Introduction

The main purpose of Algebra I is to develop students’ fluency with linear, quadratic and exponential functions. The critical areas of instruction involve deepening and extending students’ understanding of linear and exponential relationships by contrasting them with each other and by applying linear models to data that exhibit a linear trend. In addition, students engage in methods for analyzing, solving, and using exponential and quadratic functions. Some of the overarching ideas in the Algebra I course include: the notion of function, solving equations, rates of change and growth patterns, graphs as representations of functions, and modeling.

The standards in the Algebra I course come from the following conceptual categories: Modeling, Functions, Number and Quantity, Algebra, and Statistics and Probability. The content of the course will be expounded on below according to these conceptual categories, but teachers and administrators alike should note that the standards are not listed here in the order in which they should be taught. Moreover, the standards are not simply topics to be checked off a list during isolated units of instruction, but rather content that should be present throughout the school year through rich instructional experiences.

AN OVERVIEW: WHAT STUDENTS LEARN IN ALGEBRA I

In Algebra I, students use reasoning about structure to define and make sense of rational exponents and explore the algebraic structure of the rational and real number systems. They understand that numbers in real world applications often have units attached to them, that is, they are considered quantities. Students’ work with numbers and operations throughout elementary and middle school has led them to an understanding of the structure of the number system; now, students explore the structure of algebraic expressions and polynomials. They see that certain properties must persist when working with expressions that are meant to represent numbers, now written in an abstract form involving variables. When two expressions with overlapping domains are set equal to each other, resulting in an equation, there is an implied solution set (be it empty or non-empty), and students not only refine their techniques for solving equations and finding the solution set, but they can clearly explain the algebraic steps they used to do so.

Students began their exploration of linear equations in middle school. They first connected proportional equations ($y=kmx+b$, $m\neq0$) to graphs, tables and real-world contexts, and then moved towards an understanding of general linear equations ($y=mx+b$, $m\neq0$) and their graphs. In Algebra I, students extend this knowledge to working with absolute value equations, linear inequalities, and systems of linear equations. After learning a more precise definition of function in this course, students examine this new idea in the familiar context of linear equations (for example, by seeing the solution of a linear equation as solving $f(x)=g(x)$ for two linear functions $f$ and $g$).

Students continue building their understanding of functions beyond linear ones by investigating tables, graphs, and equations that build on previous understandings of numbers and expressions. They make connections between different representations of the same function. They learn to build functions in a modeling context, and solve problems related to the resulting functions. Note that the focus in Algebra I is on linear, simple exponential, and quadratic equations.
Finally, students extend their prior experiences with data, using more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

Examples of Key Advances from Grades K-8

- Having already extended arithmetic from whole numbers to fractions (grades 4–6) and from fractions to rational numbers (grade 7), students in grade 8 encountered particular irrational numbers such as $\sqrt{5}$ and $\pi$. In Algebra I, students will begin to understand the real number system.
- Students in middle grades worked with measurement units, including units obtained by multiplying and dividing quantities. In Algebra I, students apply these skills in a more sophisticated fashion to solve problems in which reasoning about units adds insight (N-Q).
- Themes from middle school continue and deepen during high school. As early as grades 6 and 7, students began to use the properties of operations to generate equivalent expressions (6.EE.3, 7.EE.1). By grade 7, they began to recognize that rewriting expressions in different forms could be useful in problem solving (7.EE.2). In Algebra I, these aspects of algebra carry forward as students continue to use properties of operations to rewrite expressions, gaining fluency and engaging in what has been called “mindful manipulation.”
- Students in grade 8 extended their prior understanding of proportional relationships to begin working with functions, with an emphasis on linear functions. In Algebra I, students will master linear and quadratic functions and deepen their understanding of exponential functions. Students encounter other kinds of functions to ensure that general principles are perceived in generality, as well as to enrich the range of quantitative relationships considered in problems.
- Students in grade 8 connected their knowledge about proportional relationships, lines and linear equations (8.EE.5, 6). In Algebra I, students solidify their understanding of the analytic geometry of lines. They understand that in the Cartesian coordinate plane the graph of any linear equation in two variables is a line, and any line is the graph of a linear equation in two variables.
- As students acquire mathematical tools from their study of algebra and functions, they apply these tools in statistical contexts (e.g., S-ID.6). In a modeling context, they might informally fit a quadratic function to a set of data, graphing the data and the model function on the same coordinate axes. They also draw on skills they first learned in middle school to apply basic statistics and simple probability in a modeling context. For example, they might estimate a measure of center or variation and use it as an input for a rough calculation.
- Algebra I techniques open a huge variety of word problems that can be solved that were previously inaccessible or very complex in grades K–8. This expands problem solving from grades K–8 dramatically.
# Algebra 1

## Scope and Sequence

**Year at a Glance**

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Semester 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intro Unit</strong> (1 week)</td>
<td><strong>Equations and Expressions</strong></td>
</tr>
<tr>
<td></td>
<td>Equations and Expressions</td>
</tr>
<tr>
<td><strong>Functions</strong></td>
<td><strong>Modeling and Projects</strong> (2 weeks)</td>
</tr>
<tr>
<td>Unit 1 Modeling with Functions (3 weeks)</td>
<td>Unit 4 Systems of Linear Equations and Inequalities (3 weeks)</td>
</tr>
<tr>
<td>Unit 2 Linear Functions (4 weeks)</td>
<td><strong>Quadratic Functions</strong> (4 weeks)</td>
</tr>
<tr>
<td>Unit 3 Linear Equations and Inequalities One Variable (3 weeks)</td>
<td><strong>Quadratic Equations</strong> (5 weeks)</td>
</tr>
</tbody>
</table>

