Mississippi Assessment Program (MAP)

Algebra I Blueprint Interpretive Guide

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Mississippi Assessment Program
Algebra I Blueprint Interpretive Guide

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Mississippi Assessment Program
Algebra I Blueprint Interpretive Guide

Table of Contents

Mississippi Assessment Program
Algebra I Blueprint Interpretive Guide

1.0 Purpose Statement

Test blueprints contain information about individual tests, including the number of test items and the number of points for each test item. In addition, test blueprints identify the number of test item types: performance task (PT), closed-ended, and open-ended. Blueprints serve as a guide for test developers to create/select test questions and construct test forms. They are used throughout the life cycle of the testing program to design the test forms for each administration.

1.1 Blueprint Design Overview

The Mississippi Assessment Program Blueprint (Appendix A) for the 2015-16 Algebra I End-of-Course (EOC) Assessment details the alignment of the 2014 Mississippi College- and Career-Readiness Standards for Mathematics (Appendix B) and the assessment. (http://www.mde.k12.ms.us/ESE/math) The standards are divided into five conceptual categories:

- Number and Quantity (N),
- Algebra (A),
- Functions (F),
- Statistics and Probability (S), and
- Modeling (*).

The conceptual category of Modeling is present throughout the Algebra I content standards. The Modeling notation, * is used for an individual content standard, a domain, or an entire conceptual category. In case of the latter two, it should be understood that Modeling applies to all content standards in that group.

Under each of these conceptual categories, the Blueprint delineates which standards will be measured. The Blueprint includes the item types that will appear on the assessment. The

Mississippi Assessment Program
Algebra I Blueprint Interpretive Guide

Blueprint details a numerical range of items that will appear per domain and provides a numerical range of items per standard and item type. Additionally, more detailed information about the MAP assessment can be found in the MAP Technical Guide (publication date June 2016).

<u>Table 1.2 Interpreting the Blueprints</u>

	Column A	Column B	Column C	Column D	Column E	Column F
Row # 1	**Standard**	**Performance Task (PT)**	**Closed-ended**	**Open-ended**	**Total #Items**	**Total #Pts.**
Row # 2	***Number and Quantity The Real Number System (N-RN)***	***0***	***0-1***	***0-1***	***1***	***1***
Row # 3	**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.	0	0-1	0-1	1	

- Row # 1 includes:
  - headings that indicate the conceptual category,
  - Item type,
    - Performance Tasks,
    - closed-ended items, and
    - open-ended items.
  - Total number of items, and
  - Total number of points.
- Row # 2 identifies:

  - the conceptual categories
    - delineated by bold and italicized print.
- Row # 3 identifies:
  - the standard,
  - the numerical range of performance tasks,
  - closed-ended items,
  - open-ended items per standard, and
  - the total number of points assessed per standard.
- Column A
  - the conceptual category,
  - domain, and
  - individual standard to be assessed.
- Columns B-D
  - detail the numerical range of items per item type that will appear on the assessment.
- Column E
  - provides the reader with the numerical range of total items per standard.
- Column F
  - provides a total number of points per strand only because the total number of points per standard is dependent upon how many items appear per standard.

1.3 Total Number of Points

The total number of items and the total number of points assessed per strand and standard are different because items are worth either one point or two points. Items that require students to complete a single interaction per item are worth one point. Items that require students to complete two or more interactions per item will be worth two points. A closed-ended item with a single interaction (students select one answer from four possible answer choices) is worth one point. An open-ended, multiple choice item with a Part A and a Part B requires students to complete two interactions with the item (choosing an answer to Part A and choosing another answer to Part B) is worth two points. An open-ended, technology- enhanced item that asks students to drag-and-drop responses into a table and requires students to complete multiple interactions in the item is worth two points. Partial credit is available for all two-point items.

