Alaska Tutorials are designed specifically for Alaska Standards and prepare students for the PEAKS exams in English and Mathematics.

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

1. REAL NUMBER SYSTEM

- **LAWS OF 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.*
  - **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
  - **N-RN.2** *Rewrite expressions involving radicals and rational exponents using the properties of exponents.*

- **OPERATIONS ON RATIONAL AND IRRATIONAL NUMBERS**
  - **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.*

- **MONITORING PRECISION AND ACCURACY**
  - **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.*

2. EQUATIONS AND INEQUALITIES

- **ONE-STEP EQUATIONS AND INEQUALITIES**
  - **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **A-REI.3** *Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.*
  - **F-BF.1.a** *Determine an explicit expression, a recursive process, or steps for calculation from a context.*

- **MULTI-STEP EQUATIONS AND INEQUALITIES**
  - **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret*

solutions as viable or nonviable options in a modeling context.

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

3. APPLYING PROPERTIES OF EQUATIONS AND INEQUALITIES

AXIOMS OF EQUALITY

- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
- **A-REI.1** *Apply properties of mathematics to justify steps in solving equations in one variable.*

LITERAL EQUATIONS

- **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
- **A-REI.3** *Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.*
- **A-CED.4** *Rearrange formulas (literal equations) to highlight a quantity of interest, using the same reasoning as in solving equations.*

4. WRITING EXPRESSIONS AND EQUATIONS

FORMULATING AND SIMPLIFYING ALGEBRAIC EXPRESSIONS

- **F-BF.1.a** *Determine an explicit expression, a recursive process, or steps for calculation from a context.*
- **A-SSE.1.a** *Interpret parts of an expression, such as terms, factors, and coefficients.*
- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*

FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS

- **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
- **F-LE.1.b** *Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.*
- **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
- **A-SSE.1.a** *Interpret parts of an expression, such as terms, factors, and coefficients.*

FORMULATING AND SOLVING INEQUALITIES FROM WORD PROBLEMS

- **A-SSE.1.a** *Interpret parts of an expression, such as terms, factors, and coefficients.*
- **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
- **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
- **A-REI.3** *Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.*

5. FUNCTIONS

FUNCTIONS AND RELATIONS

- **F-IF.2** *Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.*
- **F-IF.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.7.b** *Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.*

DOMAIN AND RANGE

- **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*

EVALUATING FUNCTIONS

- **F-IF.1** *Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).*
- **F-IF.2** *Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.*

6. GRAPHS OF LINEAR EQUATIONS AND INEQUALITIES 1

- **SLOPE**
  - **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
  - **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.*
  - **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).*
  - **G-GPE.5** *Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).*

- **GRAPHING AND ANALYZING LINEAR FUNCTIONS**
  - **F-IF.1** *Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).*
  - **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
  - **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
  - **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*
  - **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
  - **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.*

7. GRAPHS OF LINEAR EQUATIONS AND INEQUALITIES 2

- **GRAPHING AND MANIPULATING Y = MX + B**
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
  - **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.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
  - **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
  - **S-ID.7** *Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*
  - **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
  - **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.*
  - **F-LE.1.b** *Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.*
  - **F-LE.5** *Interpret the parameters in a linear or exponential function in terms of a context.*
  - **F-IF.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*

- **GRAPHS OF LINEAR INEQUALITIES**
  - **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.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*

8. LINEAR EQUATIONS

- **SLOPE-INTERCEPT FORM OF A LINEAR EQUATION**
  - **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).*
  - **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.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*
  - **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
  - **G-GPE.5** *Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).*
  - **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.*
  - **S-ID.7** *Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*

- **POINT-SLOPE FORM OF A LINEAR EQUATION**
  - **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-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
  - **F-IF.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*
  - **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).*
  - **G-GPE.5** *Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).*

9. TWO-VARIABLE LINEAR SYSTEMS

- **SOLVING SYSTEMS OF LINEAR EQUATIONS: GUESS AND CHECK**
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **F-BF.1.a** *Determine an explicit expression, a recursive process, or steps for calculation from a context.*
  - **A-REI.6** *Solve systems of linear equations exactly and approximately, e.g., with graphs or algebraically, focusing on pairs of linear equations in two variables.*

- **SOLVING SYSTEMS OF LINEAR EQUATIONS: GRAPHING**
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **A-REI.6** *Solve systems of linear equations exactly and approximately, e.g., with graphs or algebraically, focusing on pairs of linear equations in two variables.*
  - **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.*

10. SOLVING TWO-VARIABLE LINEAR SYSTEMS ALGEBRAICALLY

- **SOLVING SYSTEMS OF LINEAR EQUATIONS: SUBSTITUTION**
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on*

coordinate axes with labels and scales.

