SpringBoard Algebra 1 Textbook to Curriculum Map Alignment for CC Algebra 1

Algebra 1 – UNIT 1
Relationships between Quantities and Reasoning with Equations

Critical Area: By the end of eighth grade, students have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. This unit builds on these earlier experiences by asking students to analyze and explain the process of solving an equation. Students develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and using them to solve problems. They master the solution of linear equations and apply related solution techniques and the laws of exponents to the creation and solution of simple exponential equations. All of this work is grounded on understanding quantities and on relationships between them.

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
(m) Interpret the structure of expressions. *Limit to linear expressions and to exponential expressions with integer exponents.* **(m) Understand solving equations as a process of reasoning and explain the reasoning.** *Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses.*	**Algebra - Seeing Structure in Expressions** A.SSE.1 Interpret expressions that represent a quantity in terms of its context.★ a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as single entity. *For example, interpret P(1+r)n as the product of P and a factor not depending on P.*	1-1 Numeric and Graphic Representations of Data 1-2 Writing Expression 2-1 Writing and Solving Equations 2-2Equations with Variables on Both Sides 2-3 Solving More Complex Equations 2-4 Equations with No Solutions or Infinitely Many Solutions 2-5 Solving Literal Equations for a Variable 31-1 Solving by Graphing or Factoring 31-2 The Axis of Symmetry and the Vertex 31-3 Graphing a Quadratic Function	**MARS Tasks:** Solving Equation in One Variable Sorting Equations and Identities Manipulating Polynomials Defining Regions of Inequalities Comparing Investments **Teaching Channel:** Using Stations to Explore Algebra Expressions
(m) Solve equations and inequalities in one variable. *Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents,*	**Algebra - Reasoning with Equations and Inequalities** 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	3-1 Inequalities and Their Solutions 3-2 Solving Inequalities 3-3 Compound Inequalities	**Illustrative Mathematics:** Exploring Equations Algebra Tiles **Mathematics Vision Project:** Module 1: Getting Ready Module

such as $5x = 125$ or $2x = \frac{1}{16}$.	method. A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. A.REI.3.1 Solve one-variable equations and inequalities involving absolute value, graphing the solutions and interpreting them in context. **CA addition**		**Illustrative Mathematics:** Integer Solutions to Inequality **Teaching Channel:** Collaborate to Solve Compound Inequalities
(s/a) Reason quantitatively and use units to solve problems. *Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.* **(m) Create equations that describe numbers or relationships.** *Limit A.CED.1 and A.CED.2 to linear and exponential equations, and, in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs. Limit A.CED.3 to linear equations and inequalities. Limit A.CED.4 to formulas which are linear in the variable of interest.*	**Numbers - Quantities** 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. **Algebra - Creating Equations** 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.	1-1 Numeric and Graphic Representations of Data 1-2 Writing Expression 2-1 Writing and Solving Equations 2-2Equations with Variables on Both Sides 2-3 Solving More Complex Equations 2-4 Equations with No Solutions or Infinitely Many Solutions 2-5 Solving Literal Equations for a Variable 33-1 Fitting Data with a Quadratic Function 33-2 Interpreting Solutions of Quadratic Equations 3-1 Inequalities and Their Solutions 3-2 Solving Inequalities 3-3 Compound Inequalities 4-1 Absolute Value Equations 4-2 Absolute Value Inequalities	**MARS TASK:** Leaky Faucet Dan Meyer **Achieve the Core:** Yogurt Packing **Illustrative Mathematics:** How Much is a penny worth Traffic Jam **Georgia Standards:** Unit 1: Relationships Between Quantities **MARS Tasks:** Building and Solving Equations Optimization Problems: Boomerangs

		10-1 Direct Variation 10-2 Indirect Variation 10-3 Another Linear Model 10-4 Inverse Functions 33-1 Fitting Data with a Quadratic Function 33-2 Interpreting Solutions of Quadratic Equations	
	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 non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. 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.	18-1 Representing the Solution of a System of Inequalities 18-2 Interpreting the Solution of a System of Inequalities	**Illuminations:** Bathtub Water Levels **Inside Mathematics:** On a Balance **Illustrative Mathematics:** Dimes and Quarters Equations and Formulas Rewriting Equations **Teaching Channel** Reviewing Linear Equations in Two Variables

