Los Angeles Unified School District
Office of Curriculum Instruction and School Support
2014-2015 Accelerated Algebra 1 Common Core Curriculum Map

Overview of the Common Core Mathematics Curriculum Map

Introduction to the Document:

Welcome to the Los Angeles Unified School District's Common Core Mathematics Curriculum Map. The Grade 8 Accelerated Common Core Algebra 1 Curriculum Map for Los Angeles Unified School District is developed as a tool for instructional planning and delivery. It is a living document that is interactive and web-based. There are specific, precise links to provide readily accessible resources needed to appropriately meet the rigors of the common core state standards. The curriculum map is intended to be a one-stop tool for teachers, administrators, parents, and other school support personnel. It provides information on the Common Core Standards for Mathematics, assessment sample items, and suggested instructional tools organized into units providing one easy-to-read resource.

Accelerated Common Core Algebra 1 Curriculum Map

This curriculum map is designed to be used to plan, direct, and clarify instruction for Grade 8 students enrolled in Accelerated Common Core (CC) Algebra 1 course. Accelerated CC Algebra 1 contains part of the CC Math 8 standards and all the CC Algebra 1 standards. According to the Common Core State Standards Initiative: "*Decisions to accelerate students into higher mathematics before ninth grade must require solid evidence of mastery of prerequisite* CA CCSSM." "Mathematics is by nature hierarchical. Every step is a preparation for the next one. Learning it properly requires thorough grounding at each step and skimming over any topics will only weaken one's ability to tackle more complex material down the road" (Wu 2012). Serious efforts must be made to consider solid evidence of a student's conceptual understanding, knowledge of procedural skills, fluency, and ability to apply mathematics before moving a student into an accelerated pathway." (The California Mathematics Framework - Appendix A, November 6, 2013.). The Accelerated Pathway is only for students who show advanced readiness or for students currently enrolled in an accelerated pathway. Students should not skip any math concepts as they accelerate to higher courses, otherwise, they will not have the depth of understanding needed to be successful in those courses.

Components of the Mathematics Curriculum Map:

The curriculum map is designed around the standards for mathematics k – 12 which are divided into two sets: Practice Standards and Content standards. The Standards for Mathematical Practice are identical for each grade level. They are the expertise and understanding which the mathematics educators will seek to develop in their students. These practices are also the "processes and proficiencies" to be used as instructional "habits of mind" to be developed at all grade levels. It is critical that mathematical literacy is emphasized throughout the instructional process.

The Mathematics Curriculum Map for Algebra 1 is grouped into five coherent units by grade level. Each unit clarifies the cluster and specific standards students are to master. In addition, the relevant Mathematical Practices and learning progressions are correlated.

These sections of the Mathematics Curriculum Map define the big idea of the unit. These five units are summarized in the **Unit Organizer** which provides the overview for the year.

Instructional components are specified in:

- **Enduring Understandings** are the key understandings/big ideas that the students will learn from the unit of study. These are statements that communicate the learning in a way that engages students.
- **Essential Questions** are based on enduring understandings. They are used to gain student interest in learning and are limited in number. They promote critical or abstract thinking and have the potential of more than one "right" answer. They are connected to targeted standards and are the framework and focus for the unit.
- **Standards**: Targeted (content and skills to be taught and assessed) and supporting (content that is relevant to the unit but may not be assessed; may include connections to other content areas). This includes what students have to know and be able to do (learning targets) in order to meet the standards.

Mathematical literacy is a critical part of the instructional process, which is addressed in:

- **Key Vocabulary** and **Language Goals** which clearly indicate strategies for meeting the needs of EL and SEL students.

Planning tools provided are:

- **Instructional Strategies** lead to enduring understandings. They are varied and rigorous instructional strategies to teach content. They are plan experiences that reinforce and enrich the unit while connecting with the standards and assessments. Instructional strategies addresses individual student needs, learner perspectives, integration of technology, learning styles, and multiple intelligences.
- **Resources** and **Performance Tasks** offer concept lessons, tasks, and additional activities for learning.
- **Assessments:** This is also a listing of formative and summative Assessments to guide backwards planning. Student progress in achieving targeted standards/expected learning is evaluated. Entry-level (formative)-based on summative expectations, determine starting points for learning. Benchmark-determine progress of learning, misconceptions, strengths/weaknesses along the learning trajectory.
- **Differentiation** (🕮) falls into three categories:
  - **Front Loading:** strategies to make the content more accessible to all students, including EL, SEL and students with special needs. This defines prerequisite skills needed to be successful.
  - **Enrichment:** activities to extend the content for all learners, as all learners can have their thinking advanced, and to support the needs of GATE students. These are ideas to deepen the conceptual understanding for advanced learners.
  - **Intervention:** alternative methods of teaching the standards, in which all students can have a second opportunity to connect to the learning, based on their own learning style. They guide teachers to resources appropriate for students needing additional assistance

Using the Mathematics Curriculum Map:

The guide can be thought of as a menu. It cannot be expected that one would do every lesson and activity from the instructional resources provided. To try to teach every lesson or use every activity would be like ordering everything on a menu for a single meal. It is not a logical option. Nor is it possible given the number of instructional days and the quantity of resources. That is why the document is called a "***Mathematics Curriculum Map***" and not a "*Mathematics Pacing Plan*." And, like a menu, teachers select, based on instructional data, which lessons best fit the needs of their students – sometimes students need more time with a concept and at other times, less.

An effective way to use this guide is to review and assess mathematical concepts taught in previous grades to identify potential learning gaps. From there, teachers would map out how much time they feel is needed to teach the concepts within the unit based on the data of their students' needs. For example, some classes may need more time devoted to developing expressions and equations, while another class in the same course may need more focused time on understanding the concept of functions.

The starting point for instructional planning is the standards and how they will be assessed. By first considering how the standards will be assessed, teachers can better select the instructional resources that best build mathematical understanding. There are hundreds of resources available, both publisher- and teacher-created, as well as web-based, that may be used to best teach a concept or skill. Collaborative planning, both within and among courses, is strongly encouraged in order to design effective instructional programs for students.

Learning Progressions:

The Common Core State Standards in mathematics were built on progressions: narrative documents describing the progression of a topic across a number of grade levels, informed both by research on children's cognitive development and by the logical structure of mathematics. The progressions documents can explain why standards are sequenced the way they are, point out cognitive difficulties and pedagogical solutions, and give more detail on particularly knotty areas of the mathematics. This would be useful in teacher preparation and professional development, organizing curriculum, and writing textbooks.

Standards for Mathematical Practice:

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the National Council of Teachers of Mathematics (NCTM) process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

The Mathematics Curriculum Map is a living document—it is neither set in stone for all time nor is it perfect. Teachers and other users are encouraged to provide on-going feedback as to its accuracy, usability, and content. Please go to math.lausd.net and share your comments and suggestions. Your participation in making this instructional guide a meaningful and useful tool for all is needed and appreciated.

The grade level Common Core State Standards-aligned Curriculum Maps of the courses in this 2014 edition of the *CCSS Mathematics Instructional Guide* are the result of the collective expertise of the LAUSD Secondary Mathematics Team.

The District extends its gratitude to the following CC Accelerated CC Algebra 1 and CC Algebra1, CC Geometry, and CC Algebra 2 development team:

