# Algebra I | A1

**Algebra I emphasizes linear and quadratic expressions, equations, and functions. This course also introduces students to polynomial and exponential functions with domains in the integers. Students explore the structures of and interpret functions and other mathematical models. Students build upon previous knowledge of equations and inequalities to reason, solve, and represent equations and inequalities numerically and graphically.**

### The major work of Algebra I is from the following domains and clusters:

- **Seeing Structure in Expressions**
  - Interpret the structure of expressions.
  - Write expressions in equivalent forms to solve problems.
- **Arithmetic with Polynomials and Rational Expressions**
  - Perform arithmetic operations on polynomials.
- **Creating Equations**
  - Create equations that describe numbers or relationships.
- **Reasoning with Equations and Inequalities**
  - Understand solving equations as a process of reasoning and explain the reasoning.
  - Solve equations and inequalities in one variable.
  - Represent and solve equations and inequalities graphically.
- **Interpreting Functions**
  - Understand the concept of a function and use function notation.
  - Interpret functions that arise in applications in terms of the context.
- **Interpreting Categorical and Quantitative Data**
  - Interpret linear models.

### Supporting work is from the following domains and clusters:

- **Quantities**
  - Reason quantitatively and use units to solve problems.
- **Arithmetic with Polynomials and Rational Expressions**
  - Understand the relationship between zeros and factors of polynomials.
- **Reasoning with Equations and Inequalities**
  - Solve systems of equations.
- **Interpreting Functions**
  - Analyze functions using different representations.
- **Building Functions**
  - Build a function that models a relationship between two quantities.
  - Build new functions from existing functions.
- **Linear, Quadratic, and Exponential Models**
  - Construct and compare linear, quadratic, and exponential models and solve problems.
  - Interpret expressions for functions in terms of the situation they model.
- **Interpreting Categorical and Quantitative Data**
  - Summarize, represent, and interpret data on a single count or measurement variable.
  - Summarize, represent, and interpret data on two categorical and quantitative variables.

## Mathematical Modeling

Mathematical Modeling is a Standard for Mathematical Practice (MP4) and a Conceptual Category. Specific modeling standards appear throughout the high school standards indicated with a star (★). Where an entire domain is marked with a star, each standard in that domain is a modeling standard.

## Standards for Mathematical Practice

Being successful in mathematics requires the development of approaches, practices, and habits of mind that need to be in place as one strives to develop mathematical fluency, procedural skills, and conceptual understanding. The Standards for Mathematical Practice are meant to address these areas of expertise that teachers should seek to develop in their students. These approaches, practices, and habits of mind can be summarized as "processes and proficiencies" that successful mathematicians have as a part of their work in mathematics. Additional explanations are included in the main introduction of these standards.

| Standards for Mathematical Practice |
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| 1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>4. Model with mathematics.<br>5. Use appropriate tools strategically.<br>6. Attend to precision.<br>7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning. |

## Literacy Standards for Mathematics

Communication in mathematics employs literacy skills in reading, vocabulary, speaking and listening, and writing. Mathematically proficient students communicate using precise terminology and multiple representations including graphs, tables, charts, and diagrams. By describing and contextualizing mathematics, students create arguments and support conclusions. They evaluate and critique the reasoning of others, analyze, and reflect on their own thought processes. Mathematically proficient students have the capacity to engage fully with mathematics in context by posing questions, choosing appropriate problem-solving approaches, and justifying solutions. Further explanations are included in the main introduction.

| Literacy Skills for Mathematical Proficiency |
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| 1. Use multiple reading strategies.<br>2. Understand and use correct mathematical vocabulary.<br>3. Discuss and articulate mathematical ideas.<br>4. Write mathematical arguments. |

# Number and Quantity

## Quantities* (N.Q)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Reason quantitatively and use units to solve problems.** | **A1.N.Q.A.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. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.N.Q.A.2** Identify, interpret, and justify appropriate quantities for the purpose of descriptive modeling. | *Descriptive modeling refers to understanding and interpreting graphs; identifying extraneous information; choosing appropriate units; etc.*<br><br>*There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.N.Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |

# Algebra

## Seeing Structure in Expressions (A.SSE)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Interpret the structure of expressions.** | **A1.A.SSE.A.1** Interpret expressions that represent a quantity in terms of its context.★<br>**a.** Interpret parts of an expression, such as terms, factors, and coefficients.<br>**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.*<br><br>*There are no assessment limits for this standard. The entire standard is assessed in this course.* |

