Sequenced Units for the Common Core State Standards in Mathematics
High School Algebra I

In the three years prior to Algebra I, students have already begun their study of algebraic concepts. They have investigated variables and expressions, solved equations, constructed and analyzed tables, used equations and graphs to describe relationships between quantities, and studied linear equations and systems of linear equations.

The Algebra I course outlined in this document begins with connections back to that earlier work, efficiently reviewing algebraic concepts that students have already studied while at the same time moving students forward into the new ideas described in the high school standards. Students contrast exponential and linear functions as they explore exponential models using the familiar tools of tables, graphs, and symbols. Finally, they apply these same tools to a study of quadratic functions. Throughout, the connection between functions and equations is made explicit to give students more ways to model and make sense of problems.

This document reflects our current thinking related to the intent of the Common Core State Standards for Mathematics (CCSSM) and assumes 160 days for instruction, divided among 11 units. The number of days suggested for each unit assumes 45-minute class periods and is included to convey how instructional time should be balanced across the year. The units are sequenced in a way that we believe best develops and connects the mathematical content described in the CCSSM; however, the order of the standards included in any unit does not imply a sequence of content within that unit. Some standards may be revisited several times during the course; others may be only partially addressed in different units, depending on the focus of the unit. Strikethroughs in the text of the standards are used in some cases in an attempt to convey that focus, and comments are included throughout the document to clarify and provide additional background for each unit.

Throughout Algebra I, students should continue to develop proficiency with the Common Core's eight Standards for Mathematical Practice:

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning 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.**

These practices should become the natural way in which students come to understand and do mathematics. While, depending on the content to be understood or on the problem to be solved, any practice might be brought to bear, some practices may prove more useful than others. Opportunities for highlighting certain practices are indicated in different units in this document, but this highlighting should not be interpreted to mean that other practices should be neglected in those units.

When using this document to help in planning your district's instructional program, you will also need to refer to the CCSSM document, relevant progressions documents for the CCSSM, and the appropriate assessment consortium framework.

Sequenced Units for the Common Core State Standards in Mathematics
High School Algebra I

Unit 1: Representing relationships mathematically	Suggested number of days: 10

In this unit, students solidify their previous work with functional relationships as they begin to formalize the concept of a mathematical function. This unit provides an opportunity for students to reinforce their understanding of the various representations of a functional relationship—words, concrete elements, numbers, graphs, and algebraic expressions. Students review the distinction between independent and dependent variables in a functional relationship and connect those to the domain and range of a function. The standards listed here will be revisited multiple times throughout the course, as students encounter new function families.

Common Core State Standards for Mathematical Content

Quantities★— N-Q

A. Reason quantitatively and use units to solve problems.

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.
2. Define appropriate quantities for the purpose of descriptive modeling.

Seeing Structure in Expressions — A-SSE

A. Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.★
   a. Interpret parts of an expression, such as terms, factors, and coefficients.

Creating equations★— A-CED

A. Create equations that describe numbers or relationships

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

Reasoning with Equations and Inequalities—A-REI

D. Represent and solve equations ~~and inequalities graphically~~

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).

Interpreting Functions — F-IF

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

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 the function.*★

Comments

To make the strongest connection between students' previous work and the work of this course, the focus for **A-CED.A.1**, **A-CED.A.3** and **F-BF.A.1a** should be on linear functions and equations. Students will have solved linear equations using algebraic properties in their previous courses, but that should not be the focus of this unit. Instead, use students' work with **A-REI.D.10 F-IF.B.5**, and **F-IF.C.9** to reinforce students' understanding of the different kinds of information about a function that is revealed by its graph. This will build a solid foundation for students' ability to estimate solutions and their reasonableness using graphs.

In this unit, students can begin to build proficiency with **MP.4** as they create mathematical models of contextual situations, while attending to limitations on those models. In order to create the models and interpret the results, students must attend to **MP.2**. As students create graphs of functional relationships, they must pay careful attention to quantities and scale, and so should be demonstrating **MP.6**.

C. Analyze functions using different representations 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.* **Building Functions — F-BF** A. Build a function that models a relationship between two quantities 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. **Common Core State Standards for Mathematical Practice** 2. Reason abstractly and quantitatively. 4. Model with mathematics. 6. Attend to precision.	