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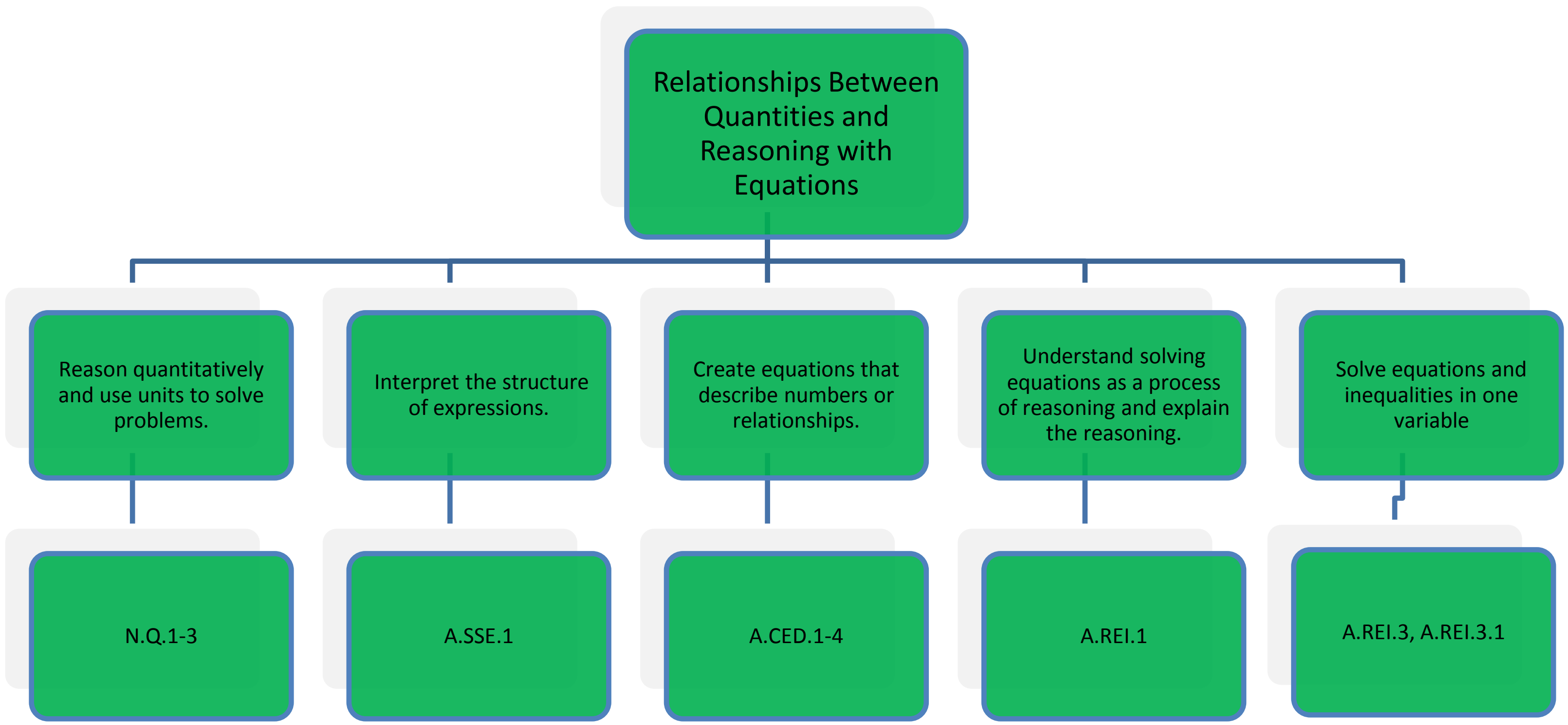
Accelerated Algebra 1

Unit 1



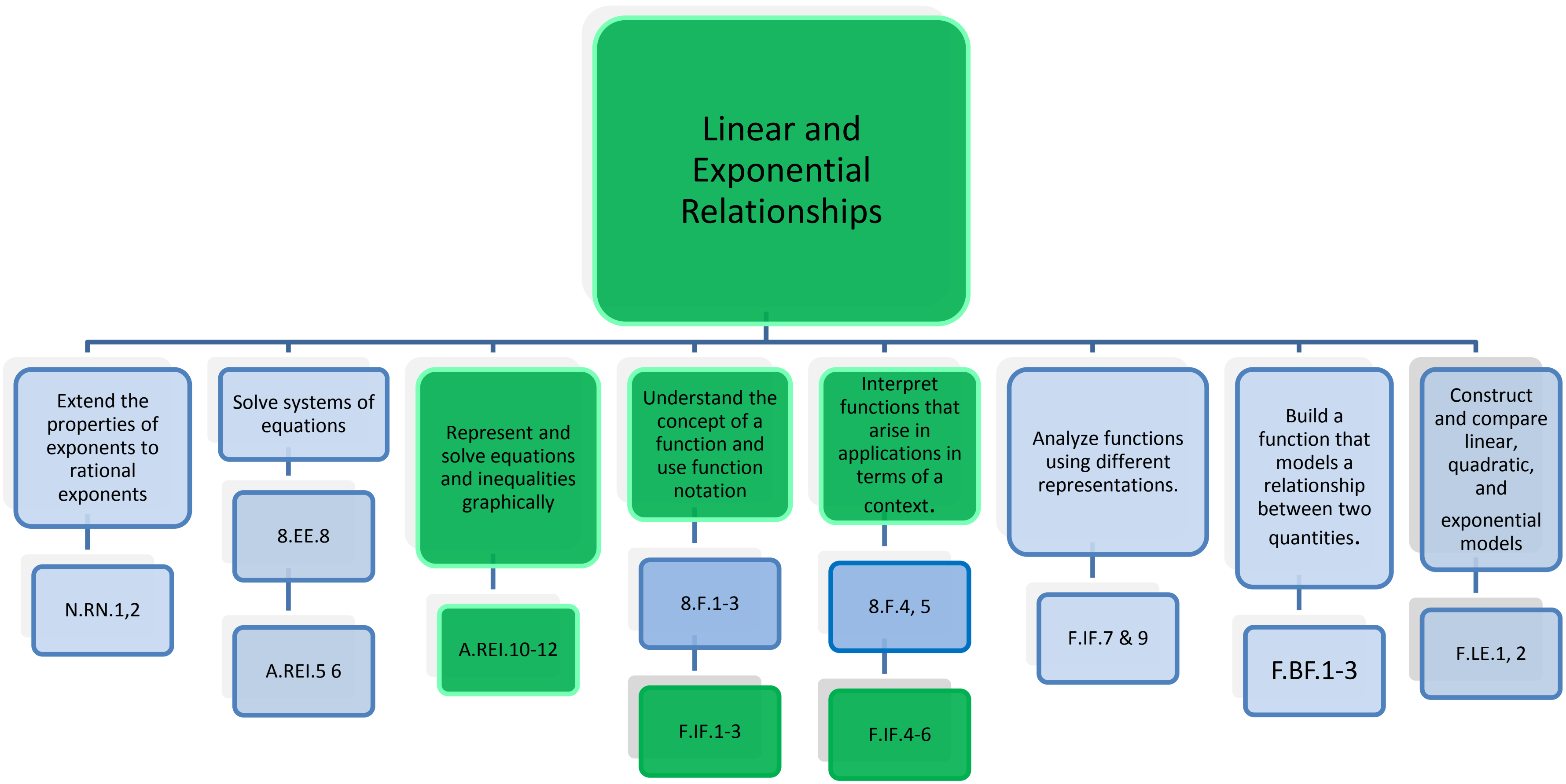
A-SSE 1: Modeling Involving Interpreting Expressions that Represent a Quantity in Terms of its Context

Key: Major Clusters; Additional / Supporting Clusters

Accelerated Algebra 1

Unit 2

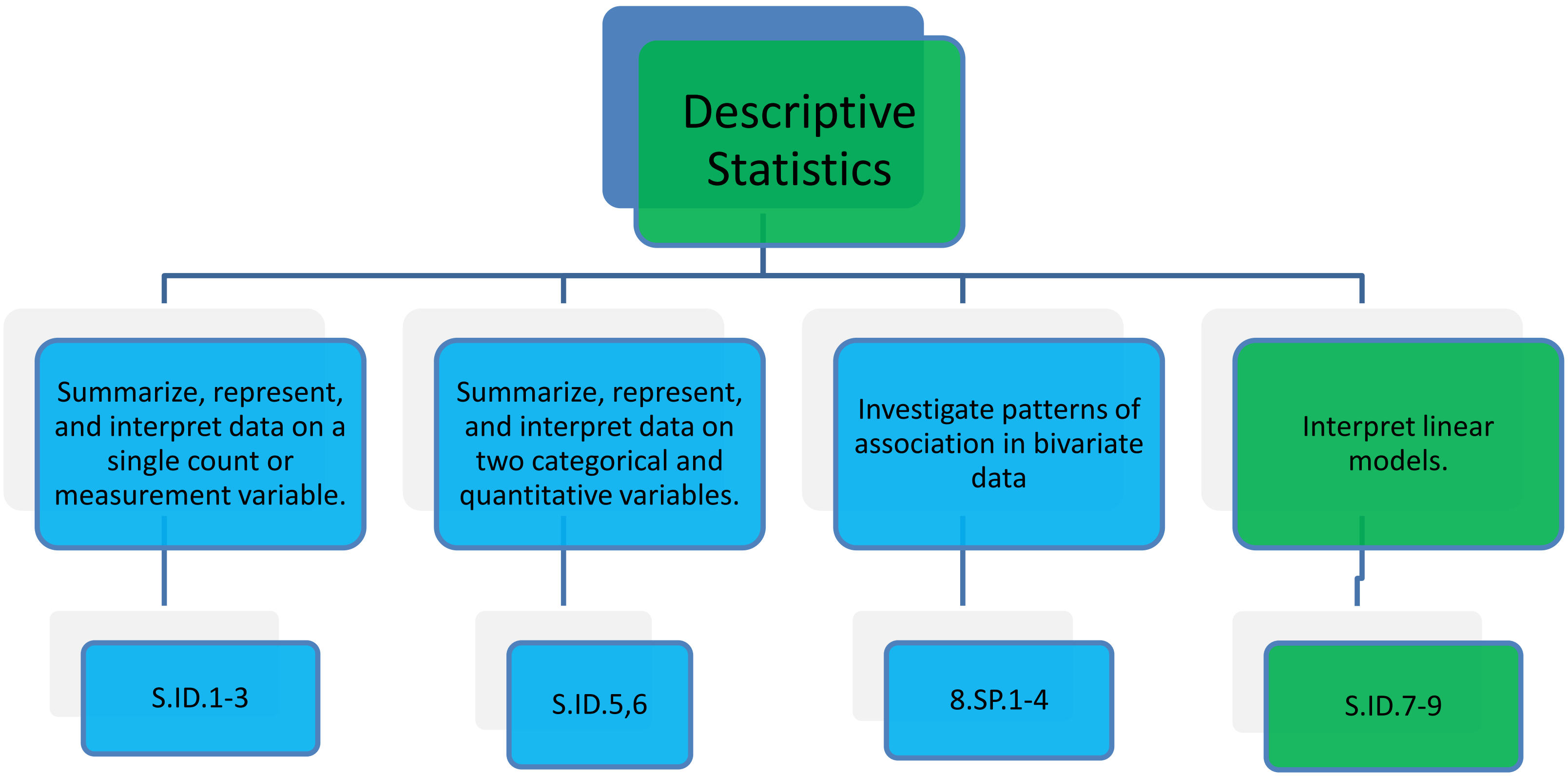
F-IF.4 Model Functions Relationships between two Quantities and Interprete key Features