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Interpret the structure of expressions.** | **A1.A.SSE.A.2** Use the structure of an expression to identify ways to rewrite it. | *For example, recognize $53^2 - 47^2$ as a difference of squares and see an opportunity to rewrite it in the easier-to-evaluate form (53 + 47) (53 – 47). See an opportunity to rewrite* $a^2 + 9a + 14$ *as (a + 7) (a + 2).*<br><br>*Tasks are limited to numerical expressions and polynomial expressions in one variable.* |
| **B. Write expressions in equivalent forms to solve problems.** | **A1.A.SSE.B.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★<br>**a.** Factor a quadratic expression to reveal the zeros of the function it defines.<br>**b.** Complete the square in a quadratic expression in the form $Ax^2 + Bx + C$ to reveal the maximum or minimum value of the function it defines.<br>**c.** Use the properties of exponents to rewrite exponential expressions. | *For A1.A.SSE.B.3c:*<br>*For example, the growth of bacteria can be modeled by either $f(t) = 3^{(t+2)}$ or $g(t) = 9(3^t)$ because the expression $3^{(t+2)}$ can be rewritten as $(3^t)(3^2) = 9(3^t)$.*<br><br>*i) Tasks have a real-world context. As described in the standard, there is an interplay between the mathematical structure of the expression and the structure of the situation such that choosing and producing an equivalent form of the expression reveals something about the situation.*<br><br>*ii) Tasks are limited to exponential expressions with integer exponents.* |

## Arithmetic with Polynomials and Rational Expressions (A.APR)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Perform arithmetic operations on polynomials.** | **A1.A.APR.A.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. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| **B. Understand the relationship between zeros and factors of polynomials.** | **A1.A.APR.B.2** 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. | *Graphing is limited to linear and quadratic polynomials.* |

## Creating Equations★ (A.CED)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Create equations that describe numbers or relationships.** | **A1.A.CED.A.1** Create equations and inequalities in one variable and use them to solve problems. | *Tasks are limited to linear, quadratic, or exponential equations with integer exponents.* |
| | **A1.A.CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations with two variables on coordinate axes with labels and scales. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.A.CED.A.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. | *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*<br><br>*There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.A.CED.A.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. | *i) Tasks are limited to linear, quadratic, and exponential equations with integer exponents.*<br><br>*ii) Tasks have a real-world context.* |

## Reasoning with Equations and Inequalities (A.REI)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Understand solving equations as a process of reasoning and explain the reasoning.** | **A1.A.REI.A.1** Explain each step in solving an 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. | *Tasks are limited to linear, quadratic, and absolute value equations with integer exponents.* |
| **B. Solve equations and inequalities in one variable.** | **A1.A.REI.B.2** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **B. Solve equations and inequalities in one variable.** | **A1.A.REI.B.3** Solve quadratic equations and inequalities in one variable.<br>**a.** Use the method of completing the square to rewrite 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.<br>**b.** Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, knowing and applying the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions. | *For A1.A.REI.B.3b:*<br>*Tasks do not require students to write solutions for quadratic equations that have roots with nonzero imaginary parts. However, tasks can require the student to recognize cases in which a quadratic equation has no real solutions.*<br>*Note: solving a quadratic equation by factoring relies on the connection between zeros and factors of polynomials. This is formally assessed in Algebra II.* |
| **C. Solve systems of equations.** | **A1.A.REI.C.4** Write and solve a system of linear equations in context. | *Solve systems both algebraically and graphically.*<br>*Systems are limited to at most two equations in two variables.* |
| **D. Represent and solve equations and inequalities graphically.** | **A1.A.REI.D.5** 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). | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.A.REI.D.6** 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 approximate solutions using technology. ⋆ | *Include cases where f(x) and/or g(x) are linear, quadratic, absolute value, and exponential functions. For example, $f(x) = 3x + 5$ and $g(x) = x^2 + 1$.*<br>*Exponential functions are limited to domains in the integers.* |
| | **A1.A.REI.D.7** 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. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |

# Functions

## Interpreting Functions (F.IF)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Understand the concept of function and use function notation.** | **A1.F.IF.A.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*). | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.F.IF.A.2** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| **B. Interpret functions that arise in applications in terms of the context.** | **A1.F.IF.B.3** 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; and end behavior.*<br><br>*i) Tasks have a real-world context.*<br><br>*ii) Tasks are limited to linear functions, quadratic functions, absolute value functions, and exponential functions with domains in the integers.* |
| | **A1.F.IF.B.4** 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.*<br><br>*There are no assessment limits for this standard. The entire standard is assessed in this course.* |

