

Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Overview (90 Days)

Pre-Requisites Skills:

- Students need to know the meanings of exponents ($2^4 = 2 \times 2 \times 2 \times 2$)
- Students need to know how to graph a simple inequality on a number line (i.e. $x > 4$)
- Students need to know inequality symbols and what they mean
- Students need to know order of operations
- Students need to know what the opposite operations are of addition, subtraction, multiplication and division.
- Students need to know how to model certain words with mathematical symbols
- Students need to know what a variable and symbols are.
- Students need to know how to add, subtract, multiply and divide.
- Students need to know how to plot points on the coordinate grid
- Students need to know how to combine like terms in an expression/equation

Key Vocabulary:

Piecewise-Linear Function	Equivalent Algebraic Expressions	Leading Term and Leading Coefficient
Numerical Symbol	Polynomial Expression	of a Polynomial in Standard Form
Variable Symbol	Monomial	Constant Term of a Polynomial in
Numerical Expression	Degree of a Monomial	Standard Form
Algebraic Expression	Standard Form of a Polynomial	Solution
Equivalent Numerical Expressions	Expression in One Variable	Solution Set
	Degree of a polynomial in standard form	Graph of an Equation in Two Variables
		Zero Product Property

Familiar Terms and Symbols

Equation	Properties of Equality	Formula
Identity	Properties of Inequality	Term
Inequality	Solve	
Systems of Equations	Linear Function	

Module Themes:

Module 1 plants the seeds used throughout Algebra. This module provides a deep study of algebraic equivalence, the structure of expressions, and reasoning to solve equations all within real world contexts. Throughout the module students should be able to express their answers in terms of the context of the problems. Students need to focus on the validity of their answer and should be able to explain how they know their answer is correct or not.

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Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 1: Graphing Equations (20 Days)

Topic Theme:

During this topic students will explore the main functions they will work with in Algebra (Linear, Exponential, and quadratic). The goal is to introduce students to these functions by having them make graphs of a situation in which the functions naturally arise. As they graph they will reason quantitatively and use units to solve the problems based on the graphs they create.¹

Skills throughout Topic:

Identify appropriate scales and origins for graphs and data displays using the context of the problem.
Choose and consistently use appropriate units throughout the problems.
Explain the units for the problems using appropriate units
Define appropriate quantities in terms of the context of real world problems
Round solutions appropriately within the context of the word problems
Explain what the solution means in a specific context
Graph and analyze situations that can be represented by piece-wise linear, quadratic, and exponential functions

Essential Questions:

How can we use different types of graphs to model real-world situations?

What information can we get from a graph?

Common Core Standards Addressed in Topic 1:

A-CED.2-Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

N-Q.1. Use units as a way to understand problems and to guide the solution of multi-step problems; Choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

N-Q.2. Define appropriate quantities for the purpose of descriptive modeling

N-Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

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Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 1: Graphing Equations			
Major Topic	Key Skills	Chapters	Key Vocabulary
Graph Piece-wise and Linear	<p>Define appropriate quantities from a situation</p> <p>Choose and interpret appropriate scales when graphing</p> <p>Graph a piecewise-linear function based on a situation</p> <p>Identify the correct domain for the solution within the constraints of a word problem</p>	<p>4.1-Plot Points on a Coordinate Plane</p> <p>4.7-Graph Linear Functions</p> <p>Lesson 1-Graph Piece-wise defined Linear Functions</p>	Piecewise-Linear Function
Graph of Quadratic (Not defined as quadratic)	<p>Graph a non-linear relationship between two quantities</p> <p>Interpret key features of the graph</p>	Lesson 2-Graphs of Quadratic Functions	
Graph of Exponential Functions	<p>Choose and interpret an appropriate scale</p> <p>Plot points based on an exponential relationship</p>	Lesson 3-Graphs of Exponential Functions	
Analyzing Graphs	<p>Explain what the solution means in a specific context</p> <p>Choose an appropriate level of accuracy and identify the limitations on measurements</p>	<p>Lesson 4-Analyze Graphs Water usage during a typical school day</p> <p>**Need more Resources**</p>	