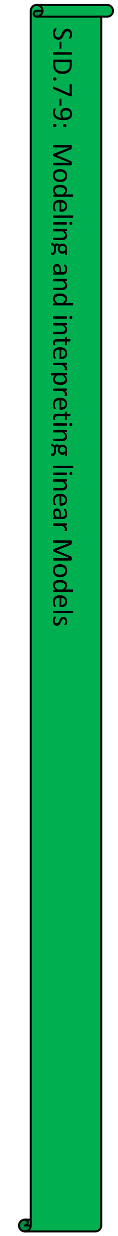


Key: Major Clusters; Additional / Supporting Clusters

Accelerated Algebra 1

Unit 3

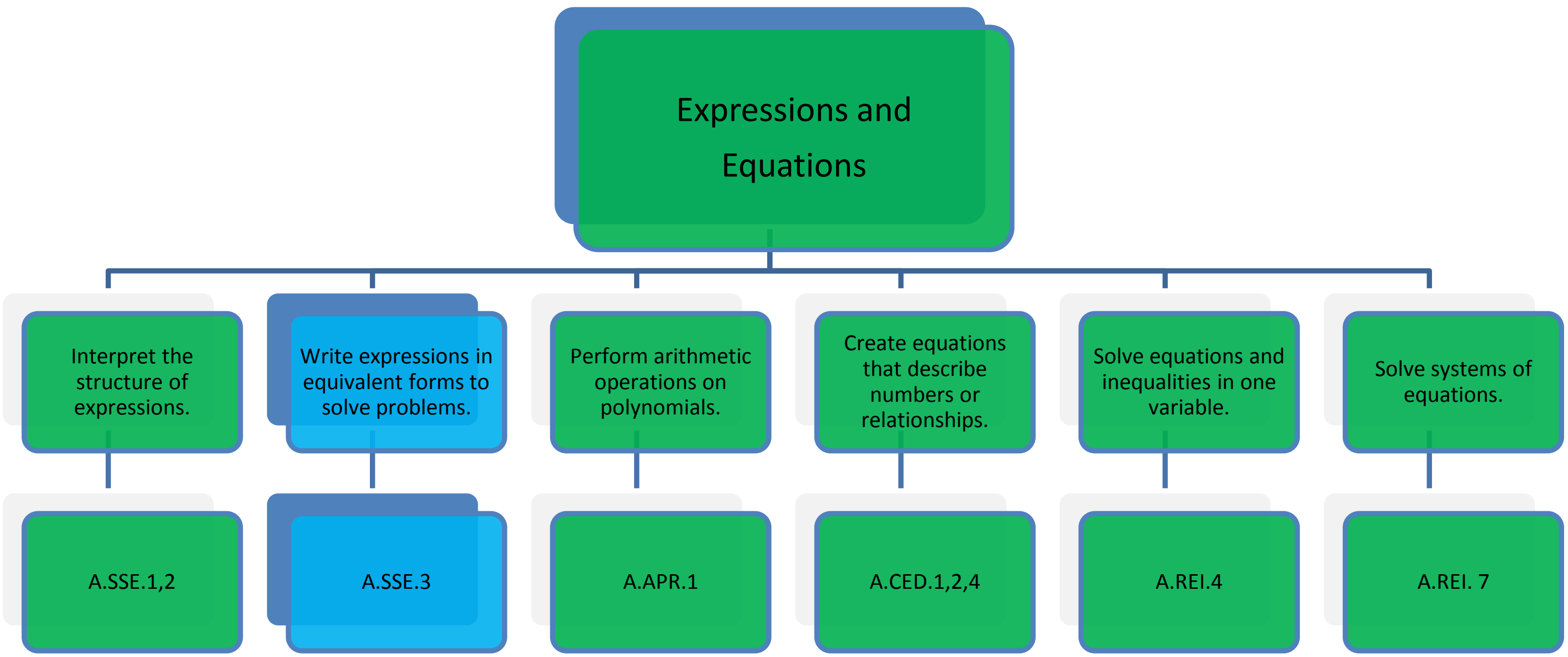




Key: Major Clusters; Additional / Supporting Clusters

Accelerated Algebra 1

Unit 4

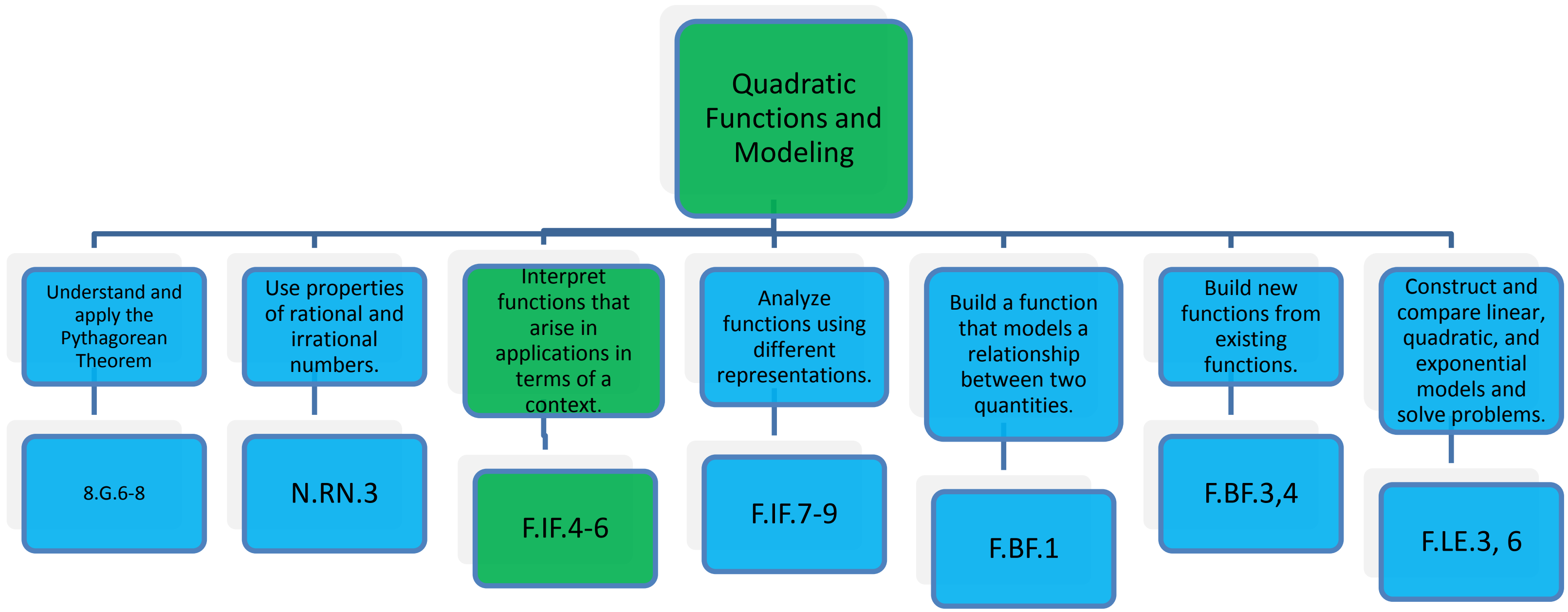


A-SSE.3: Choose and Produce an Equivalent Form of an Expression and explain properties of Quantities

Key: Major Clusters; Additional / Supporting Clusters

Accelerated Algebra 1

Unit 5



F-IF.4-6: Interpret Functins that arise in Applications in Terms of the Context

Key: Major Clusters; Additional / Supporting Clusters

Accelerated 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
(m) Interpret the structure of expressions. *Limit to linear expressions and to exponential expressions with integer exponents.*	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.*
(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.*	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.
(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, such as* $5x = 125$ or $2x = \frac{1}{16}$.	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**
(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.*	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.