Unit 2: Understanding functions	**Suggested number of days: 15**
In this unit students build on their work in the previous unit to formalize the concept of a function. They will continue to explore continuous functions, but they will also investigate sequences as functions.	
Common Core State Standards for Mathematical Content **Interpreting Functions — F-IF** A. Understand the concept of a function and use function notation 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*). 2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. 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.* B. Interpret functions that arise in applications in terms of the context 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.*★ 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 the function.*★ **Common Core State Standards for Mathematical Practice** 2. Reason abstractly and quantitatively. 4. Model with mathematics. 6. Attend to precision. 8. Look for and express regularity in repeated reasoning.	**Comments** In addition to sequences such as the one given in the example for **F-IF.A.3**, include arithmetic sequences and make the connection to linear functions. Geometric sequences could also be included as contrast to foreshadow work with exponential functions later in the course. In this unit, students investigate functions as mathematical models (**MP.4**). In order to analyze and communicate about these models, students must attend to **MP.2** and **MP.6**. In developing symbolic representations of mathematical relationships, students might examine several specific instances of the relationship to find a generalizable regularity (**MP.8**).

Unit 3: Linear functions	**Suggested number of days: 15**

This unit solidifies students' understanding of linear functions. It reviews the connection between the constant rate of change of a linear function, the slope of the line that is the linear function's graph, and the slope-intercept form for the equation of a line, ***y*** = ***mx*** + ***b*** before introducing the ***x***-intercept, the standard form for the equation of a line, and the point-slope form for the equation of a line. This unit also introduces students to the idea that graphs of linear functions can be thought of as transformations on the graphs of other linear functions, setting the stage for the broader study of transformations of functions that continues in this and subsequent mathematics courses. This unit continues to reinforce the work with creating and representing equations described in **A-CED.A.2** and **A-REI.D.10** and with connecting the structure of expressions to contexts (**A-SSE.A.1.a**). This unit also deepens students' understanding of functions and their notation as described in **F-IF.A.1** and **F-IF.A.2.** Students will investigate key features, domains, and ranges of linear functions as described in **F-IF.B.4** and **F-IF.B.5**; write linear functions to model relationships between two quantities as in **F-BF.A.1a**; and compare properties of linear functions as in **F-IF.C.9**.

Common Core State Standards for Mathematical Content

Interpreting Functions — F-IF

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

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.★

C. Analyze functions using different representations

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~~.

Building Functions — F-BF

B. Build new functions from existing functions

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.*

Linear, Quadratic, and Exponential Models★ — F-LE

A. Construct and compare linear, quadratic, and exponential models and solve problems

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.
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).

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

5. Interpret the parameters in a linear ~~or exponential~~ function in terms of a context.

Comments

The focus of **F-IF.B.6** should be on the constant rate of change of a linear function, although non-linear functions could be investigated for contrast. In this unit, focus **F-IF.C.7a** on linear functions and their intercepts; quadratic functions will be studied in **Unit 10: Quadratic functions**. Likewise, the focus of **F-BF.B.3**, **F-LE.A.1a**, **F-LE.A.2**, and **F-LE.B.5** should be on linear functions here; exponential functions will be studied in **Unit 8: Exponential functions and equations**.

In this unit, students continue to demonstrate their proficiency with **MP.4** as they create linear models of contextual situations, while attending to limitations on those models. Work with linear functions creates a number of opportunities to reinforce students' ability to recognize and leverage regularity in reasoning (**MP.8**), whether they are developing a general formula for finding the slope of a line or generalizing a pattern of repeated calculations to write a symbolic representation for a linear function.

Interpreting Categorical and Quantitative Data — S★-ID C. Interpret linear models 7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **Common Core State Standards for Mathematical Practice** 4. Model with mathematics. 8. Look for and express regularity in repeated reasoning.	