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Algebra 1 – UNIT 2
Linear and Exponential Relationships

Critical Area: Students will learn function notation and develop the concepts of domain and range. They move beyond viewing functions as processes that take inputs and yield outputs and start viewing functions as objects in their own right. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. They work with functions given by graphs and tables, keeping in mind that, depending upon the context, these representations are likely to be approximate and incomplete. Their work includes functions that can be described or approximated by formulas as well as those that cannot. When functions describe relationships between quantities arising from a context, students reason with the units in which those quantities are measured. Students explore systems of equations and inequalities, and they find and interpret their solutions. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
Extend the properties of exponents to rational exponents.	**Number and Quantity - The Real Number System** **N.RN.1**. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5. **N.RN.2** Rewrite expressions involving radicals and rational exponents using the properties of exponents.	19-1 Basic Exponents Properties 19-2 Negative and Zero Powers 19-3 Additional Properties of Exponents	**Mars Tasks:** Applying Properties of Exponents Giantburgers Multiplying Cells The Real Number System Manipulating Radicals
Build a function that models a relationship between two quantities. *Limit to F.BF.1a, 1b, and 2 to linear and exponential functions. In F.BF.2, connect arithmetic sequences to linear functions and geometric sequences to exponential functions.*	**Functions - Building Functions** **F.BF.1.** Write a function that describes a relationship between two quantities.★ a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to*	10-1 Direct Variation 10-2 Indirect Variation 10-3 Another Linear Model 10-4 Inverse Functions 33-1 Fitting Data with a Quadratic Function 33-2 Interpreting Solutions of Quadratic Equations 34-1 Constructing Models 34-2 Comparing Models	**MARS Tasks:** A Golden Crown **Illuminations:** Graphing Real-Life Data **Illustrative Mathematics:** Skeleton Tower A Sum of Functions Lake Algae Kim and Jordan

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
	a decaying exponential, and relate these functions to the model. **F.BF.2.** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★	34-3 Extending Models 1-1 Numeric and Graphic Representations of Data 1-2 Writing Expression 21-1 Identifying Geometric Sequences 21-2 Formulas for Geometric Sequences	 Intervention **MARS Task:** Modeling Situations with Linear Equations
Build new functions from existing functions. *Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept. While applying other transformations to a linear graph is appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in this standard.*	**Functions - Building Functions** **F.BF.3.** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*		**Illustrative Mathematics:** Campus Flu **Teaching Channel: Intervention** Conjecturing About Functions **YouCubed.org Intervention** Patterns and Functions Unit
Understand the concept of a function notation.	**Functions - Interpreting Functions** **F.IF.1.** Understand 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. 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	5-1 Relations and Functions 5-2 Domain and Range 5-3 Function Notation	**Illustrative Mathematics** Foxes and Rabbits **Mathematics Vision Project:** Module 5 Features of Functions

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
	of *f* is the graph of the equation $y = f(x)$. **F.IF.2.** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **F.IF.3.** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by* $f(0) = f(1) = 1$, $f(n + 1) = f(n) + f(n - 1)$ *for* $n \geq 1$.	13-1 Scatter Plots and Trend Lines 13-2 Linear Regression 13-3 Quadratic and Exponential Regressions 11-1 Identifying Arithmetic Sequence 11-2 Point-Slope From 11-3 Standard Form 11-4 Recursive Formulas 21-1 Identifying Geometric Sequences 21-2 Formulas for Geometric Sequences	Domain and Range
Interpret functions that arise in applications in terms of a context. *Focus linear and exponential functions*	**Functions - Interpreting Functions** **F.IF.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★	6-1 Key Features of Graphs 6-2 More Complex 6-3 Graphs of Real-World Situations 13-1 Scatter Plots and Trend Lines 13-2 Linear Regression 13-3 Quadratic and Exponential Regressions 15-1 Writing Equations from Graphs and Tables 15-2 Comparing Functions with Inequalities 15-3 Writing Equations from Verbal Descriptions 22-1 Exponential Functions and Exponential Growth 22-2 Exponential Decay	