(s/a) 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*.	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 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.
MATHEMATICAL PRACTICES	
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. **3. Construct viable arguments and critique the arguments of others.** 4. **Model with mathematics**. 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.	As you begin the year, it is advised that you start with MP1 and MP 3 and MP4 to set up your expectations of your classroom. This will help you and your students become proficient in the use of these practices. All other practices may be evident based on tasks and classroom activities.
LEARNING PROGRESSIONS	
CDE Progress to Algebra K-8 www.cde.ca.gov/be/cc/cd/documents/updateditem12catt3.doc	

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• Understand that numbers in real world applications often have units attached to them, and they are considered quantities. • Understand the structure of algebraic expressions and polynomials. • Understand general linear equations (□=□□+□, □≠0) and their graphs and extend this to work with absolute value equations, linear inequalities, and systems of linear equations. • The properties of equality and order of operation can be used to solve an equation by using inverse operations. • Solving equations and inequalities give all the values of a variable that make the equation/inequality true.	• What are the "pieces" of an algebraic expression? What do they represent in the context of the real-world situation? • What do the parts of an expression tell us in a real-world context? • How would you describe the difference between an expression and an equation? • How do the properties of equality and order of operations extend to support the solving of an equation? • Why is it important to be able to solve linear equations and inequalities in one variable?	Absolute Value Equation Equality Expression Exponent Graph Inequality Linear equation Linear inequality Polynomial System of linear equations Variable

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT

Materials:
• **California Revised Mathematics Framework:**
• http://www.cde.ca.gov/be/cc/cd/draftmathfwchapters.asp.
• **Mathematics Assessment Project Formative Assessments/Tasks**
  ◦ Solving Equations in One Variable: **http://map.mathshell.org/materials/lessons.php?taskid=442** (8.EE)
  ◦ Sorting Equations and Identities: **http://map.mathshell.org/materials/lessons.php?taskid=426#task426** (A-SSE, A-REI)
  ◦ Manipulating Polynomials: **http://map.mathshell.org/materials/lessons.php** (A-SSE, A-APR)
  ◦ Defining Regions of Inequalities: **http://map.mathshell.org/materials/lessons.php?taskid=219&subpage=concept** (A-REI)
  ◦ Interpreting Algebraic Expressions: **http://map.mathshell.org/materials/lessons.php?taskid=221&subpage=concept** (A-SSE, A-APR)
  ◦ Comparing Investments: **http://map.mathshell.org/materials/lessons.php?taskid=426&subpage=concept** (A-SSE, F-LE)
NCTM Books:
• **Developing Essential Understanding for Teaching Mathematics in Grades 9-12**
	Start by directing students to understand written sequence of steps for solving linear equations which is code for a narrative line of reasoning that would use words like "if", "then", "for all" and "there exists." In the process of learning to solve equations, students should learn certain "if - then" moves: e.g. "if $x = y$ then $x + c = y + c$ for any c." The first requirement in this domain (REI) is that students understand that solving equations is a process of reasoning (A.REI.1).
	
	Have students reason through problems with careful selection of units, and how to use units to understand problems and make sense of the answers they deduce.
	
	Example
	As Felicia gets on the freeway to drive to her cousin's house, she notices that she is a little low on gas. There is a gas station at the exit she normally takes, and she wonders if she will have to get gas before then. She normally sets her cruise control at the speed limit of 70 mph and the freeway portion of the drive takes about an hour and 15 minutes. Her car gets about 30 miles per gallon on the freeway, and gas costs $3.50 per gallon.
	a. Describe an estimate that Felicia might do in her head while driving to decide how many gallons of gas she needs to make it to the gas station at the other end.
	b. Assuming she makes it, how much does Felicia spend per mile on the freeway?
	
	Students will create multiple ways to rewrite an
		SBAC - http://www.smarterbalanced.org/
		
		PARCC - http://parcconline.org/samples/mathematics/grade-6-slider-ruler
		
		http://www.parcconline.org/samples/mathematics/high-school-seeing-structure-equation -

• **Implementing the Common Core State Standards through Mathematical Problem Solving: High School** **NCTM Illuminations** • Pan Balance – Expressions: **http://illuminations.nctm.org/ActivityDetail.aspx?id=10** • Exploring Equations: **http://illuminations.nctm.org/LessonDetail.aspx?ID=L746** • Algebra tiles: **http://illuminations.nctm.org/ActivityDetail.aspx?ID=216** • Function Matching: **http://illuminations.nctm.org/ActivityDetail.aspx?ID=216** **Other Resources** **LAUSD Adopted Textbooks: Glencoe Algebra 1**	expression that represents its equivalent form. http://a4a.learnport.org/page/algebra-tiles The use of algebraic tiles to establish a visual understanding of algebraic expression and the meaning of terms, factors, and coefficients. **Writing in Mathematics** **Think-Ink-Pair-Share** **Think-Pair-Share** **Purposeful Grouping** **Every Pupil Response** (EPR) strategies for whole group instruction: • Thumbs up/thumbs down • Individual White Boards • Fist of Five • Signal Cards	

LANGUAGE GOALS

Students will be able to use mathematical vocabulary to explain orally and in writing parts of an expression/equation/inequality using such vocabulary as terms, factors, and coefficients.
Students will describe the relationship between a linear equation and a system of linear equations.
Students will explain how to solve an equation to a partner. The partner should retell what was explained to them.
Students will write, in their own words, an explanation of linear equation.
Students will write a constructed response to a one variable equation/inequality word problem using the appropriate mathematic vocabulary.
Example: The unknown variable is _____ because ___. This solution demonstrates that _______.

PERFORMANCE TASKS

LAUSD Concept Lessons – http://math.lausd.net/middle-school/algebra-1-concept-lessons

-Tommy's T-Shirts -Storage Tanks
-Surround the Pool -Calling Plan
-Stacking Cups

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- **Comparing Investments: http://map.mathshell.org/materials/lessons.php?taskid=426&subpage=concept (A-SSE, F-LE)**

DIFFERENTIATION📖		
FRONT LOADING	ACCELERATION	INTERVENTION
Prerequisites: Familiarity with order of operations, exponents, variables, coefficients, function, domain, quadrant, x-axis, y-axis, line, fractions, integers, equation, rational numbers, irrational numbers, real numbers, expressions by utilizing sentence stems, language frames, visuals, and cloze reading. Experience in problem solving, reading and communicating, estimating and verifying answers and solutions, logical reasoning, and using technology. Students must be able to use the language of mathematics orally and in writing to explain the thinking processes, mathematical concepts and solution strategies they use in solving problems. Students, at least informally, should become familiar with examples of inductive and deductive reasoning. Students should become proficient in the use of scientific calculators and graphing calculators to enhance their understanding of mathematical ideas and concepts.	Due to their intuitive understanding of mathematical function and processes, students who are mathematically gifted may skip over steps and be unable to explain how they arrived at the correct answer to a problem. Utilize Math Practice 3 with them often. Provide students with opportunities to share their previous knowledge and avoid redundant learning by being encouraged to learn the sophisticated and advanced information and skills of the curriculum or related curriculums at their own rate. This also includes the opportunity for students to make personal meaning of the lesson. Provide students with a variety of learning/assessment options. Use engaging, active, and grounded in reality activities. The increased complexity of the problems should require higher order thinking skills and provide opportunities for open-ended responses. Students who are accelerated in mathematics often demonstrate an uneven pattern of mathematical understanding and development, and may be much stronger in concept development than they are in computation. These students often prefer to learn all they can about a particular mathematical idea before leaving it for new concepts. Therefore, a more expansive approach focused on student interest may avoid the frustration that occurs when the regular classroom schedule demands that it is time to move on to another topic.	• Design an activity involving currency conversions or deriving quantities such as person-hours and heating degree-days, social science rates such as per-capita income, and rates in everyday life such as points scored per game or batting averages. • Teachers utilize concrete models such as Algebra tiles for an extended period of time. • Have students verbalize what they are doing through words, pictures, and numbers. Students are encouraged to justify their thinking using targeted mathematical vocabulary. • Students practice creating an expression that describes a computation involving a general quantity. • Students are encouraged to restate word problems in their own words. • Students are provided opportunities to teach the concept to each other. • An abstract concept is represented in a variety of ways, such as concrete examples, words, symbols, drawings, and acting it out. • Emphasize purposeful transformation of expressions into equivalent forms that are suitable for the purpose at hand.