Unit 4: Statistical models	**Suggested number of days: 20**

This unit reviews the univariate data representations students studied previously and then introduces statistical models for bivariate categorical and quantitative data. Students have already addressed in previous units many of the standards in this unit, and they should now be able to apply their understandings from that previous work in the new work with the statistics standards in this unit. This unit provides opportunities to reinforce students' work from the previous unit with representing linear functions symbolically and graphically, as described in **A-SSE.A.1a**, **A-CED.A.2**, **F-IF.A.2**, **F-IF.B.4**, **F-IF.B.5**, **F-FI.C.9**, **F-BF.B.3**, and **F-LE.A.2**, and **F-LE.B.5.**

Common Core State Standards for Mathematical Content

Quantities★— N-Q

A. Reason quantitatively and use units to solve problems.

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.
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Interpreting Categorical and Quantitative Data — S★-ID

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

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
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.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

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

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.
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~~, quadratic, 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.

Comments

The work of **S-ID.B.6a** should focus on linear functions. Students will have the opportunity to create exponential and quadratic models for data when they study those functions in **Unit 8: Exponential functions and equations** and **Unit 10: Quadratic functions**.

In this unit, students make sense of problems through data (**MP.1**). They create statistical models (**MP.4**), sometimes using different tools such as spreadsheets and graphing technology (**MP.5**). Students must defend the appropriateness of their models and any conclusions they draw based on those models (**MP.3**).

C. Interpret linear models 7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. 8. Compute (using technology) and interpret the correlation coefficient of a linear fit. 9. Distinguish between correlation and causation. **Common Core State Standards for Mathematical Practice** 1. Make sense of problems and persevere in solving them. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically.	

Unit 5: Linear equations and inequalities	Suggested number of days: 10

Students have written and solved linear equations and inequalities in their previous mathematics courses. The work of this unit should be on bringing students to mastery of this area of their mathematical study. This unit leverages the connection between equations and functions and explores how different representations of a function lead to techniques to solve linear equations, including tables, graphs, concrete models, algebraic operations, and "undoing" (reasoning backwards). This unit provides opportunities for students to continue to practice their ability to create and graph equations in two variables, as described in **A-CED.A.2** and **A-REI.D.10**.

Common Core State Standards for Mathematical Content

Creating equations★— A-CED

A. Create equations that describe numbers or relationships

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~~.*
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.*
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.*

Reasoning with Equations and Inequalities—A-REI

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

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.

B. Solve equations and inequalities in one variable

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

D. Represent and solve equations and inequalities graphically

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~~.★
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~~.

Common Core State Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
4. Model with mathematics.
6. Attend to precision.

Comments

The work of **A-CED.A.1** should focus on linear equations and inequalities. Exponential equations will be addressed in **Unit 8: Exponential functions and equations**, and quadratic equations will be addressed **Unit 11: Quadratic equations.** Rational equations should be addressed in Algebra II.

The work of **A-CED.A.3**, **A-REI.D.11,** and **A-REI.D.12** should focus on single linear equations and inequalities, as systems of linear equations and inequalities are addressed in **Unit 6: Systems of linear equations and inequalities**.

In this unit, students must be able to understand the questions they are being asked to answer, create appropriate equations and inequalities that will allow them to answer these questions, and be creative and flexible in the approaches they take to solve these equations and inequalities (**MP.1**, **MP.4**). In order to create accurate equations and inequalities, students must be able to describe relationships precisely (**MP.6**).

Unit 6: Systems of linear equations and inequalities	**Suggested number of days: 15**

In this unit students continue the study of systems of linear equations that they began in Grade 8. This unit should solidify their understanding of that prior work, and extend that understanding to creating and solving systems of linear inequalities. This unit provides opportunities for students to continue creating and graphing equations in two variables, as described in **A-CED.A.2**. They also extend their understanding of estimating solutions to equations graphically (**A-REI.D.11)** to estimating solutions of systems of equations.

Common Core State Standards for Mathematical Content

Creating equations★— A-CED

A. Create equations that describe numbers or relationships

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.*

Reasoning with Equations and Inequalities—A-REI

C. Solve systems of equations

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.
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

D. Represent and solve equations and inequalities graphically

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.

Common Core State Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
6. Attend to precision.

Comments

For **A-CED.A.3** and **A-REI.D.12**, students should focus on systems of linear equations and inequalities in two variables.