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **B. Interpret functions that arise in applications in terms of the context.** | **A1.F.IF.B.5** 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.★ | *i) Tasks have a real-world context.*<br><br>*ii) Tasks are limited to linear functions, quadratic functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers.* |
| **C. Analyze functions using different representations.** | **A1.F.IF.C.6** Graph functions expressed symbolically and show key features of the graph, by hand and using technology.<br>**a**. Graph linear and quadratic functions and show intercepts, maxima, and minima.<br>**b**. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. | *Tasks in A1.F.IF.C.6b are limited to piecewise, step and absolute value functions.* |
| | **A1.F.IF.C.7** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.<br>**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. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.F.IF.C.8** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). | *i) Tasks have a real-world context.*<br><br>*ii) Tasks are limited to linear functions, quadratic functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers.* |

## Building Functions (F.BF)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Build a function that models a relationship between two quantities.** | **A1.F.BF.A.1** Write a function that describes a relationship between two quantities.⋆<br><br>**a.** Determine an explicit expression, a recursive process, or steps for calculation from a context. | *i) Tasks have a real-world context.*<br><br>*ii) Tasks are limited to linear functions, quadratic functions, and exponential functions with domains in the integers.* |
| **B. Build new functions from existing functions.** | **A1.F.BF.B.2** 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. | *i) Identifying the effect on the graph of replacing f(x) by f(x) + k, k f(x), and f(x+k) for specific values of k (both positive and negative) is limited to linear, quadratic, and absolute value functions.*<br><br>*ii) f(kx) will not be included in Algebra 1. It is addressed in Algebra 2.*<br><br>*iii) Experimenting with cases and illustrating an explanation of the effects on the graph using technology is limited to linear functions, quadratic functions, absolute value, and exponential functions with domains in the integers.*<br><br>*iv) Tasks do not involve recognizing even and odd functions.* |

## Linear, Quadratic, and Exponential Models★ (F.LE)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Construct and compare linear, quadratic, and exponential models and solve problems.** | **A1.F.LE.A.1** Distinguish between situations that can be modeled with linear functions and with exponential functions.<br>**a.** Recognize that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.<br>**b.** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.<br>**c.** Recognize situations in which a quantity grows or decays by a constant factor per unit interval relative to another. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.F.LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a table, a description of a relationship, or input-output pairs. | *Tasks are limited to constructing linear and exponential functions in simple context (not multi-step).* |
| | **A1.F.LE.A.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. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| **B. Interpret expressions for functions in terms of the situation they model.** | **A1.F.LE.B.4** Interpret the parameters in a linear or exponential function in terms of a context. | *For example, the total cost of an electrician who charges 35 dollars for a house call and 50 dollars per hour would be expressed as the function y = 50x + 35. If the rate were raised to 65 dollars per hour, describe how the function would change.*<br>*i) Tasks have a real-world context.*<br>*ii) Exponential functions are limited to those with domains in the integers.* |

# Statistics and Probability

## Interpreting Categorical and Quantitative Data (S.ID)

| Cluster Headings | Content Standards | Scope & Clarifications |
|---|---|---|
| **A. Summarize, represent, and interpret data on a single count or measurement variable.** | **A1.S.ID.A.1** Represent single or multiple data sets with dot plots, histograms, stem plots (stem and leaf), and box plots. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.S.ID.A.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. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.S.ID.A.3** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| **B. Summarize, represent, and interpret data on two categorical and quantitative variables.** | **A1.S.ID.B.4** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.<br>**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.<br>**b.** Fit a linear function for a scatter plot that suggests a linear association. | *Emphasize linear models, quadratic models, and exponential models with domains in the integers.*<br><br>*For A1.S.ID.B.4a:*<br>*i) Tasks have a real-world context.*<br><br>*ii) Exponential functions are limited to those with domains in the integers.* |
| **C. Interpret linear models.** | **A1.S.ID.C.5** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.S.ID.C.6** Use technology to compute and interpret the correlation coefficient of a linear fit. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |
| | **A1.S.ID.C.7** Distinguish between correlation and causation. | *There are no assessment limits for this standard. The entire standard is assessed in this course.* |

Major content of the course is indicated by the light green shading of the cluster heading and standard's coding.

| | Major Content | | Supporting Content |
|---|---|---|---|