Accelerated 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
Extend the properties of exponents to rational exponents.	**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.
Define evaluate and compare functions	**8.F.1.** 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. **8.F.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* **8.F.3** 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.*
Understand the concept of a function and use function notation.	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 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

CLUSTERS	COMMON CORE STATE STANDARDS
	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 □□1.*
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.*	**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 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.★
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.*	**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.*
Construct and compare linear, quadratic, and exponential models	**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. ★ **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). ★

CLUSTERS	COMMON CORE STATE STANDARDS
Use functions to model relationships between quantities	8F.4 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. 8F.5 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.
Interpret functions that arise in applications in terms of a context. *Focus linear and exponential 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 function h 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 the 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.
Analyze functions using different representations. *Linear, exponential, quadratic, absolute value, step, piecewise-defined.*	**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.
Analyze and solve linear equations and pairs of simultaneous linear equations	8.EE.8 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. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by

CLUSTERS	COMMON CORE STATE STANDARDS
	graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* c. Solve real-world and mathematical problems leading to to linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*
Solve systems of equations. *Linear-linear and linear-quadratic.*	**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.
Represent and solve equations and inequalities Graphically. *Linear and exponential; learn as general principle.*	**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 forming a curve (which could be a line). **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. ★ **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.
MATHEMATICS PRACTICES	
1. Make sense of problems and persevere in solving them. 2. **Reason abstractly and quantitatively**. 3. Construct viable arguments and critique the arguments of others. **4. Model with mathematics.** 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.	Emphasize Mathematical Practices 1, 2, 4, and 7 in this unit.
LEARNING PROGRESSIONS	
CDE Progress to Algebra K-8 www.cde.ca.gov/be/cc/cd/documents/updateditem12catt3.doc Progression on HS Math - http://commoncoretools.me/wp-content/uploads/2012/12/ccss_progression_functions_2012_12_04.pdf	

(m)Major Clusters – area of intensive focus where students need fluent understanding and application of the core concepts.
(s)Supporting/Additional Clusters – designed to support and strengthen areas of major emphasis/expose students to other subjects.
★Indicates a modeling standard linking mathematics to everyday life, work, and decision-making.
(+) Indicates additional mathematics to prepare students for advanced courses.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• Write in equivalent forms that represent both linear and exponential functions and construct functions to describe the situation and to find solutions • Apply rules that builds a function that models a relationship between two quantities • Represent equations and inequalities in one variable in various ways and use them to extend the properties of exponents to rational exponents • Understand the relationship between quantities of two systems of equations and the methods to solve two system of linear equations • Model with linear and exponential functions.	1. How will students identify the different parts of a two-system equation and explain their meaning within the context of the problem? 2. What is the importance of identifying the structure of functions and using different ways to represent them? 3. Why is it important to identify and extend the properties of exponents to rational exponents? 4. When do students decide which is the best method to solve an inequality? 5. How do you know which method to use in solving a system of equations? 6. Why is it important to analyze functions using different representations? 7. How do I analyze algebraic equations/inequalities to solve problems? 8. What must students understand in order to create equations that describe numbers or relationships? 9. How do students know which is the most efficient ways to build a function that models a relationship between two quantities? 10. Why is it important to understand solving a system of linear and exponential relationships in two variables algebraically and graphically? 11. Is there functional relationship in non-linear and ambiguous data?	Arithmetic Sequence Asymptote Boundary Coefficients Domain Exponential Explicit Function Geometric Sequence In-equalities Linear Range Rate of change Rational Recursively Symmetries

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
Materials: **California Revised Mathematics Framework:**	***Use Analogy in the Context of the Math Exponential Growth***. When a quantity grows with	SBAC - http://www.smarterbalanced.org/

http://www.cde.ca.gov/be/cc/cd/draftmathfwchapters.asp. **Engage New York** http://www.engageny.org/sites/default/files/resource/attachments/algebra-i-m1-copy-ready-materials.pdf **Illustrative Mathematics** Skeleton Tower – F. BF.1a http://www.illustrativemathematics.org/illustrations/75 A Sum of Functions – F. BF. 1a http://www.illustrativemathematics.org/illustrations/230 Lake Algae – F. BF.1a http://www.illustrativemathematics.org/illustrations/533 Logistic Growth Model, Explicit Version: F-IF.4 http://www.illustrativemathematics.org/illustrations/804 **Inside Mathematics** http://www.insidemathematics.org/index.php/tools-for-teachers/course-1-algebra Tools for algebra **Math Assessment Project** (MAPS) Building and Solving Equations 2: A-REI http://map.mathshell.org/materials/lessons.php?taskid=554#task554 Manipulating Radicals: N-RN http://map.mathshell.org/materials/lessons.php?taskid=547#task547	time by a multiplicative factor greater than 1, it is said the quantity grows exponentially. Hence, if an initial population of bacteria, P_0, doubles each day, then after t days, the new population is given by $P(t) = P_0 2^t$ This expression can be generalized to include different growth rates, as in $(t) = P_0 r^t$. The following example illustrates the type of problem that students can face after they have worked with basic exponential functions like these. ***Example*.** On June 1, a fast growing species of algae is accidentally introduced into a lake in a city park. It starts to grow and cover the surface of the lake in such a way that the area covered by the algae doubles every day. If it continues to grow unabated, the lake will be totally covered and the fish in the lake will suffocate. At the rate it is growing, this will happen on June 30. a. When will the lake be covered halfway? b. Write an equation that represents the percentage of the surface area of the lake that is covered in algae as a function of time (in days) that passes since the algae was introduced into the lake. Facilitate a discussion that would direct students to generate recursive formula for the sequence $P(n)$, which gives the population at a given time period n in terms of the population n-1 for the following example: Populations of bacteria can double every 6 hours under ideal conditions, at least until the nutrients in its supporting culture are depleted. This means a population of 500 such bacteria would grow to 1000, etc.	PARCC - http://parcconline.org/samples/mathematics/high-school-functions F-IF.9 http://parcconline.org/sites/parcc/files/PARCC_SampleItems_Mathematics_HSAlgIMylaPool_081913_Final.pdf Myla's Swimming Pool: F-LE.2 http://parcconline.org/sites/parcc/files/HSAlg1Math2MiniGolfPrices.pdf Mini -Golf Prices: F-BF.2 http://www.ccsstoolbox.com/parcc/PARCCPrototype_main.html • Cellular growth: F-LE.2 and F-BF.2 • Rabbit populations: F-LE. 2 and 5

	Use of Exit Slips to assess student understanding. **http://daretodifferentiate.wikispaces.com/Pre-Assessment** EPR) strategies for whole group instruction. Strategies to check for understanding: Individual White Boards, Fist of Five, Exit Slip, etc.	

LANGUAGE GOALS

Students will be able to justify (orally and in writing) their rationale for solving a system of equations using various methods.

Example: To solve these equations, I use__________________________ instead of ____________________________ because______________.

Students will be able to explain (writing/speaking/listening) their understanding of the properties of the quantity represented in terms of their context.
Example: $3x – 9y = 5$ and $y = 1/3\ x +1$__________________________.

Students will be able to read a word problem and identify the language need to create an algebraic representation.

Students will be able to explain (orally and in writing) and justify their rationale for their choice of method to solve inequality equations.
Example: To solve this inequality, I use__________________________ because____________________________.

Students will be able to describe their understanding (orally and in writing) math vocabulary around whole expressions and equations.

PERFORMANCE TASKS

Illustrative Mathematics
Influenza epidemic : F.IF.4 http://www.illustrativemathematics.org/illustrations/637
Logistic Growth Model, Abstract Version : F.IF.4 http://www.illustrativemathematics.org/illustrations/800
ow is the Weather?: F.IF.4 http://www.illustrativemathematics.org/illustrations/649
Telling a Story With Graphs : F.IF.4 http://www.illustrativemathematics.org/illustrations/650

LAUSD Concept Lessons – http://math.lausd.net/middle-school/algebra-1-concept-lessons
Tying the Knots

Mathematics Assessment Project Formative Assessments/ Tasks
Comparing Investment – F.LE 1-5. http://map.mathshell.org/materials/download.php?fileid=1250
Fuctions and Everyday – F.BF.1 and F.LE.1-5 : http://map.mathshell.org/materials/download.php?fileid=1259

DIFFERENTIATION		
FRONT LOADING	ACCELERATION	INTERVENTION
Prerequisites • Help students understand how to apply their understanding of the properties of exponents. This would help them to identify exponential functions. • Students should understand domain as the set of inputs to a function. When describing relationships between quantities, the defining characteristic of a function is that the input value determines the output value, or equivalently, that the output value depends upon the input value. • The knowledge of rational numbers should help students to work with exponents. They should apply and extend this knowledge to finding the values of numerical values that include exponents. • Engage students in a discussion that would enable them apply their knowledge about the meaning of the representation of radicals with rational exponents. • Have students extend their knowledge of learning the relationship between the algebraic representation and its graph. They will use their prior knowledge of creating tables of values for function to find a solution. • Students will extend their prior knowledge of graphing two equations and be able to interpret the intersection of the graph as the solution to the original equation.	• Students will design a word problem that reflects the use of graphing inequalities. • Students will write a scenario and explain the process needed to solve a system of linear equations with two variables. • Have student create a real world problem where students will build a function that model a relationship between two quantities. • Have students apply their math knowledge that will extend the properties of exponents to exponential functions. • Students will compare and contrast the properties of a linear equation and linear inequality equation. • A function can be described in various ways, such as by a graph (e.g., the trace of a seismograph); by a verbal rule, as in, “I’ll give you a state, you give me the capital city.” Have students answer the following question: “Does each element of the domain correspond to exactly one element of the range?”	• Use real-word context examples to demonstrate the meaning of the parts of a system of equations for the students. • Use of visual interactive websites that through the manipulation of graphs represent inequalities. • Students find it useful through technology to recognize function that represents the same relationship. • Provide a situation that uses realia to demonstrate how to build a function that model a relationship between two quantities. • In the learning of Sequences, students should understand that Patterns are examples of sequences, and the work here is intended to formalize and extend students’ earlier understandings.