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Graphing Stories	Meaning of the intersection of two graphs Explain what the solution means in a specific context	Chapter 4.4-pg. 241 38, 39- given graph explain situation Pg.238 Example 6 and 7 Lesson 5-Two Graphing Stories	
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Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 2: Expressions (20 Days)

Topic Themes:

Students will study the structure of equivalent expressions by investigating collections of all expressions equivalent to a given expression. In doing this students will use the commutative, associative, and distributive property¹

Skills throughout Topic:

Distinguish between operation symbols (i.e. that a fraction bar means divide)

Follow written instructions and strategies

Use the properties of real numbers to rearrange an expression

Show and Prove two expressions are equivalent using the distributive property, commutative property and the associative property

Add, subtract, and multiply polynomials to come up with a new polynomial

Essential Questions:

1. How can we use the properties of numbers (associative, transitive, commutative, and distributive) to rearrange expressions?
2. How can we use expressions to model real world situations?
3. How can we compare the value of expressions involving variables?
4. Using the properties of exponents how do you simplify expressions?
5. How can we use variables to model real-world situations?

Common Core Standards Addressed in Topic 2:

A-SSE-1. Interpret expressions that represent a quantity in terms of its context

A-SSE.1a-Interpret parts of an expression, such as terms, factors and coefficients

A.SSE.1.b-Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P .

A-SSE.2- Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$*

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Topic 2: Expressions			
Major Topic	Key Skills	Chapters	Key Vocabulary
Parts of an Expression (Essential Question 5)	Identify parts of an expression using vocabulary such as term, equation, inequality Explain how the different parts of the expression effect the expression	1.3-Write Expressions 1.4-Write Equations and Inequalities	Numerical Symbol Variable Symbol Numerical Expression Algebraic Expression
Properties of Expressions (Essential Question 1)	Identify the different of properties of expressions (Distributive, commutative, associative, transitive) Use the different properties of expressions Identify when and what property is used	2.4-Multiplying real numbers Lesson 6- The Distributive Property 2.5-Apply the distributive property Lesson 7- The Commutative and Associative Property	Zero-Product Property Equivalent Numerical Expressions Equivalent Algebraic Expressions
Interpreting Expressions (Essential Question 2 and 3)	Identify factors of an expression Distributive Property backwards Write and interpret different variables in an expression Identify the meaning of an expression in a real world context i.e. $M + K$ means the total number of animals if M is monkeys and K is Kangaroos	**Need more Resources** Interpreting Algebraic Expressions Lesson (outside resource)	
Polynomials (Essential Question 3)	Add, Subtract and Multiply polynomials to get a new polynomial Identify the different types and parts of a polynomial Substitute a value into a polynomial	Lesson 8: Adding and Subtracting Polynomials 9.1-Adding and Subtracting Polynomials Lesson 9: Generating Polynomials 9.2-Multiplying Polynomials	Monomial Degree of a Monomial Polynomial Expression Standard Form of a polynomial Expression in one Variable Degree of a polynomial in standard form Leading term and leading coefficient of a polynomial in standard form Constant term of a polynomial in standard form

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Properties of Exponents (Essential Question 4)	Apply the properties of exponents to simplify algebraic expressions	8.1-Apply Exponent properties involving products 8.2-Apply Exponent properties involving quotients 8.3-Define and use zero and negative exponents	
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Mid-Module Assessment

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Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 3: Solving Equations and Inequalities (30 Days)

Topic Themes:

In middle school, students learned how and practiced solving equations. In this topic instead of just solving equations, students will formalize descriptions of what they learned before and are able to explain the steps of solving the equations and construct viable arguments to justify their solution methods.¹

Skills throughout Topic:

Recognize that equations are a statement of equality between two expressions.

