you solve inequalities?
- How do you use the words "AND/OR" to write and solve compound inequalities?
- Why do we use variables?
- Why are "the order of operations" and other properties of mathematics important?
- Why is advantageous to use and solve equations algebraically for real-world problems?
- When would we want to use the absolute value of numbers?
- How does the slope affect direct variation?
- What does the slope-intercept form of an equation tell us?
- How can words be turned into math equations?
- How can you find the domain and range of a linear function?

ACADEMIC VOCABULARY

Factors, coefficients, laws of exponents, power, perfect squares, perfect cubes, root, square root, cube root, scientific notation, radical, radicand, standard form of a number, inverse operations, linear and quadratic functions, simple rational, exponential functions, inequalities, function notation, domain, range, Fibonacci sequence, intercepts, intervals, relative maximums, minimums; symmetries, end behavior, rate of change, quadratic functions, exponential and logarithmic functions, midline, amplitude, coordinate plane, slope, f (x) and/or g (x).

2nd Nine Weeks

***Expressions and Equations*Writing equations of lines, parallel / perpendicular, and linear modeling*Systems*Statistics, Exponential Functions**

ESSENTIAL QUESTIONS

- How can real-life data be displayed and used?
- What's the best way to solve a system of equations?
- How can you solve a system of equations or inequalities?
- Can systems of equations model real-world situations?
- Can equations that appear to be different be equivalent?
- How can you solve equations?
- How can you represent quantities, patterns, and relationships?
- How are properties related to algebra?
- How are residual plots and correlation coefficient used with scatter plots?
- How are rational exponents used?
- What do samples of exponential growth and decay look like?
- How can an exponential equation be altered to show a translation?
- How parallel lines similar? How do perpendicular lines relate to one another?

ACADEMIC VOCABULARY

Intersecting, parallel lines, coefficient, distributive property, like terms, substitution, system of linear equations, residuals, correlation and causation, parallel or perpendicular, elimination, half-planes, inequalities, scatter plots, line of fit, residual line, causation, association, systems of inequalities, rational exponents, Exponential functions, exponential growth, exponential decay, geometric sequences, explicit, recursive,

Return to Main Menu

3rd Nine Weeks

***Polynomials and Quadratics *Functions**

ESSENTIAL QUESTIONS

- What does a Quadratic Equation look like when graphed?
- What are QE and how can they be rewritten?
- How are zeros and factors of quadratics related?
- How can you find the maxima/Minima for an equations?
- How can you solve word problems for QE?
- How can you rewrite QE to find the vertex?
- How can you compare quadratic functions when represented differently?
- How is the quadratic function derived?
- What does the discriminant inform you?
- What are the special cases when factoring or multiplying binomials?

ACADEMIC VOCABULARY

Linear or exponential function, constant rate of change, linear relationship, rate of change, slope, initial value, y-intercept, polynomials, combining like terms, binomial, trinomial, polynomial, discriminant, quadratic formula, roots, zeros, maxima, minima, vertex form, factors, FOIL

4th Nine Weeks

***Series and Sequences *Statistics and Probability *Geometry**

ESSENTIAL QUESTIONS

- How is Geometry used to find answers and solve problems?
- What kind of data is displayed in a two-way table?
- How can a two-way table be used to examine the relationship between two categorical variables?
- How can you use coordinates to prove simple geometric theorems algebraically?
- How can you find the endpoint or midpoint of a line segment?
- How can coordinates be used to find the perimeter of a polygon?

ACADEMIC VOCABULARY

Bivariate data, outliers, positive association, negative association, categorical data, two-way table, relative frequency, recursive, arithmetic sequence, common ratio, geometric sequence, perpendicular line, parallel line, line segment, Pythagorean Theorem, distance formula, Cavalieri's principle, dot plots, histograms, box plots, median, mean, spread, interquartile range, standard deviation, outliers, joint, marginal, and conditional relative frequencies

Return to Main Menu

CLICK ON THE ICONS FOR BILL OF FARE

Return to Main Menu

Video Links

- **Learn Zillion**

https://learnzillion.com/resources/57276-8th-grade-geometry

https://learnzillion.com/resources/57275-8th-grade-functions

https://learnzillion.com/resources/57279-8th-grade-statistics-and-probability

https://learnzillion.com/resources/57274-8th-grade-expressions-and-equations

https://learnzillion.com/resources/57273-8th-grade-the-number-system

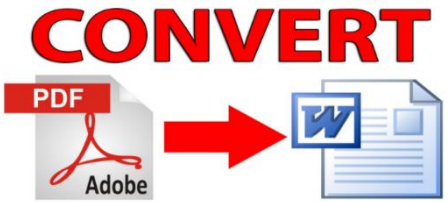
- **Khan Academy** https://www.khanacademy.org/