### Goals

- **Reason quantitatively and use units to solve problems**
  - N-Q 1, 2, 3
  - Interpret functions (linear and exponential)
  - F-IF 4, 5
  - Analyze functions using different representations
  - F-IF 9
  - Understand the concept of a function and use function notation
  - F-IF 1, 2, 3
- **Reasoning with Equations**
  - A-REI 1, 3
  - 3.1CA, 11
- **Create Equations**
  - A-CED 1, 3, 4
- **Reasoning with Equations in Context**
  - F-IF 4, 5, 6
- **Create Equations**
  - A-CED 2, 3, 4
- **Interpreting Functions in Context**
  - F-IF 7, 7a, 7b, 8, 8a, 8b, 9
- **Use complex numbers in equations**
  - N-CN 7
- **Write expressions in equivalent forms to solve problems**
  - A-SSE 3a, 3b
- **Solve equations and inequalities in one variable (quadratic)**
  - A-REI 4, 4a, 4b
- **Solve a system of equations (linear-quadratic)**
  - A-REI 7, 8+, 9+
- **Summarize, represent and interpret data (single variable)**
  - S-ID 1, 2, 3
- **Summarize, represent and interpret data (two variables)**
  - S-ID 5, 6, 6a, 6b, 6c
- **Interpret Linear Models**
  - S-ID 7, 8, 9
**Algebra 1 limits functions to linear, exponential, quadratic, absolute value, and piecewise (step, square root and cube root included in Honors). Building functions limited to linear, exponential and quadratic. One-variable limited to linear, quadratic and simple exponential (logarithms not needed, honors includes absolute value, square and cube root). Systems limited to linear (honors includes simple linear/quadratic). Red standards are specific to honors sections subject to the limitations described here.**

<table>
<thead>
<tr>
<th>Functions (continued)</th>
<th>Equations and Expressions (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1</strong>&lt;br&gt;Modeling with Functions (3 weeks)</td>
<td><strong>Unit 2</strong>&lt;br&gt;Linear Functions (4 weeks)</td>
</tr>
<tr>
<td>Linear and exponential models&lt;br&gt;F-LE 1, 1a, 1b, 3, 5</td>
<td>Linear and Exponential Models&lt;br&gt;F-LE 1, 1a, 1b, 1c, 2</td>
</tr>
<tr>
<td></td>
<td>Interpret the structure of expressions (linear and exponential)&lt;br&gt;A-SSE 1a, 1b, 3</td>
</tr>
</tbody>
</table>

**Red lettering = CA addition**

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**Mathematical Practices**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.
# Algebra I Content Emphases by Cluster (PARCC/SBAC)

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Major Clusters (70%)</th>
<th>Supporting Clusters (20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALGEBRA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeing the Structure in Expressions</td>
<td>Interpreting the structure of expression.</td>
<td></td>
</tr>
<tr>
<td>Arithmetic with Polynomials and Rational Expressions</td>
<td>Perform arithmetic operations on polynomials.</td>
<td></td>
</tr>
<tr>
<td>Creating Equations</td>
<td>Create equations that describe numbers or relationships.</td>
<td></td>
</tr>
<tr>
<td>Reasoning with Equations and Inequalities</td>
<td>Understand solving equations as a process of reasoning and explain the reasoning.</td>
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<tr>
<td></td>
<td>Solve equations and inequalities in one variable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Represent and solve equations and inequalities graphically.</td>
<td></td>
</tr>
<tr>
<td><strong>FUNCTIONS</strong></td>
<td><strong>Interpreting Functions</strong></td>
<td><strong>Interpreting Functions</strong></td>
</tr>
<tr>
<td></td>
<td>Interpret the concept of a function and use function notation.</td>
<td>Analyze functions using different representations.</td>
</tr>
<tr>
<td></td>
<td>Interpret functions that arise in application in terms of the context.</td>
<td></td>
</tr>
<tr>
<td><strong>STATISTICS &amp; PROBABILITY</strong></td>
<td><strong>Interpreting Categorical and Quantitative Data</strong></td>
<td><strong>Interpreting Categorical and Quantitative Data</strong></td>
</tr>
<tr>
<td></td>
<td>Interpret linear models.</td>
<td>Summarize, represent, and interpret data on a simple count or measurement variable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Summarize, represent, and interpret data on two categorical and quantitative variables.</td>
</tr>
<tr>
<td><strong>NUMBER &amp; QUANTITY</strong></td>
<td><strong>Quantities</strong></td>
<td><strong>The Real Number System</strong></td>
</tr>
<tr>
<td></td>
<td>Reason quantitatively and use units to solve problems.</td>
<td>Use properties of rational and irrational numbers.</td>
</tr>
</tbody>
</table>

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Algebra 1
Modeling in High School Mathematics

Students develop increasing levels of proficiency as they progress from grade 8 mathematics through Algebra II in terms of modeling. Each of the high school mathematics courses has specific modeling and project based units built into the schedule. Modeling problems are genuine problems, in the sense that students care about answering the question under consideration. In modeling, mathematics is used as a tool to answer questions that students really want answered. This will be a new approach for many teachers and will be challenging to implement, but the effort will produce students who can appreciate that mathematics is relevant to their lives. From a pedagogical perspective, modeling gives a concrete basis from which to abstract the mathematics and often serves to motivate students to become independent learners.

Figure 1: The modeling cycle. Students examine a problem and formulate a mathematical model (an equation, table, graph, etc.), compute an answer or rewrite their expression to reveal new information, interpret their results, validate them, and report out.