Understand the commutative, Associative, and distributive property as identities-the equation doesn't change its value when applied to both sides.

Explain the process of solving equations using the properties of equality (commutative, associative and distributive).

Describe the solution set of equations or inequalities by either "and" or "or".

Graph the solution of an inequality on a number line.

Rewrite equations in terms of other variables.

Represent solution sets graphically.

Interpret solutions in terms of a context.

Essential Questions:

1. What properties are used when solving equations for a variable?
2. How can we compare the relative value of variables given an equation?
3. What strategies can you use to manipulate equations to find the solution of complex equations? (Example: If you are given $6x + 8 = 10x - 8$, if you replace x with x^2 , solve for x . Students should be able to solve so $x = 4$ they can then say $x^2 = 4$, $x = 2$ or -2)

Common Core Standards Addressed in Topic 3:

A-REI.1-Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method

A-REI.3-Solve linear equations and inequalities in one variable, including equations with coefficients represented by letter

A-CED.4-Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V=IR$ to highlight resistance R

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Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 3: Solving Equations and Inequalities

Major Topic	Key Skills	Chapters	Key Vocabulary
Solving Linear Equations	<p>Solve linear equations with variable and rational coefficients</p> <p>Substituting values into an equation to verify solutions</p>	<p>Lesson 10-True and False Equations</p> <p>3.1-One step equations 3.2-Two step equations Alternative method pg. 147 3.3-Solve multiple step equations 3.4-Solve equations with variables on both side Chapter 3 Review</p> <p>Lesson 12-Solving Equations</p>	<p>Solution</p> <p>Solution Set</p>
Explaining solving Linear Equations (Essential Question 1)	<p>Solve one variable equations</p> <p>Explaining the steps to solving a linear equation and identify the properties used</p> <p>Verify solutions of equations using operations and vocabulary</p> <p>Identify and justify the reasonableness of an answer</p> <p>Identify and justify the method used to solve an equation</p> <p>Knowing what different parts of the equation mean. (Example: How the operations effect the variable)</p>	<p>3.1-One step equations 3.2-Two step equations Alternative method pg. 147 3.3-Solve multiple step equations 3.4-Solve equations with variables on both side Chapter 3 Review</p> <p>**Word Problems and context**</p> <p>Lesson 13-Some Potential Dangers when Solving Equations</p>	

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<p>Rearranging Expressions/ Equations (Essential Question 3)</p>	<p>Rewrite different literal equations in terms of a different variable using real world formulas</p> <p>Based on the context of the problem, rearrange formula to highlight desired variables</p>	<p>Lesson 19- Rearranging Formulas</p> <p>3.8-Rewrite Equations and Formulas</p>	<p>Literal Equations</p>
<p>Solving Linear Inequalities</p>	<p>Solve one variable inequalities with rational coefficients</p> <p>Describe the solution of two equations (or inequalities) joined by either “and” or “or”</p> <p>Graph the solution set on the number line of an inequality.</p>	<p>6.1-Solve inequalities using addition and subtraction 6.2-Solve inequalities using multiplication and division 6.3-Solve inequalities using multiple steps *6.4-Solve compound inequalities *6.5-Solve absolute value equations *6.6-Solve absolute value inequalities</p> <p>Lesson 11-Solution Sets for Equations and Inequalities</p> <p>Lesson 14-Solving Inequalities</p>	
<p>Graphing Inequalities</p>	<p>Graph an inequality and shade correctly</p> <p>Identify the difference between a strict boundary and where a boundary is not included (dotted vs. solid line)</p>	<p>Lesson 15-Solution Sets of Two or more Equations (Inequalities) Joined by “And” or “Or”</p> <p>Lesson 16-Solving and Graphing Inequalities Joined by “And” or “Or”</p> <p>6.7-Graph Linear inequalities in two variables</p>	