- **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
- **A-REI.6** *Solve systems of linear equations exactly and approximately, e.g., with graphs or algebraically, focusing on pairs of linear equations in two variables.*
- **A-REI.5** *Show 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.*

- **SOLVING SYSTEMS OF LINEAR EQUATIONS: ELIMINATION**
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **A-REI.5** *Show 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 or algebraically, focusing on pairs of linear equations in two variables.*

11. LINEAR SYSTEMS

- **SOLVING SYSTEMS OF LINEAR INEQUALITIES**
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **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.*

- **SOLVING THREE-VARIABLE SYSTEMS OF LINEAR EQUATIONS**
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **A-REI.5** *Show 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.*

12. EXPONENTIAL FUNCTIONS, EQUATIONS, AND INEQUALITIES

- **EXPONENTIAL FUNCTIONS**
  - **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
  - **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
  - **F-IF.8.b** *Use the properties of exponents to interpret expressions for exponential functions.*
  - **F-LE.1.c** *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*
  - **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.*
  - **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.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*
  - **F-IF.7.e** *Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*
  - **A-SSE.1.b** *Interpret complicated expressions by viewing one or more of their parts as a single entity.*
  - **A-SSE.3.c** *Use the properties of exponents to transform expressions for exponential functions.*
  - **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on*

coordinate axes with labels and scales.

- **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
- **F-LE.5** *Interpret the parameters in a linear or exponential function in terms of a context.*

- **EXPONENTIAL GROWTH AND DECAY**
  - **F-IF.8.b** *Use the properties of exponents to interpret expressions for exponential functions.*
  - **F-LE.1.a** *Show that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.*
  - **F-LE.5** *Interpret the parameters in a linear or exponential function in terms of a context.*
  - **A-SSE.1.b** *Interpret complicated expressions by viewing one or more of their parts as a single entity.*
  - **F-LE.1.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 input-output table of values.*
  - **S-ID.6.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.*
  - **F-LE.1.b** *Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.*
  - **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.*
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*

- **SOLVING EXPONENTIAL INEQUALITIES**
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **A-SSE.1.b** *Interpret complicated expressions by viewing one or more of their parts as a single entity.*
  - **A-CED.1** *Create equations and inequalities in one variable and use them to solve problems.*
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
  - **F-LE.1.c** *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*

13. SEQUENCES

- **SEQUENCES**
  - **F-BF.1.a** *Determine an explicit expression, a recursive process, or steps for calculation from a context.*
  - **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.*
  - **F-IF.3** *Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.*
  - **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*

- **ARITHMETIC AND GEOMETRIC SEQUENCES**
  - **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.*
  - **F-LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output table of values.*
  - **F-IF.3** *Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.*
  - **F-BF.1.a** *Determine an explicit expression, a recursive process, or steps for calculation from a context.*

14. ARITHMETIC WITH POLYNOMIALS

- **POLYNOMIAL BASICS**

- **A-SSE.1.a** *Interpret parts of an expression, such as terms, factors, and coefficients.*
- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
- **A-APR.1** *Add, subtract, and multiply polynomials. Understand that polynomials form a system similar to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication.*

ADDITION AND SUBTRACTION OF POLYNOMIALS

- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
- **A-APR.1** *Add, subtract, and multiply polynomials. Understand that polynomials form a system similar to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication.*

MULTIPLICATION OF POLYNOMIALS

- **A-APR.1** *Add, subtract, and multiply polynomials. Understand that polynomials form a system similar to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication.*
- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*

15. FACTORING POLYNOMIALS

FACTORING QUADRATIC TRINOMIALS

- **A-SSE.3.a** *Factor a quadratic expression to reveal the zeros of the function it defines.*
- **A-REI.4.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.*

FACTORING SPECIAL CASES

- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
- **A-APR.4** *Prove polynomial identities and use them to describe numerical relationships.*
- **A-SSE.1.b** *Interpret complicated expressions by viewing one or more of their parts as a single entity.*
- **A-APR.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.*

FACTORING HIGHER-ORDER POLYNOMIALS

- **A-SSE.1.a** *Interpret parts of an expression, such as terms, factors, and coefficients.*
- **A-SSE.1.b** *Interpret complicated expressions by viewing one or more of their parts as a single entity.*
- **A-APR.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.*
- **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
- **A-APR.4** *Prove polynomial identities and use them to describe numerical relationships.*

16. GRAPHS AND REPRESENTATIONS OF QUADRATIC FUNCTIONS

QUADRATIC FUNCTIONS

- **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*

ANALYZING GRAPHS OF QUADRATIC FUNCTIONS

- **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*
- **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.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
- **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
- **F-IF.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*
- **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*

(both positive and negative); find the value of k given the graphs.