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
		22-3 Graphs of Exponential Functions 29-1 Modeling with a Quadratic Functions 29-2 Graphing and Analyzing a Quadratic Function 30-1 Translations of the Quadratic parent Functions 30-2 Stretching and Shrinking the Quadratic Parent Function 30-3 Multiple Transformation of the Quadratic Parent Function	
Analyze functions using different representations. *Linear, exponential, quadratic, absolute value, step, piecewise-defined.*	**Functions - Interpreting Functions** **F.IF.7.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ★ **F.IF.9**. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	6-1 Key Features of Graphs 6-2 More Complex 6-3 Graphs of Real-World Situations 7-1 The Spring Experiment 7-2 The Falling Object Experiment 7-3 The Radioactive Decay Experiment 13-1 Scatter Plots and Trend Lines 13-2 Linear Regression 13-3 Quadratic and Exponential Regressions 14-1 Function Notation and Rate of Change 14-2 Writing Functions and Finding Domain and Range 14-3 Evaluating Functions and Graphing Piecewise-Defined Linear Functions 14-4 Comparing Functions 15-1 Writing Equations from	**Illustrative Mathematics** Foxes and Rabbits Interpreting the Graph

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
		Graphs and Tables 15-2 Comparing Functions with Inequalities 15-3 Writing Equations from Verbal Descriptions 29-1 Modeling with a Quadratic Functions 29-2 Graphing and Analyzing a Quadratic Function 30-1 Translations of the Quadratic parent Functions 30-2 Stretching and Shrinking the Quadratic Parent Function 30-3 Multiple Transformation of the Quadratic Parent Function 35-1 Solving a System Graphically 35-2 Solving a System Algebraically	
Solve systems of equations. *Linear-linear and linear-quadratic.*	**Algebra - Reasoning with Equations and Inequalities** **A.REI.5**. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions **A.REI.6**. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	17-1 The Graphing Method 17-2 Using Tables and the Substitution Method 17-3 The Elimination Method 17-4 Systems Without a Unique Solution 17-5 Classifying Systems of Equations	
Represent and solve equations and inequalities **Graphically.** *Linear and exponential; learn as general principle.*	**Algebra - Reasoning with Equations and Inequalities** **A.REI.10**. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often	7-1 The Spring Experiment 7-2 The Falling Object Experiment	**Mars Tasks:** Defining Regions Using Inequalities

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
	forming a curve (which could be a line).	7-3 The Radioactive Decay Experiment 12-1 Slope-Intercept Form 12-2 Point-Slope Form 12-3 Standard Form 12-4 Slopes of Parallel and Perpendicular Lines	
	A.REI.11. Explain why the x-coordinates of the points where the graphs of the equations y=f(x) and y=g(x) intersect are the solutions of the equation f(x) = g(x) find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/ or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. ★	17-1 The Graphing Method 17-2 Using Tables and the Substitution Method 17-3 The Elimination Method 17-4 Systems Without a Unique Solution 17-5 Classifying Systems of Equations 35-1 Solving a System Graphically 35-2 Solving a System Algebraically	
	A.REI.12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	16-1 Writing and Graphing Inequalities in Two Variables 16-2 Graphing Inequalities in Two Variables 18-1 Representing the Solution of a System of Inequalities 18-2 Interpreting the Solution of a System of Inequalities	

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Algebra 1 – UNIT 3
Descriptive Statistics

Critical Area: Experience with descriptive statistics began as early as Grade 6. Students were expected to display numerical data and summarize it using measures of center and variability. By the end of middle school they were creating scatterplots and recognizing linear trends in data. This unit builds upon that prior experience, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