- **REV Videos** (All 2 to 3 minutes in length – Easily Downloadable)

Negative Exponents
https://onslow.rev.vbrick.com/#/videos/5ff6550c-b276-45a0-a795-b48471d13576
Cube Roots
https://onslow.rev.vbrick.com/#/videos/d86be7bd-7d8a-428e-8f88-4f26890050ce
Graphing Calculator: Cubes & Cube Roots
https://onslow.rev.vbrick.com/#/videos/6f7f154f-b4ae-437a-99ca-4b251b00cb8c
Scientific Notation
https://onslow.rev.vbrick.com/#/videos/2626124c-954d-4ff8-8478-9b80a2a6b5ff
Pythagorean Theorem
https://onslow.rev.vbrick.com/#/videos/5c3dd3aa-05a5-4698-89eb-365e269409c4
Multi-step Equations
https://onslow.rev.vbrick.com/#/videos/3d622c8d-81ef-4289-9d28-799be2738bef
Equations with variables on both sides
https://onslow.rev.vbrick.com/#/videos/46f14ffb-b14a-4d4a-969a-04983d4a676a
Equations: Two variables (word problems)
https://onslow.rev.vbrick.com/#/videos/cf500c1c-b5bd-4e01-a8a8-ba4e8a83c4d6
Slope Intercept Form
https://onslow.rev.vbrick.com/#/videos/2f650ad3-38d8-4305-9ae7-e9beca8fc372
Volume
https://onslow.rev.vbrick.com/#/videos/3df72380-1501-4c6e-8b4a-cf7c4ce68800

Growth and Decay
https://onslow.rev.vbrick.com/#/videos/3b9c13b9-9452-4b83-900f-c07dbc4c79be
Quadratics
https://onslow.rev.vbrick.com/#/videos/d2b026b5-eca6-4aa2-bd5f-3c848546c9e0
System of Equations
https://onslow.rev.vbrick.com/#/videos/38fd6a52-470c-4764-b4b5-9cd6e185b173
Factoring (Box Method)
https://onslow.rev.vbrick.com/#/videos/ff91dfe5-8426-46de-8c88-8d01585d1946
Point Slope Form
https://onslow.rev.vbrick.com/#/videos/63a20788-0983-4a45-9a65-9ed803d52c69
Rational Expressions I
https://onslow.rev.vbrick.com/#/videos/d3ca13f3-ba65-487b-8d7a-155a1547e388
Rational Expressions II
https://onslow.rev.vbrick.com/#/videos/bb9b6ff3-a0aa-484a-b95a-0faba6b24297
Determining Slope from graph *Slope Rida*
https://onslow.rev.vbrick.com/#/videos/989339b7-458a-4ed7-b063-647527c5577b
Transversals
https://onslow.rev.vbrick.com/#/videos/6d3f9a74-371f-4fae-8b52-14df911c6a91

Return to Main Menu

EOC Prep	EOC Released Test
➢ https://parcc.pearson.com/practice-tests/math/ ➢ https://cuacs8.mck.ncsu.edu/mathsampleitems/main.html	➢ http://www.ncpublicschools.org/docs/accountability/testing/releasedforms/releasedmath1.pdf
Assessment Options	**STEM – Project Based Learning**
➢ **EDMENTUM** http://www.edmentum.com/product-login ➢ https://goformative.com/ ➢ https://www.tenmarks.com/ ➢ https://quizizz.com/ ➢ https://quizlet.com/ ➢ https://www.assistments.org/ ➢ **http://8thgradeschoolnetassessments.weebly.com/** ➢ **http://math1schoolnetassessments.weebly.com/**	●http://projectbasedmath.weebly.com/ ●http://www.livebinders.com/play/play?id=767726 ●http://bie.org/ ●http://www.edutopia.org/project-based-learning ●http://www.mathalicious.com/ FREE Online PDF to Word Converter  https://www.pdftoword.com/ No Password – Quick & Easy! **Return to Main Menu**

For more information, suggestions or input contact: Joe Sarrero joe.sarrero@onslow.k12.nc.us