- **A-REI.4.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.*
- **F-IF.9** *Compare properties of two functions each represented in a different way (algebraically, graphically, numerically, in tables, or by verbal descriptions).*

- **REPRESENTATIONS OF QUADRATIC FUNCTIONS**
  - **A-SSE.2** *Use the structure of an expression to identify ways to rewrite it.*
  - **A-REI.4.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.*
  - **F-IF.8.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.*
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **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.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
  - **A-SSE.3.a** *Factor a quadratic expression to reveal the zeros of the function it defines.*
  - **A-APR.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.*
  - **F-IF.7.c** *Graph polynomial functions, identifying zeros (using technology) or algebraic methods when suitable factorizations are available, and showing end behavior.*
  - **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*

17. SOLVING QUADRATIC EQUATIONS

- **SOLVING QUADRATIC EQUATIONS BY FACTORING**
  - **A-SSE.3.a** *Factor a quadratic expression to reveal the zeros of the function it defines.*
  - **A-REI.4.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.*
  - **F-IF.8.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.*
  - **A-APR.4** *Prove polynomial identities and use them to describe numerical relationships.*
  - **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.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*
  - **A-CED.2** *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*

- **COMPLETING THE SQUARE**
  - **A-REI.4.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.*
  - **A-REI.4.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.*
  - **F-IF.8.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.*
  - **A-SSE.3.b** *Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.*
  - **F-IF.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*

- **QUADRATIC FORMULA**
  - **A-REI.4.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.*
  - **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.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
  - **F-IF.7.a** *Graph linear and quadratic functions and show intercepts, maxima, and minima.*
  - **A-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
  - **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
  - **F-BF.1.a** *Determine an explicit expression, a recursive process, or steps for calculation from a context.*

18. PARENT FUNCTIONS

- **LINEAR AND EXPONENTIAL PARENT FUNCTIONS**
  - **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).*
  - **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
  - **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
  - **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*
  - **F-IF.7.e** *Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*
  - **F-LE.1.c** *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*

- **QUADRATIC PARENT FUNCTION**
  - **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).*
  - **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*

19. TRANSFORMATIONS OF PARENT FUNCTIONS

- **TRANSFORMATIONS OF THE LINEAR AND EXPONENTIAL PARENT FUNCTIONS**
  - **F-BF.3** *Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of (both positive and negative); find the value of k given the graphs.*
  - **G-CO.6** *Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.*

- **TRANSFORMATIONS OF THE QUADRATIC PARENT FUNCTION**
  - **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 (both positive and negative); find the value of k given the graphs.*
  - **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*

20. NONLINEAR FUNCTIONS

- **LINEAR VERSUS NONLINEAR FUNCTIONS**
  - **F-LE.1.a** *Show that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.*
  - **F-LE.1.b** *Recognize situations in which one quantity changes at a constant 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 input-output table of values.

- **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.*
- **F-IF.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
- **F-LE.1.c** *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*
- **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
- **F-IF.9** *Compare properties of two functions each represented in a different way (algebraically, graphically, numerically, in tables, or by verbal descriptions).*

ABSOLUTE VALUE FUNCTIONS

- **F-IF.5** *Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.*
- **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.4.a** *interpret key features of graphs and tables in terms of the quantities, and*
- **F-IF.4.b** *sketch graphs showing key features given a verbal description of the relationship.*
- **F-IF.7.b** *Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.*
- **F-BF.3** *Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of (both positive and negative); find the value of k given the graphs.*

SYSTEMS OF NONLINEAR EQUATIONS

- **A-REI.7** *Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.*
- **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.5** *Show 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-CED.3** *Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.*
- **A-REI.6** *Solve systems of linear equations exactly and approximately, e.g., with graphs or algebraically, focusing on pairs of linear equations in two variables.*

21. WORKING WITH FUNCTIONS

ARITHMETIC OPERATIONS ON FUNCTIONS

- **F-BF.1.b** *Combine standard function types using arithmetic operations.*

MULTIPLE REPRESENTATIONS OF 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.*
- **F-IF.9** *Compare properties of two functions each represented in a different way (algebraically, graphically, numerically, in tables, or by verbal descriptions).*

INVERSE FUNCTIONS

- **F-BF.4.c** *Read values of an inverse function from a graph or a table, given that the function has an inverse.*
- **F-BF.4.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.*
- **F-BF.4.b** *Verify by composition that one function is the inverse of another.*
- **F-BF.4.d** *Produce an invertible function from a non-invertible function by restricting the domain.*

22. STATISTICS

- **DATA ANALYSIS**
  - **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).*

- **FREQUENCY TABLES**
  - **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-CP.4** *Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.*
  - **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).*

23. SCATTERPLOTS AND REGRESSION

- **SCATTERPLOTS**
  - **S-ID.9** *Distinguish between correlation and causation.*
  - **S-ID.6.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.*
  - **S-ID.6.b** *Informally assess the fit of a function by plotting and analyzing residuals.*
  - **S-ID.6.c** *Fit a linear function for a scatter plot that suggests a linear association.*
  - **S-ID.7** *Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*

- **SCATTERPLOTS AND MODELING**
  - **S-ID.6.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.*
  - **S-ID.6.b** *Informally assess the fit of a function by plotting and analyzing residuals.*
  - **S-ID.6.c** *Fit a linear function for a scatter plot that suggests a linear association.*
  - **S-ID.8** *Compute (using technology) and interpret the correlation coefficient of a linear fit.*
  - **S-ID.7** *Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*
  - **F-LE.1.a** *Show that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.*
  - **F-LE.1.c** *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*