CLUSTERS	COMMON CORE STATE STANDARDS	Textbook: *SpringBoard* (2014)	OTHER RESOURCES
(*s*) Summarize, represent, and interpret data on a single count or measurement variable. ★ *In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.*	**Statistics and Probability - Interpreting Categorical and Quantitative Data** S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.2 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. S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	**36-1: Mean, Median, Mode and MAD** **36-2: Another Measure of Variability** **37-1: Dot Plots and Box Plots** **37-2: Modified Box Plots** **37-3: Normally Distributed** **EA1: Comparing Univariate** **Distributions – *Splitting the Bill***	**MARS Tasks:** Using Frequency Graphs Using Box Plots **Illustrative Mathematics:** Haircut Costs Speed Trap Understanding the Standard Deviation Measuring Variability in a Data Set **Mathematics Vision Project:** Module 8-Modeling Data
(*s*) Summarize, represent, and interpret data on two categorical and quantitative variables. ★ *Students take a more sophisticated look at using a linear function to model the relationship between two*	**Statistics and Probability - Interpreting Categorical and Quantitative Data** S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.	**39-1: Line of Best Fit** **39-2: Residuals** **40-1: Bivariate Categorical Data** **40-2: Presenting Relative Frequency**	**MARS Tasks:** A Case of Muddying the Waters Interpreting and Using a Graph: Taxi Fares Devising a Measure for Correlation

numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. *S.ID.6b should be focused on linear models, but may be used to preview quadratic functions in Unit 5 of this course.*	S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.* b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.	**Data Graphically**	**Illustrative Mathematics:** Musical Preference Support for a Longer School Day Coffee and Crime Laptop Battery Charge Restaurant Bill and Party Size **Illuminations:** Automobile Mileage: Year vs. Mileage Barbie Bungee Impact of a Superstar
(*s*) Interpret linear models. ★ *Build on students' work with linear relationships in eighth grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9.*	**Statistics and Probability - Interpreting Categorical and Quantitative Data** S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. S.ID.9 Distinguish between correlation and causation.	**38-1: Scatter Plots** **38-2: Correlation Coefficient** **39-3: Interpreting the Slope and** **Intercept of the Best-Fit Line** **39-4: Plotting Residuals**	**MARS Tasks:** A Case of Muddying the Waters **Illustrative Mathematics:** Texting and Grades II Olympic Men's 100-meter Dash Coffee and Crime Golf and Divorce High Blood Pressure Math Test Grades

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Algebra 1 - Unit 4
Expressions and Equations

Description of the critical area: In this unit, students build on their knowledge from Unit 2, where they extended the laws of exponents to rational exponents. Students apply this new understanding of numbers and strengthen their ability to see structure in and create quadratic and exponential expressions. They create and solve equations, inequalities, and systems of equations involving quadratic expressions and determine the values of the function it defines. Students understand that polynomials form a system analogous to the integers, they choose and produce equivalent forms of an expression.

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
(m)Interpret the structure of expressions.	**Algebra - Seeing Structure in Expressions** A-SSE.1 Interpret expressions that represent a quantity in terms of its context.★ a. Interpret parts of an expression, such as terms, factors, and coefficients. 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.*	2-1 Writing and Solving Equations 2-2Equations with Variables on Both Sides 2-3 Solving More Complex Equations 2-4 Equations with No Solutions or Infinitely Many Solutions 2-5 Solving Literal Equations for a Variable 24-1 Polynomial Terminology 24-2 Adding Polynomial Terminology 24-3 Subtracting Polynomials 25-1 Multiplying Binomials 25-2 Special Products of Binomials 25-3 Multiplying Polynomials 26-1 Factoring by Greatest Common Factor (GCF) 26-2 Factoring Special Products 27-1 Factoring $x^2 + bx + c$ 27-2 Factoring $ax^2 + bx + c$ 31-1 Solving by Graphing or Factoring	**Mathematics Vision Project:** **Mathematics Vision Project:** Module 2- Structures of Expressions Module 1 – Quadratic Functions