In this unit, students must be able to understand the problem they are being asked to solve and the constraints on the quantities in the problem (**MP.1**, **MP.4**). In order to model the constraints of the problem, students must be able to create precise algebraic representations (**MP.6**) in the form of equations or inequalities. Students must then be able to manipulate these representations and then interpret the results of that manipulation in the context of the problem being solved (**MP.2**).

Unit 7: Relationships that are not linear	**Suggested number of days: 15**
In this unit students explore examples of nonlinear functions that exhibit some linear characteristics as they work with absolute value and step functions. Students also connect rational exponents to roots, and investigate square root and cube root functions as other special instances of nonlinear functions. This unit again provides opportunities for students to create and graph equations in two or more variables (**A-CED.A.2**) and use and interpret function notation (**F-IF.A.2**).	
Common Core State Standards for Mathematical Content	**Comments**
The Real Number System — N-RN A. Extend the properties of exponents to rational exponents. 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.* 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. **Interpreting Functions — F-IF** C. Analyze functions using different representations 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.	When possible in this unit, students should work with real-world applications of absolute value, step, square root, and cube root functions to allow them to demonstrate their ability to reason abstractly and quantitatively (**MP.2**) and model with mathematics (**MP.4**). Their work in extending the properties of exponents to rational exponents will require careful use of definitions and precision in communicating their reasoning (**MP.6**).
Common Core State Standards for Mathematical Practice 2. Reason abstractly and quantitatively. 4. Model with mathematics. 6. Attend to precision.	

Unit 8: Exponential functions and equations	**Suggested number of days: 15**
This unit explores different situations that can be modeled with exponential functions and equations. Students use tables and graphs to contrast the repeated multiplication of exponential patterns with the repeated addition of linear patterns. This unit continues to reinforce the work with creating and representing equations described in **A-CED.A.2** and **A-REI.D.10** and with connecting the structure of expressions to contexts (**A-SSE.A.1.a**). This unit also deepens students' understanding of functions and their notation as described in **F-IF.A.2.** Students will investigate key features, domains, and ranges of exponential functions as described in **F-IF.B.4** and **F-IF.B.5**; write exponential functions to model relationships between two quantities as in **F-BF.A.1a**; use technology to explore simple transformations of exponential functions as described in **F-BF.B.3**; and compare properties of exponential functions as in **F-IF.C.9**.	
Common Core State Standards for Mathematical Content	**Comments**
Seeing Structure in Expressions — A-SSE B. Write expressions in equivalent forms to solve problems 3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★ c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* **Interpreting Functions — F-IF** C. Analyze functions using different representations 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ e. Graph exponential ~~and logarithmic~~ functions, showing intercepts and end behavior~~, and trigonometric functions, showing period, midline, and amplitude~~. **Linear, Quadratic, and Exponential Models★— F-LE** A. Construct and compare linear, quadratic, and exponential models and solve problems 1. Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove ~~that linear functions grow by equal differences over equal intervals, and~~ that exponential functions grow by equal factors over equal intervals. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. 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. B. Interpret expressions for functions in terms of the situation they model 5. Interpret the parameters in a ~~linear or~~ exponential function in terms of a context.	The work with **F-IF.C.7e**, **F-LE.A.1a**, **F-LE.A.1c**, and **F-LE.B.5** should focus on exponential functions with domains in the integers. In this unit, students continue to create mathematical models of contextual situations, while attending to limitations on those models and interpreting the results (**MP.2, MP.4, MP.6**). As they compare exponential to linear functions, students should make and justify conjectures (**MP.**3). They may use graphing technology as they explore transformations and fit exponential functions to data (**MP.5**).

Interpreting Categorical and Quantitative Data — S★-ID B. Summarize, represent, and interpret data on two categorical and quantitative variables 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, quadratic, and exponential models.* **Common Core State Standards for Mathematical Practice** 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision.	