Accelerated Algebra 1 – UNIT 3
Descriptive Statistics

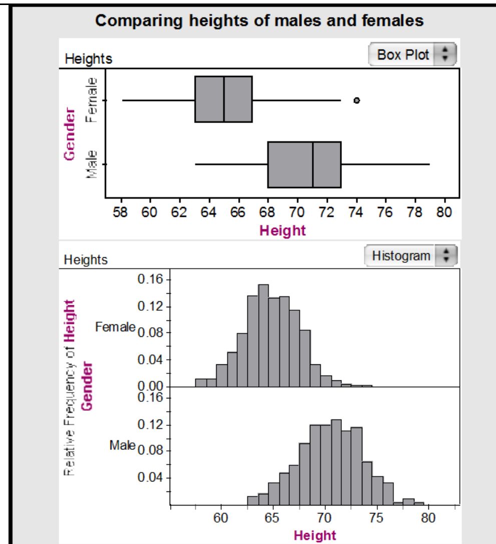
Critical Area: Experience with descriptive statistics began as early as Grade 6. Students were expected to display numerical data and summarize it using measures of center and variability. By the end of middle school they were creating scatterplots and recognizing linear trends in data. This unit builds 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.

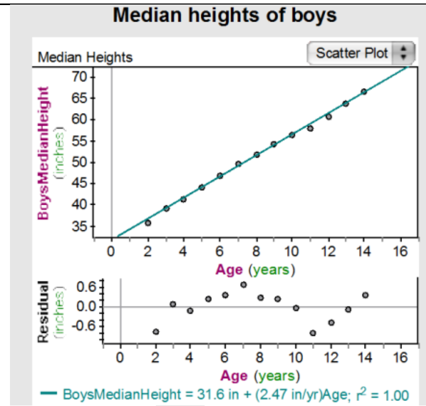
CLUSTERS	COMMON CORE STATE STANDARDS
Summarize, represent, and interpret data on a single count or measurement variable. *In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.*	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).
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 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.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. 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.
Investigate patterns of association in bivariate data. *While this content is likely subsumed by S. I.D. 6-9, it could be used for scaffolding instruction to the more sophisticated content found there.*	8.SP.1 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.2 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

CLUSTERS	COMMON CORE STATE STANDARDS
	model fit by judging the closeness of the data points to the line. 8.SP.3 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.4 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?
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.*	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.
MATHEMATICS PRACTICES	**LEARNING PROGRESSIONS**
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the arguments of others. 4. Model with mathematics. 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.	CDE Progress to Algebra K-8 www.cde.ca.gov/be/cc/cd/documents/updateditem12catt3.doc

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. • Students will be introduced to the correlation coefficient. The focus 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 is studied. • Students take a deeper look at bivariate data, using their knowledge of proportions to describe categorical associations and using their knowledge of functions to fit models to quantitative data.	How would you analysis bivariate data using your knowledge of proportions? How would you describe categorical associations and use your knowledge of functions to fit models to quantitative data? How would you interpret the parameters of a linear model in the context of data that it represents? How can you compute correlation coefficients using technology and interpret the value of the coefficient?	Association Bivariate data Box plots Categorical association Causation Correlation coefficient Dot plots Histogram Intercept (constant term) Linear model Line of best fit Mean, Median Outlier Quantitative variables Scatter plot Slope (rate of change)

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
Materials: **California Revised Mathematics Framework:** http://www.cde.ca.gov/be/cc/cd/draftmathfwchapters.asp. **NCTM Illuminations** • Line of Best Fit http://illuminations.nctm.org/ActivityDetail.aspx?ID=146 • Linear Regression http://illuminations.nctm.org/ActivityDetail.aspx?ID=82 **Illustrative Mathematics** http://www.illustrativemathematics.org/illustrations/942 **Mathematics Assessment Project – MARS Tasks**	Use graphs such as the one below to show two ways of comparing height data for males and females in the 20-29 age group. Both involve plotting the data or data summaries (box plots or histograms) on the same scale, resulting in what are called parallel (or side-by-side) box plots and parallel histograms (S-ID.1). The parallel histograms show the distributions of heights to be mound shaped and fairly symmetrical (approximately normal) in shape. The data can be described using the mean and standard deviation. Have students sketch each distribution and answer questions about it just from knowledge of these three facts (shape, center, and spread). They also observe that the two measures of center, median and mean, tend to be close to each other for symmetric distributions.	SBAC - http://www.smarterbalanced.org/ Thermometer Crickets http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/09/performance-tasks/crickets.pdf PARCC - http://parcconline.org/samples/mathematics/grade-6-slider-ruler

Representing Data Using Box Plots – S.ID. 5, 6 a- c: http://map.mathshell.org/materials/download.php?fileid=1243 Representing Data 1: Using Frequency Graphs – S.ID 1-3: http://map.mathshell.org/materials/download.php?fileid=1230 Statistics Online Computational Resource (SOCR) http://www.socr.ucla.edu/	 *Heights of U.S. males and females in the 20–29 age group.* Source: *U.S. Census Bureau, Statistical Abstract of the United States: 2009*, Table 201. Have students learn how to take a careful look at scatter plots, as sometimes the "obvious" pattern does not tell the whole story, and can even be misleading. The graphs show the median heights of growing boys through the ages 2 to 14. The line (least squares regression line) with slope 2.47 inches per year of growth looks to be a perfect fit (S-ID.6c). But, the residuals, the differences between the corresponding coordinates on the least squares line and the actual data values for each age, reveal additional information.	



LANGUAGE GOALS

Students will analysis bivariate data using your knowledge of proportions and explain their findings.

Students will describe categorical associations and use their knowledge of functions to fit models to quantitative data.

Students will interpret the parameters of a linear model in the context of data that it represents.

Students will compute correlation coefficients using technology and interpret the value of the coefficient.

PERFORMANCE TASKS

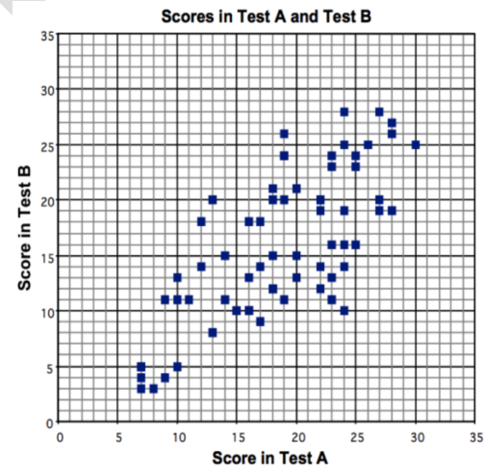
ILLUSTRIVE MATHEMATICS

- Haircut Costs – S.ID.1, 2, 3 : http://www.illustrativemathematics.org/illustrations/942
- Speed Trap – S.ID.1, 2, 3: http://www.illustrativemathematics.org/illustrations/1027
- Coffee and Crime – S.ID.6-9: http://www.illustrativemathematics.org/illustrations/1307
- Olympic Men's 100-meter dash – S.ID.6a, 7: http://www.illustrativemathematics.org/illustrations/1554
- Used Subaru Foresters I – S.ID.6: http://www.illustrativemathematics.org/illustrations/941
- Texting and Grades II – S.ID.7 : http://www.illustrativemathematics.org/illustrations/1028

MARS Tasks:

- Representing Data 1: Using Frequency Graphs – S.ID 1-3: http://map.mathshell.org/materials/download.php?fileid=1230
- Representing Data Using Box Plots – S.ID. 5, 6 a- c: http://map.mathshell.org/materials/download.php?fileid=1243
- Interpreting Statistics: A Case of Muddying the Waters – S.ID 7-8 http://map.mathshell.org/materials/download.php?fileid=686
- Devising a Measure for Correlation – S.ID : http://map.mathshell.org/materials/download.php?fileid=1234