1.4 Item Types

1.4.1 Performance Task

The Algebra I End-of-Course performance task will give students the opportunity to demonstrate their knowledge, precision, interpretation skills, and conceptual understanding in a measurable format related to creating, analyzing, and using functions to model real world phenomena. This performance task will yield a tangible product (e.g., graphic display) and a series of written arguments that will measure the student's proficiency level from the following content Algebra I content standards: A-CED.2, A-CED.3, A-REI.6, F-IF.4, and F-IF.5.

1.4.2 Closed-Ended Items

1.4.2(a) Multiple-Choice Static (MC) and Multiple-Choice Multi-Select (MCMS)

Multiple-choice items are an efficient way to assess knowledge and skills, and they can be developed to measure each of the cognitive targets. In a well-designed multiple-choice item, the stem clearly presents the question to the student. The stem may be in the form of a question, a phrase, or an expression, as long as it conveys what is expected of the student. The stem is followed by four (or more for multi-select) answer choices, or options, only one of which is correct. For multi-select there are multiple keys in the options.

1.4.2(b) Multiple-Choice Dynamic (MCD)

A multiple-choice item that uses drop-down boxes for the student to select the answer choice(s). The dropdown box can be inline text or standalone. The item can include multiple drop-down boxes.

1.4.3 Open-Ended Items

1.4.3(a) Multi-select table (MST)

The student indicates their answer by clicking on an open cell. Clicking again will remove the "blue checkmark". The number of "blue checkmarks" can be restricted by row or column. It is also possible to have no restrictions so that the student can choose every cell.

1.4.3(b) Select Text (ST)

Select-text items are essentially a type of multiple-choice item that allows the selection of one or more text strings that are in the context of a larger piece of text. A text string could be a word, phrase, sentence or paragraph. In the select text item type, selectable text will be indicated by a change in appearance as the student hovers over the text with the mouse.

1.4.3(c) Graphing – Line Graphs (GL)

The student can place points on the coordinate grid and create a line. In addition, the student has the option for shading any section delineated by the drawn line by clicking on the shading button and then selecting the space on the grid to be shaded.

1.4.3(d) Drag-and-Drop (DD)

The student can drag and drop-items and place them in specified drop zones. The drag objects can be dragged only once or multiple times depending upon the item's configuration. It is possible to have the drop zones to be configured along a number line, in buckets, or in a graphic.

1.4.3(e) Graphing – Bar Graphs (GB)

The student will input information that will create bar graphs of data listed in the stimulus. Students will be able to add a bar for a single bar graph or add a bar pair for a double bar graph. Students will also be able to set bars to correct heights or lengths.

1.4.3(f) Matching (M)

In the matching interaction type, the student draws lines to connect objects in two or three sets (composed of either text or images).

1.4.3(g) Two-Part (2P)

Two-part items consist of two standards response items. The student answers Part 1 first and then answers Part 2, which is support or evidence for Part 1.

2.0 Conceptual Categories and Standards

The Blueprints for the Algebra I EOC assessment indicate a numerical range of items that will be written to each content standard. However, some standards have a higher numerical range than others while some standards have a 0 count. The numerical range for each content standard was determined by a committee of Mississippi math educators. This committee utilized their expertise to determine the priority of each standard. Standards were identified as top priority, 2nd priority, 3rd priority, or standards that should be "assessed in the classroom". This prioritization was used to determine the numerical range of items that would appear on the assessment.

2.1 Number and Quantity (N) Standards

Items written to measure the Number and Quantity content standards are written to measure a student's ability to 1) use properties of rational and irrational numbers and 2) reason quantitatively and use units to solve problems.

2.2 Algebra (A) Standards

Items written to measure the Algebra content standards are written to measure a student's ability to 1) interpret the structure of expressions, 2) write expressions in equivalent forms to solve problems, 3) perform arithmetic operations on polynomials, 4) understand the relationship between zeroes and factors of polynomials, 5) create equations that describe numbers or relationships, 6) understand solving equations as a process of reasoning and explain the reasoning, 7) solve equations and inequalities in one variable, 8) solve systems of equations, and 9) represent and solve equations and inequalities graphically.