Unit 9: Polynomial expressions and functions	**Suggested number of days: 15**
In this unit students learn how to multiply, add, and subtract quadratic and cubic polynomials using concrete models and analytic techniques. They also learn how to factor quadratic trinomials and cubic polynomials using concrete models and analytic techniques. This work with polynomial expressions serves as a bridge to introductory work with polynomial functions, laying the foundation for deeper study of quadratic functions in **Unit 10** of this course and general polynomial functions in Algebra II. In this unit students will have many opportunities to interpret parts of an expression, as described in **A-SSE.A.1a**.	
Common Core State Standards for Mathematical Content	**Comments**
Seeing Structure in Expressions — A-SSE A. Interpret the structure of expressions 1. Interpret expressions that represent a quantity in terms of its context.★ 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.*	Limit the work under **A-APR.B.3** to quadratic and cubic polynomials having linear and quadratic factors.
2. Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$, *thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$. B. Write expressions in equivalent forms to solve problems 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. **Arithmetic with Polynomial and Rational Expressions—A-APR** A. Perform arithmetic operations on polynomials 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. B. Understand the relationship between zeros and factors of polynomials 3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.	In order to be successful with factoring, students must become adept at seeing the structure in various expressions and making use of that structure (**MP.7**) and they must also be willing to try different strategies when an initial strategy does not work (**MP.1**). Their ability to look for regularity in calculations (**MP. 8**) will be helpful as they explore the relationship between multiplication and factoring.
Common Core State Standards for Mathematical Practice 1. Make sense of problems and persevere in solving them. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.	

Unit 10: Quadratic functions	Suggested number of days: 15

This unit builds on students' previous exposure to quadratic functions, focusing on how to build quadratic functions that model real-world situations. Students learn how to use the method of completing the square to transform quadratic function rules to understand the behavior of the function. This unit provides opportunities for students to continue to engage with a number of standards they have encountered previously. They will work with **A-SSE.A.1** and **A-SSE.A.2** as they interpret and use the structure in quadratic expressions to understand quadratic functions. They will create and represent quadratic equations in two variables (**A-CED.2** and **A-REI.10**), apply function notation in the context of quadratic functions (**F-IF.A.2**), relate the domain of a quadratic function to its graph (**F-IF.B.5**) and compare properties of quadratic functions represented in different ways (**F-IF.C.9**). They will build quadratic functions to model relationships between two quantities (**F-BF.A.1a**) and continue their study of transformations as they explore how changes in different parameters affect the graph of $y = x^2$ (**F-BF.B.3**).

Common Core State Standards for Mathematical Content

Seeing Structure in Expressions — A-SSE

B. Write expressions in equivalent forms to solve problems

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★
   - b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

Interpreting Functions — F-IF

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

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~~.*★

C. Analyze functions using different representations

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.
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.

Interpreting Categorical and Quantitative Data — S★-ID

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

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, quadratic, and exponential models.*

Comments

Students return to **F-IF.B.4**, **F-IF.C.7a**, and **S-ID.B.6a** as they analyze graphs of quadratic functions and fit quadratic models to data.

In this unit, students will investigate data that can be modeled with quadratic functions and will create algebraic representations of those models that precisely communicate different characteristics of the situation being modeled (**MP.4**, **MP. 6**). They may choose to use graphing technology to explore transformations or to fit quadratic functions to data (**MP.5**) They will make use of the structure of different quadratic expressions to make sense of the situations being modeled (**MP.7**).

Common Core State Standards for Mathematical Practice	
4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure.	

Unit 11: Quadratic equations	Suggested number of days: 15
This unit focuses on quadratic equations in one variable (**A-CED.A.1**) that arise from quadratic functions. Students learn to solve these equations by graphing, factoring, and completing the square, and they see how the solution methods are connected as they connect the roots of an equation, the ***x***-intercepts of a graph, and the zeros of a function. It also introduces students to the quadratic formula as a method for solving quadratic equations.	
Common Core State Standards for Mathematical Content **The Real Number System — N-RN** B. Use properties of rational and irrational numbers. 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. **Reasoning with Equations and Inequalities—A-REI** B. Solve equations and inequalities in one variable 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 $x^2 = 49$), 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. **Common Core State Standards for Mathematical Practice** 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 4. Model with mathematics. 5. Use appropriate tools strategically. 7. Look for and make use of structure.	**Comments** In this unit, students must be able to understand the problem they are being asked to solve, create equations that model the problem, and interpret the solutions in the context of the problem (**MP.1**, **MP.2**, **MP.4**). They must become adept at seeing the structure in various expressions and making use of that structure to choose efficient solution tools and techniques (**MP.5**, **MP.7**).