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<p>Factoring Expressions</p>	<p>Solve problems that involve factoring (i.e. $3x + 6 = 3(x+2)$)</p> <p>Solve equations with variables in the denominator</p> <p>Solve factored equations or easily factored equations (i.e recognize $(x-a)(x-b) = 0$ means $(x-a)=0$ or $(x-b)=0$)</p>	<p>Need more resources doing the distributive property backwards</p> <p>Lesson 17-Equations involving Factored Expressions</p> <p>Lesson 18-Equations involving Expressions with a Variable in the Denominator</p>	
<p>Systems of Equations (Informal introduction) (Essential Question 2)</p>	<p>Identify solutions to two-variable equations</p> <p>Represent the solution set graphically</p> <p>Interpret the inequality symbol correctly and determine which portion of the coordinate plane is shaded to represent the solution</p> <p>Solve systems graphically or algebraically</p> <p>Create a system of equations informally to model a real world situation.</p>	<p>Lesson 20-21- Solution sets of equations and inequalities with two variables</p> <p>Lesson 22-23-Solution Sets of Simultaneous Equations</p> <p>Lesson 24: Applications of Systems of Equations and Inequalities</p>	<p>Graph of an equation in two variables</p>

Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 4: Creating Equations to solve problems (15 Days)

Topic Themes:

Students have already created equations to solve multistep word problems and compare solution methods. In this topic students will be formally introduced to modeling relationships through problems that can be solved using equations and inequalities in one variable, a system of equations and graphing¹

Skills throughout topic:

Identify appropriate scales and origins for graphs and data displays using the context of the problem.

Choose and consistently use appropriate units throughout the problems.

Explain the units for the problems using appropriate units

Students can compare/analyze different approaches to solve real world problems

Essential Questions:

1. How can we use equations to model real world situations (single variable and systems of equations)?
2. How can we use equations to help us compare outcomes?
3. How can we model real-world situations where the population is doubling (tripling)?
4. What different ways can we model real world situations and how do they compare?

Common Core Standards Addressed in Topic 4:

N-Q.1. Use units as a way to understand problems and to guide the solution of multi-step problems; Choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

A-CED.1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions

A-CED.2- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A-CED.3-Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different food.

A.REI.3-Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters

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Module 1: Relationships Between Quantities and Reasoning with Equations and Their Graphs

Topic 4: Creating Equations to solve problems

Major Topic	Key Skills	Chapters	Key Vocabulary
Writing and Solving Linear Equations from word problems	<p>Write and solve a linear equation from a word problem</p> <p>Explain why a solution is valid or not</p> <p>Explain what the solution means in a specific context</p> <p>Explain if a solution makes sense of not</p>	<p>Chapter 3.1-3.5-Word Problems that students will be able to create and solve equations</p> <p>Additional problems can be found in Chapter 4.1-4.5, 4.7 and 5.1-5.4</p> <p>Lesson 25: Solving Problems in two ways-Rates and Algebra</p>	
Writing and solving inequalities from word problems	<p>Write and solve linear inequalities from a word problem</p> <p>Explain why a solution is valid or not</p> <p>Explain what the solution means in a specific context</p> <p>Explain if a solution makes sense of not</p> <p>Identify the correct domain for the solution within the constraints of a word problem</p> <p>Write the correct inequality symbol based on a word problem</p>	<p>Word Problems from Chapter 6.1-6.4 (6.5-6.6)</p> <p>Lesson 28: Federal Income Tax</p>	
Sequences	<p>Understand what a recursive sequence is</p>	<p>Lesson 26-27: Recursive Challenge Problems-The Double and Add 5 game</p>	
Writing and Solving Exponential Equations	<p>Writing an exponential equation based on a word problem (example: Exponential growth problem described and come up with equation and solution)</p>	<p>8.5-Write and Graph Exponential growth functions-focus on word problems</p>	

End-of-Module Assessment

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