2.3 Functions (F) Standards

Items written to measure the Functions content standards are written to measure a student's ability to 1) understand the concept of a function and use function notation, 2) interpret functions that arise in applications in terms of the context, 3) analyze functions using different representations, 4) build a function that models a relationship between two quantities, 5) build new functions from existing functions, 6) construct and compare linear, quadratic, and exponential models and solve problems, and 7) interpret expressions for functions in terms of the situation they model.

2.4 Statistics and Probability (S) Standards

Items written to measure the Statistics and Probability content standards are written to measure a student's ability to 1) summarize, represent, and interpret data on a single count or measurement variable, 2) summarize, represent, and interpret data on two categorical and quantitative variables, and 3) interpret linear models.

Mississippi Assessment Program
Algebra I Blueprint Interpretive Guide

Appendix A

Algebra I Blueprint

Mississippi Assessment Program
Algebra I Blueprint

Strand	Performance Task (PT)	Closed-ended	Open-ended	Total #Items	Total #Pts.
Number and Quantity The Real Number System (N-RN)	***0***	***0-1***	***0-1***	***1***	***1***
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.	0	0-1	0-1	1	
Number and Quantity Quantities (N-Q)*	***0***	***1–2***	***0–1***	***2***	***3***
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.*	0	0-1	0-1	0-2	
N-Q.2-Define appropriate quantities for the purpose of descriptive modeling.*	0	0-1	0-1	0-2	
N-Q.3-Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	0	0-1	0-1	0-2	
Algebra Seeing Structure in Expressions (A-SSE)	***0***	***4–5***	***0–1***	***5***	***5***
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.	0	0-3	0-1	1-4	
A-SSE.2-Use the structure of an expression to identify ways to rewrite it.	0	0-2	0-1	1-3	
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.	0	0-2	0-1	1-2	
Algebra Arithmetic with Polynomials and Rational Expressions (A-APR)	***0***	***5–6***	***2–3***	***8***	***8***
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.	0	1-4	0-2	4	

Strand	Performance Task (PT)	Closed-ended	Open-ended	Total #Items	Total #Pts.
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.	0	1-4	0-2	4	
Algebra Creating Equations (A-CED)	***0***	***4–5***	***1–2***	***6***	***6***
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.**	0	0-2	0-1	1-2	
A-CED.2-Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*	0	0-2	0-1	1-2	
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.	0	0-1	0-1	1	
A-CED.4-Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	0	0-2	0-1	1-2	
Algebra Reasoning with Equations and Inequalities (A-REI)	***0***	***8–10***	***1–3***	***11***	***11***
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.	0	0-1	0-1	1	
A-REI.3-Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	0	0-2	0-2	1-2	
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 $x^2 = 49$), 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.	0	0-2	0-2	1-2	
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.	0	0-1	0-1	0-1	

Strand	Performance Task (PT)	Closed-ended	Open-ended	Total #Items	Total #Pts.
A-REI.6-Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	0	0-3	0-3	1-3	
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).	0	0-3	0-3	1-3	
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.*	0	0-2	0-2	0-2	
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.	0	0-3	0-3	1-3	
Functions Interpreting Functions (F-IF)	***0***	***8–9***	***1–2***	***10***	***10***
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 $y = f(x)$.	0	0-2	0-2	1-4	
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.	0	0-2	0-2	1-4	
F-IF.3-Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	0	0-1	0-1	0-1	
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.**	0	0-2	0-2	1-4	
F-IF.5-Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	0	0-2	0-2	1-4	

Strand	Performance Task (PT)	Closed-ended	Open-ended	Total #Items	Total #Pts.
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.*	0	0-2	0-2	1-4	
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.	0	0-2	0-2	1-4	
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.	0	0-2	0-2	1-4	
F-IF.9-Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	0	0-2	0-2	1-3	
Functions Building Functions (F-BF)	***0***	***3–4***	***0–1***	***4***	***5***
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.	0	0-1	0-1	0-1	
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.*	0	0-3	0-3	0-4	