NCTM Illuminations Lessons

DIFFERENTIATION📖		
FRONT LOADING	ACCELERATION	INTERVENTION
• Use graphs of experiences that are familiar to students to increase accessibility and supports understanding and interpretation of proportional relationship. Students are expected to both sketch and interpret graphs including scatter plot. • Students create an equation with given information from a table, graph, or problem situation. • Engage students in interpreting slope and intercept using real world applications (e.g. bivariate data).	Students will explore how the residuals, the differences between the corresponding coordinates on the least squares line and the actual data values for each age, reveal additional information. Students should be able to sketch each distribution and answer questions about it just from knowledge of these three facts (shape, center, and spread). Have students design an experiment (project) where they would collect data from different sources, make a scatter plot of the data, draw a line of best fit modeling the data. From the plot, students would write the regression coefficient and the residual to explain the strength of the association.	Have the students work in groups to generate data from the internet, such as the CST scores and other data. Have them construct a table based on the pattern and then graph the values and explain the relationship observed on the graph (association). Example: Certain students took two different tests (Test A and Test B). In the scatter diagram, each square represents one student and shows the scores that student got in the two tests.  Draw a line of best fit on the scatter diagram and answer some questions regarding the data.

[1] **Major Clusters – area of intensive focus where students need fluent understanding and application of the core concepts.**

[2] **Supporting/Additional Clusters – designed to support and strengthen areas of major emphasis/expose students to other subjects.**

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7. California Department of Education. (2013). Draft Mathematics Framework Chapters. Retrieved from http://www.cde.ca.gov/ci/ma/cf/documents/aug2013algebra1.pdf.
8. National Council of Teachers of Mathematics (NCTM) Illuminations. (2013). Retrieved from http://illuminations.nctm.org/Weblinks.aspx.
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Accelerated 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 number 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 form of an expression.

CLUSTERS	COMMON CORE STATE STANDARDS
Interpret the structure of 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.* A.SSE.2 Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).*
Write expressions in equivalent forms to solve problems.	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 (1.151/12)12t □□1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
Perform arithmetic operations on polynomials.	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.
Create equations that describe numbers or relationships.	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.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.*
Solve equations and inequalities in one variable.	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.
Solve systems of equations.	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 points of intersection between the line $y = –3x$ and the circle $x2 + y2 = 3$.*
MATHEMATICAL PRACTICES	LEARNING PROGRESSIONS
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the arguments of others. 4. Model with mathematics. 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.	http://ime.math.arizona.edu/progressions/ Progression to algebra

[1] **Major Clusters – area of intensive focus where students need fluent understanding and application of the core concepts.**

[2] **Supporting/Additional Clusters – designed to support and strengthen areas of major emphasis/expose students to other subjects.**

★Indicates a modeling standard linking mathematics to everyday life, work, and decision-making.

(+) Indicates additional mathematics to prepare students for advanced courses.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• Represent a quantity in terms of an expression, such as terms, factors, and coefficients by viewing one or more of their parts as a single entity. • Writing in equivalent forms to find solutions that reveal and explain properties of quadratic expressions from completing the square, factoring, and using properties of exponent. • Apply rules that polynomials form a system analogous to integers. • Represent equations and inequalities in one variable in various ways and use them to solve problems. • Understand the relationship between quantities of two or more variables through graphing on a coordinate system.	1. How will students identify the different parts of an expression and explain their meaning within the context of the problem? 2. What is the importance of identifying the structure of an expression and ways to rewrite it? 3. Why is it important to solve and produce equivalent forms of an expressing 4. When is factoring the best method to solve a quadratic expression? 5. When is completing the square useful to reveal the maximum or minimum value of the function it defines? 6. How do you know which method to use in	• Analogous • Complex • Coefficient • Coordinate • Drive • Entity • Equation • Equivalent • Exponentials • Expression • Factors • Function

• The ability to manipulate variables of formulas to solve equations. • Transforming quadratic equations using the method of completing the square to derive a solution. • Recognizing the various methods to solve quadratic equations stemming from an initial form as appropriate: taking the square root, completing the square, quadratic formula, and factoring. • Identify when the quadratic formula gives complex solutions. • The ability to solve systems of linear equations in two variables algebraically and graphically	solving quadratic expression? 7. Why is it important to know the operations of integers to understand the properties of polynomials? 8. How do I analyze algebraic equations/inequalities to solve problems? 9. What must students understand in order to create equations that describe numbers or relationships? 10. How do you know which is the most efficient ways to solve a quadratic equation? 11. Why is it important to understand solving a system of linear and quadratic equations in two variables algebraically and graphically? 12. Who are the methods of solving a quadratic equation related? 13. How do we know when the roots of a quadratic equation are real or complex? 14. Why are the methods of solving quadratic equations not learned in isolation?	• Inequalities • Interpret • Intersection • Linear • Polynomial • Product • Quadratic • Quantity • Term • Transform • Variable

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
http://www.engageny.org/resource/algebra-ii-module-1 Progression on HS Math - http://commoncoretools.me/wp-content/uploads/2012/12/ccss_progression_functions_2012_12_04.pdf Math Resources - http://mid-illini.org/CCSS_Math_Resources.html HS Algebra - http://www.parcconline.org/samples/mathematics/high-school-functions HS Algebra - http://www.illustrativemathematics.org/standards/hs http://www.wiki-teacher.com/ Math Resources – algebra http://www.insidemathematics.org/index.php/tools-for-teachers/course-1-algebra Tools for algebra	• The use of algebraic tiles to establish a visual understanding of algebraic expression and the meaning of terms, factors, and coefficients. • The development and proper use of mathematical language (ie: Frayer Model, Word Wall, using real world context). • Students will create multiple ways to rewrite an expression that represents its equivalent form.	http://www.smarterbalanced.org/ H.S. SBAC Sample Assessment http://dese.mo.gov/divimprove/assess/documents/asmt-sbac-math-hs-sample-items.pdf Missouri HS Math Assessments http://www.parcconline.org/samples/mathematics/high-school-mathematics PARCC HS Assessments

http://map.mathshell.org/materials/tasks.php Algebra lessons http://www.readingrockets.org/strategies/think-pair-share/ Pair share/peer collaboration on different methods to solve a system of equations. http://serc.carleton.edu/introgeo/gallerywalk/how.html Gallery Walk depicting various ways to solve a system of equations. Urge students to use an graphic organizer.		

LANGUAGE GOALS

Students will be able to compare and contrast the various methods of solving a quadratic equation.
Example: To solve this quadratic equation, I use__________________________ instead of ____________________________ because______________.

Students will be able to explain (writing/speaking) their understanding of the properties of the quantity represented in terms of their context.
Example: x2 + 6x + 9 = __________________________.

Students will be able to read a word problem and identify the language needed to create an algebraic representation in order to solve the problem.
Example:

Students will explain the use of the ________________________method to find the solution of the quadratic equation. (writing/speaking)
Example: To solve this quadratic equation, I use__________________________ because____________________________.

Students will be able to understand the vocabulary for the parts that make the whole expression/equation and be able to identify their parts and interpret their meaning in terms of a context.
Example: Using the Frayer Model to introduce students to understand the difference between the parts of an expression and that of an equation.

PERFORMANCE TASKS

Formative Assessment Project – MARS Task
Interpreting Algebraic Expressions - A.SSE.1-2: http://map.mathshell.org/materials/download.php?fileid=694
Solving Linear Equations in Two Variables – A.REI.5-7: http://map.mathshell.org/materials/download.php?fileid=669
Sorting Equations and Identities – A.SSE.1-3, A.REI.4: http://map.mathshell.org/materials/download.php?fileid=688

DIFFERENTIATION		
FRONT LOADING	ACCELERATION	INTERVENTION
• Students apply their understanding of expressions as sums of terms and products of factors. • Students apply and extend their knowledge of the Number System, students see all numbers as part of a unified system, and become fluent in finding and using the properties of operations to find the values of numerical expressions that include those numbers. • Students apply their knowledge about the order of operations , and properties of operations to transform, simple expressions. Transformations require an understanding of the rules for multiplying negative numbers, and properties of integer exponents. • Students will work with radicals and integer exponents to generate equivalent numerical expressions and equations. Students will extend their knowledge of analyzing and solving linear equations and pairs of simultaneous linear equations. Students will use their prior knowledge of graphing proportional relationships, lines, and linear equations.	• Students will design a word problem that reflects the use of graphing a quadratic equation. • Students will write a scenario and explain the process needed to solve a system of linear and quadratic equations with two variables. • Create a real world problem where factoring is the best method to solve a quadratic expression. • Have students apply their math knowledge of quadratic equations to solve a word problem they have created.	• Use of real context examples to demonstrate the meaning of the parts of algebraic expression, Example: To illusutrate the actual items representing the items symbolically in order to set up an equation. • Use hands-on materials, such as algebra tiles, can be used to establish a visual understanding of algebraic expressions and the meaning of terms, factors and coefficients. • Students find it useful through technology to recognize that two different expressions represent the same relationship. • Provide a situation that uses realia to further demonstrate the meaning of the parts of algebraic expressions to counter student misconceptions.