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
		31-2 The Axis of Symmetry and the Vertex 31-3 Graphing a Quadratic Function	
	A-SSE.2 Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as* $(x^2)^2 - (y^2)^2$, *thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.	20-1 Radical Expressions 20-2 Adding and Subtracting Radical Expressions 20-3 Multiplying and Dividing Radical Expressions	
(m)Write expressions in equivalent forms to solve problems.	**Algebra - Seeing Structure in Expressions** A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★ a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as* $(1.15^{1/2})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*	19-1 Basic Exponents Properties 19-2 Negative and Zero Powers 19-3 Additional Properties of Exponents 23-1 Compound Interest 23-2 Population Growth 31-1 Solving by Graphing or Factoring 31-2 The Axis of Symmetry and the Vertex 31-3 Graphing a Quadratic Function	**Mars Tasks:** Interpreting Algebraic Expressions Forming Quadratics
(m)Perform arithmetic operations on polynomials.	**Algebra – Arithmetic with Polynomial and Rational Expressions** A-APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	24-1 Polynomial Terminology 24-2 Adding Polynomial Terminology 24-3 Subtracting Polynomials	**Mathematics Vision Project:** Module 3: Polynomial Connections Lesson 3.4
(m)Create equations that describe numbers or relationships.	**Algebra - Creating Equations** A-CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions,*	10-1 Direct Variation 10-2 Indirect Variation 10-3 Another Linear Model	**Mars Tasks:** Printing Tickets

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
	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.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.*	10-4 Inverse Functions 22-1 Exponential Functions and Exponential Growth 22-2 Exponential Decay 22-3 Graphs of Exponential Functions 23-1 Compound Interest 23-2 Population Growth	**Inside Mathematics:** Miles of Tiles
(m)Solve equations and inequalities in one variable.	**Algebra - Reasoning with Equations and Inequalities** A-REI.4 Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for *x2* = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers *a* and *b*.	32-1 The Square Method 32-2 Completing the Square 32-3 The Quadratic Formula 32-4 Choosing a Method and Using the Discriminant 32-5 Complex Solutions	**Mars Task:** Multiple Solutions **Illustrative Mathematics:** Completing the Square
(*s*)Solve systems of equations.	**Algebra - Reasoning with Equations and Inequalities** A-REI.5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. A-REI.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the*	35-1 Solving a System Graphically 35-2 Solving a System	**Illustrative Mathematics:** A Linear and Quadratic System

CLUSTERS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
	points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.	Algebraically	

Algebra 1– UNIT 5
Quadratic Functions and Modeling

Critical Area: In preparation for work with quadratic relationships students explore distinctions between rational and irrational numbers. They consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students learn that when quadratic equations do not have real solutions the number system must be extended so that solutions exist, analogous to the way in which extending the whole numbers to the negative numbers allows x+1 = 0 to have a solution. Formal work with complex numbers comes in Algebra II. Students expand their experience with functions to include more specialized functions—absolute value, step, and those that are piecewise-defined.

CLUSTER HEADINGS	COMMON CORE STATE STANDARDS	SpringBoard CONNECTIONS	OTHER RESOURCES
(s)Use properties of rational and irrational numbers. *Connect N.RN.3 to physical situations, e.g., finding the perimeter of a square of area 2.*	**Number and Quantity - The Real Number System** N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.		
(m)Interpret functions that arise in applications in terms of a context. *Focus on quadratic functions; compare with linear and exponential functions studied in Unit 2.*	**Functions - Interpreting Functions** F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★ F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the*	29-1 Modeling with a Quadratic Functions 29-2 Graphing and Analyzing a Quadratic Function 7-1 The Spring Experiment 7-2 The Falling Object Experiment 7-3 The Radioactive Decay	**Illustrative Mathematics:** Influenza Epidemic Warming and Cooling How is the Weather? Logistic Growth Model, Explicit Version The Canoe Trip, Variation 1 The High School Gym Temperature Change Average Cost

	function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for *he function.*★ F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★	Experiment 11-1 Identifying Arithmetic Sequence 11-2 Point-Slope From 11-3 Standard Form 11-4 Recursive Formulas 30-1 Translations of the Quadratic parent Functions 30-2 Stretching and Shrinking the Quadratic Parent Function 30-3 Multiple Transformation of the Quadratic Parent Function 33-1 Fitting Data with a Quadratic Function 33-2 Interpreting Solutions of Quadratic Equations 9-1 Slope 9-2 Slope and Rate of Change 9-3 More about Slopes 15-1 Writing Equations from Graphs and Tables 15-2 Comparing Functions with Inequalities 15-3 Writing Equations from Verbal Descriptions	
(m)Analyze functions using different representations. *For F.IF.7b, compare and contrast absolute value, step and piecewise defined functions with linear, quadratic, and exponential functions. Highlight issues of*	**Functions - Interpreting Functions** F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima.	14-1 Function Notation and Rate of Change 14-2 Writing Functions and Finding Domain and Range 14-3 Evaluating Functions and Graphing Piecewise-Defined Linear Functions	**MARS Tasks:** Functions and Everyday Situations **Illustrative Mathematics:** Identifying Graphs of Functions Which Function? Throwing Baseballs