Strand	Performance Task (PT)	Closed-ended	Open-ended	Total #Items	Total #Pts.
Functions Linear, Quadratic, and Exponential Models (F-LE)	***0***	***3–4***	***0–1***	***4***	***5***
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.	0	0-2	0-2	1-3	
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).*	0	0-2	0-2	1-3	
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.*	0	0-1	0-1	0-1	
F-LE.5-Interpret the parameters in a linear or exponential function in terms of a context.*	0	0-2	0-2	1-3	
Statistics and Probability * Interpreting Categorical and Quantitative Data (S-ID)	***0***	***5–6***	***1–2***	***7***	***7***
S-ID.1-Represent data with plots on the real number line (dot plots, histograms, and box plots).*	0	0-2	0-2	1-2	
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.*	0	0-2	0-2	1-2	
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).*	0	0-2	0-2	1-2	
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.*	0	0-1	0-1	0-1	

Strand	Performance Task (PT)	Closed-ended	Open-ended	Total #Items	Total #Pts.
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, 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.	0	0-2	0-2	1-2	
S-ID.7-Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*	0	0-2	1-2	1-3	
S-ID.8-Compute (using technology) and interpret the correlation coefficient of a linear fit.*	0	0-1	0-1	0-1	
S-ID.9-Distinguish between correlation and causation.*	0	0-1	0-1	0-1	
Modeling with Real World Functions	***1***	***0***	***0***	***1***	***12***
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. **A-REI.6**-Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. **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.	1	0	0	1	12
Technical Note: For the Algebra I performance task (Modeling with Real World Functions), three (3) or more of the standards shall be used with one (1) performance task. The performance task is worth twelve (12) points towards the overall mathematics score.					

Appendix B

Algebra I Standards

Algebra I

Number and Quantity	
The Real Number System (N-RN)	
Use properties of rational and irrational numbers	**Additional**
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.
Quantities (N-Q) *	
Reason quantitatively and use units to solve problems	**Supporting**
N-Q.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*
N-Q.2	Define appropriate quantities for the purpose of descriptive modeling.*
N-Q.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*
Algebra	
Seeing Structure in Expressions (A-SSE)	
Interpret the structure of expressions	**Major**
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 $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$ thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$.*
Write expressions in equivalent forms to solve problems	**Supporting**
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 1.15^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%.*

Algebra I

Arithmetic with Polynomials and Rational Expressions (A-APR)		
Perform arithmetic operations on polynomials		**Major**
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.	
Understand the relationship between zeros and factors of polynomials		**Supporting**
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.	
Creating Equations (A-CED) *		
Create equations that describe numbers or relationships		**Major**
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.**	
Reasoning with Equations and Inequalities (A-REI)		
Understand solving equations as a process of reasoning and explain the reasoning		**Major**
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.	
Solve equations and inequalities in one variable		**Major**
A-REI.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	
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 $x^2 = 49$), 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.	

Algebra I

Solve systems of equations	**Additional**
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	**Major**
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.
Functions	
Interpreting Functions (F-IF)	
Understand the concept of a function and use function notation	**Major**
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.
F-IF.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by* $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ *for* $n \geq 1$.
Interpret functions that arise in applications in terms of the context	**Major**
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 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.*

Algebra I

Analyze functions using different representations		**Supporting**
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.	
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.*	
Building Functions (F-BF)		
Build a function that models a relationship between two quantities		**Supporting**
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.	
Build new functions from existing functions		**Additional**
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.*	
Linear, Quadratic, and Exponential Models (F-LE) *		
Construct and compare linear, quadratic, and exponential models and solve problems		**Supporting**
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).*	
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.*	

Algebra I

Interpret expressions for functions in terms of the situation they model		**Supporting**
F-LE.5	Interpret the parameters in a linear or exponential function in terms of a context.*	
Statistics and Probability *		
Interpreting Categorical and Quantitative Data (S-ID)		
Summarize, represent, and interpret data on a single count or measurement variable		**Additional**
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		**Supporting**
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, 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.	
Interpret linear models		**Major**
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.*	

* Modeling Standards