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Accelerated Algebra 1– UNIT 5
Irrational Numbers, 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
Understand and Apply the Pythagorean Theorem	**8.G.6** Explain a proof of the Pythagorean Theorem and its converse. 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. 8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
(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.*	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.*	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 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.★
(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 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.*	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.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.*
(m)Build a function that models a relationship between two quantities. *Focus on situations that exhibit a quadratic relationship.*	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 a decaying exponential, and relate these functions to the model.*
(*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*	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.*

the inverse to exist, such as f(x) = x2, x>0.	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.*
(*s*)Construct and compare linear, quadratic, and exponential models and solve problems. *Compare linear and exponential growth to quadratic growth.*	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. F.LE.6. Apply quadratic functions to physical problems, such as the motion of an object under the force of gravity. ★ CA
MATHEMATICAL PRACTICES	
1. Make sense of problems and persevere in solving them. **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the arguments of others.** **4. Model with mathematics.** 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.	Emphasize Mathematical Practices 1, 2, 3, 4, 6, and 7 in this unit.

LEARNING PROGRESSIONS
Progression to Algebra http://ime.math.arizona.edu/progressions/

(m)Major Clusters – area of intensive focus where students need fluent understanding and application of the core concepts.
(S)Supporting/Additional Clusters – designed to support and strengthen areas of major emphasis/expose students to other subjects.
★Indicates a modeling standard linking mathematics to everyday life, work, and decision-making.
(+) Indicates additional mathematics to prepare students for advanced courses.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
Mathematical relationships can be presented graphically, in tables, or in verbal descriptions and the meaning of features in each representation can be interpreted in terms of the situation.	How does each element of the domain correspond to exactly one element of the range? How would you relate and interpret features of relationships represented in a graph, table, and verbal	Completing the square Domain Exponential function Extreme values Factoring

Quadratic, linear or exponential function can be modeled, and the situation can be used in context to specify the domain and range as it relates to the understanding of real-world application of algebra concepts. The connection between the graph of the equation $y =$ (x) and the function itself can be made, and the coordinates of any point on the graph represent an input and output, expressed as $(x, (x))$. Translation between the tabular, graphical, and symbolic representations of a function can be explored between these representations and the situation's context. Key characteristics of functions can be identified, and function language and notation to analyze and compare functions can be used. The zeros and roots of quadratic function can be solved by factoring or completing the square. Equivalent forms of linear, exponential and quadratic functions can be created to analyze and compare functions and features of functions (e.g. rates of change in specified intervals). The same function algebraically can be represented in different forms and the differences can be interpreted in terms of the graph or context. The sum or product of two rational numbers is rational can be explained, by arguing that the sum of two fractions with integer numerator and denominator is also a fraction of the same type.	descriptions? How can you represent the same function algebraically in different forms and interpret these differences in terms of the graph or context? What differences are there in the parameters of linear, exponential, and quadratic expressions? How would you model physical problems with linear, exponential and quadratic functions and what role would their parameters play in modeling? How can you find the zeros and roots of a quadratic function? How do the graphs of mathematical models and data help us better understand the world in which we live? How would you explain the product or sum of rational and irrational numbers?	Function Intercepts Interval Irrational number Linear function Maxima Maximum Minima Minimum Parameter Range Rational number Relative maximum Relative minimum Root Quantitative relationship Quadratic function Symmetry Zeros

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
Mathematics Assessment Project – MARS Task Function and Everyday Situations - F.IF.7-8 http://map.mathshell.org/materials/download.php?fileid=1259 **Illustrative Mathematics** Influenza Epidemic – F.IF.4 http://www.illustrativemathematics.org/illustrations/637 Warming and Cooling – F.IF.4: http://www.illustrativemathematics.org/illustrations/639 How is the weather – F.IF.4: http://www.illustrativemathematics.org/illustrations/649 Logistic Growth Model, Explicit Version – F.IF.4 http://www.illustrativemathematics.org/illustrations/804 The Canoe Trip, Variation 1 – F.IF.4-5 http://www.illustrativemathematics.org/illustrations/386 The High School Gym – F.IF.6b http://www.illustrativemathematics.org/illustrations/577 Temperature Change –F.IF.6 http://www.illustrativemathematics.org/illustrations/1500 Which Function? - F.IF.8a http://www.illustrativemathematics.org/illustrations/640 Throwing Baseballs – F.IF.9 and F.IF.4 http://www.illustrativemathematics.org/illustrations/1279	Facilitate a discussion with students that would help them represent functions with graphs and identify key features in the graph. Create or use already created activity where students would match different functions with their graphs, tables, and description. Engage students in graphing linear, exponential, and quadratic functions in order for them to develop fluency and the ability to graph them by hand. Help students to develop their idea of modeling physical problems with linear, exponential, and quadratic functions by looking at practical application of linear, quadratic, and exponential situations; such as stock market and investment, compound and simple interests, rocket trajectory, and speed of cars. Provide students the opportunity to compare linear, quadratic, and exponential functions, represented in different ways (table, graph, or situation) in writing using graphic organizers; such as T-chart or Venn diagram.	Smarter Balanced: http://sampleitems.smarterbalanced.org/itempreview/sbac/index.htm PARCC Sample Assessments: http://www.parcconline.org/samples/mathematics/high-school-mathematics http://www.parcconline.org/sites/parcc/files/PARCC_SampleItems_Mathematics_HSAlgIIMathIIITemperatureChange_081913_Final_0.pdf

LANGUAGE GOALS
Students will relate and interpret orally and in writing using complex sentences the meaning and features of relationships arising from a situation – whether presented graphically, in tabular form, and/or as verbal descriptions. Students will explain (orally and in writing) how to model a situation with a quadratic, linear or exponential function, and will be able to use the situation's context to specify the domain and range. Students will write how to translate between the tabular, graphical, and symbolic representations of a function, and between these representations and the situation's context. Students will identify and orally explain key characteristics of functions using the function language and notation to analyze and compare functions.

PERFORMANCE TASKS
Mathematics Assessment Project – MARS Task ● Functions and Everyday Situations – F.IF.4- 9, F.BF.3, F.LE.3: http://map.mathshell.org/materials/download.php?fileid=1259 **Illumination Mathematics** ● Average Cost – F.IF.B.4-5 http://www.illustrativemathematics.org/illustrations/387 **Noyce Foundation – Inside Mathematics** ● Sorting Functions – F.IF.4, 7a, 7c, 8a, F.LE.2 http://insidemathematics.org/common-core-math-tasks/high-school/HS-F-2008%20Sorting%20Functions.pdf

DIFFERENTIATION 🕮		
FRONT LOADING	ACCELERATION	INTERVENTION
Prerequisites: Understanding and use the formal mathematical language of functions. Provide students an opportunity to compare two functions (quadratic and exponential), represented in different ways (table, graph, or situation).	Provide the students several opportunities to collect data to model different situations related to linear, quadratic, exponential functions, and trigonometric functions. Have students complete a project such as: The half-life of caffeine is 6 hours. In other words, after consuming some caffeine, half of that caffeine is still present in the body after 6 hours. The amount of caffeine in the body at the end of any given time interval is A=Pd-kt where P is the amount of caffeine present in the body at the beginning of the time interval, t is the length of the time interval, and k is the decay constant. For one day from the time you wake up to the time you go to bed, keep a record of the time and the amount consumed of any	Have students evaluate different functions (linear, quadratics, and exponential) for a given variable. Then engage the students in identifying appropriate domain for the functions. Help students take the "function machine" that they learned in the earlier grades and turn it into a deeper understanding of relating the situation, table, and rule (formula) of functions. The goal here is to help students make the connections.

	beverage that contains caffeine. Research how much caffeine is in each type of drink you consumed. Calculate the amount of caffeine in your body when you went to bed that night. Compare your results with your classmates. Use your calculations and the results of others to make a conjecture about the time of day you should consume your last caffeinated beverage if you want to have less than 20 milligrams in your body when you go to sleep. What time should you consume your last caffeinated beverage if you want to have no caffeine in your body when you go to sleep? (CORD Algebra 2: Learning in Context, 2008.) Which Function? - F.IF.8a http://www.illustrativemathematics.org/illustrations/640 This activity is a nice analysis that involves a real understanding of what the equation of a translated parabola looks like.	

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