domain, range, and usefulness when examining piecewise defined functions. Note that this unit, and in particular in F.IF.8b, extends the work begun in Unit 2 on exponential functions with integer exponents. For F.IF.9, focus on expanding the types of functions considered to include, linear, exponential, and quadratic. Extend work with quadratics to include the relationship between coefficients and roots, and that once roots are known, a quadratic equation can be factored.	b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$ *and classify them as representing exponential growth or decay.* F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*	14-4 Comparing Functions 15-1 Writing Equations from Graphs and Tables 15-2 Comparing Functions with Inequalities 15-3 Writing Equations from Verbal Descriptions 29-1 Modeling with a Quadratic Functions 29-2 Graphing and Analyzing a Quadratic Function 32-1 The Square Method 32-2 Completing the Square 32-3 The Quadratic Formula 32-4 Choosing a Method and Using the Discriminant 32-5 Complex Solutions 34-1 Constructing Models 34-2 Comparing Models 34-3 Extending Models	
(m)Build a function that models a relationship between two quantities. *Focus on situations that exhibit a quadratic relationship.*	**Functions - Building Functions** F.BF.1 Write a function that describes a relationship between two quantities.★ a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using	29-1 Modeling with a Quadratic Functions 29-2 Graphing and Analyzing a Quadratic Function 34-1 Constructing Models 34-2 Comparing Models	Graphing Stories (1-3 stories) **Mars Task:** Patchwork Sidewalk Patterns

	arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*	34-3 Extending Models	
(*s*)Build new functions from existing functions. *For F.BF.3, focus on quadratic functions, and consider including absolute value functions. For F.BF.4a, focus on linear functions but consider simple situations where the domain of the function must be restricted in order for the inverse to exist, such as f(x) = x2, x>0.*	**Functions - Building Functions** F.BF.3 Identify the effect on the graph of replacing *f(x)* by *f(x) + k*, *k f(x)*, *f(kx)*, and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* F.BF.4 Find inverse functions. a. Solve an equation of the form *f(x) = c* for a simple function *f* that has an inverse and write an expression for the inverse. *For example, f(x) = 2 x3 or f(x) = (x+1)/(x-1) for x ≠ 1.*	8-1 Exploring *f(x) + k* 8-2 Exploring *f(x + k)*	
(*s*)Construct and compare linear, quadratic, and exponential models and solve problems. *Compare linear and exponential growth to quadratic growth.*	**Functions – Linear, Quadratic, and Exponential Model** F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	9-1 Slope 9-2 Slope and Rate of Change 9-3 More about Slopes 21-1 Identifying Geometric Sequences 21-2 Formulas for Geometric Sequences	**MARS Task:** Modeling: Having Kittens Sorting Functions Linear and Exponential Models **Mathematics Vision Project:** Arithmetic and Geometric Sequence Linear and Exponential Functions **NCTM Illuminations** Egg Launch

	F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	11-1 Identifying Arithmetic Sequence 11-2 Point-Slope From 11-3 Standard Form 11-4 Recursive Formulas 12-1 Slope-Intercept Form 12-2 Point-Slope Form 12-3 Standard Form 12-4 Slopes of Parallel and Perpendicular Lines 34-1 Constructing Models 34-2 Comparing Models 34-3 Extending Models 35-1 Solving a System Graphically 35-2 Solving a System Algebraically	
(*s*)Interpret expressions for functions in terms of the situation they model.	**Functions – Linear, Quadratic, and Exponential Model** F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.★ [Linear and exponential of form $f(x)=b^x +k$.] F.LE.6. Apply quadratic functions to physical problems, such as the motion of an object under the force of gravity. ★ CA		**Illustrative Mathematics:** Throwing Baseballs – F.IF.9 and F.IF.4