Algebra I Overview

Numerals in parentheses designate individual content standards that are eligible for assessment in whole or in part. Underlined numerals (e.g., 1) indicate standards eligible for assessment on two or more end-of-course assessments. For more information, see Tables 1 and 2. Course emphases are indicated by: ■ Major Content; ◘ Supporting Content; ○ Additional Content. Not all CCSSM content standards in a listed domain or cluster are assessed.

The Real Number System (N-RN)

- ○ B. Use properties of rational and irrational numbers (3)

Quantities★(N-Q)

- ◘ A. Reason quantitatively and use units to solve problems (1, 2, 3)

Seeing Structure in Expressions (A-SSE)

- ■ A. Interpret the structure of expressions (1, 2)
- ◘ B. Write expressions in equivalent forms to solve problems (3)

Arithmetic with Polynomials and Rational Expressions (A-APR)

- ■ A. Perform arithmetic operations on polynomials (1)
- ◘ B. Understand the relationship between zeros and factors of polynomials (3)

Creating Equations★ (A-CED)

- ■ A. Create equations that describe numbers or relationships (1, 2, 3, 4)

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.

Reasoning with Equations and Inequalities (A-REI)

- ■ A. Understand solving equations as a process of reasoning and explain the reasoning (1)
- ■ B. Solve equations and inequalities in one variable (3, 4)
- ○ C. Solve systems of equations (5, 6)
- ■ D. Represent and solve equations and inequalities graphically (10, 11, 12)

Interpreting Functions (F-IF)

- ■ A. Understand the concept of a function and use function notation (1, 2, 3)
- ■ B. Interpret functions that arise in applications in terms of the context (4, 5, 6)
- ◘ C. Analyze functions using different representations (7, 8, 9)

Building Functions (F-BF)

- ◘ A. Build a function that models a relationship between two quantities (1)
- ○ B. Build new functions from existing functions (3)

Linear, Quadratic, and Exponential Models★ (F-LE)

- ◘ A. Construct and compare linear, quadratic, and exponential models and solve problems (1, 2, 3)
- ◘ B. Interpret expressions for functions in terms of the situation they model (5)

Interpreting categorical and quantitative data (S-ID)

- ○ A. Summarize, represent, and interpret data on a single count or measurement variable (1, 2, 3)
- ◘ B. Summarize, represent, and interpret data on two categorical and quantitative variables (5, 6)
- ■ C. Interpret linear models (7, 8, 9)

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 $\sqrt{5}$ or π. In Algebra I, students will begin to understand the real number *system*. For more on the extension of number systems, see page 58 of the standards.

- 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 beginning in middle school algebra 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.A.3, 7.EE.A.1). By grade 7, they began to recognize that rewriting expressions in different forms could be useful in problem solving (7.EE.A.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."[26]

- 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. 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.B.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.

    - 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.B.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.

[26] See, for example, "Mindful Manipulation," in *Focus in High School Mathematics: Reasoning and Sense Making* (National Council of Teachers of Mathematics, 2009).

Discussion of Mathematical Practices in Relation to Course Content

Two overarching practices relevant to Algebra I are:

- **Make sense of problems and persevere in solving them** (MP.1).
- **Model with mathematics** (MP.4).

Indeed, other mathematical practices in Algebra I might be seen as contributing specific elements of these two. The intent of the following set is not to decompose the above mathematical practices into component parts but rather to show how the mathematical practices work together.

- **Reason abstractly and quantitatively** (MP.2). This practice standard refers to one of the hallmarks of algebraic reasoning, the process of decontextualization and contextualization. Much of elementary algebra involves creating abstract algebraic models of problems (A-CED, F-BF) and then transforming the models via algebraic calculations (A-SSE, A-APR, F-IF) to reveal properties of the problems.
- **Use appropriate tools strategically** (MP.5). Spreadsheets, a function modeling language, graphing tools, and many other technologies can be used strategically to gain understanding of the ideas expressed by individual content standards and to model with mathematics.
- **Attend to precision** (MP.6). In algebra, the habit of using precise language is not only a mechanism for effective communication but also a tool for understanding and solving problems. Describing an idea precisely (A-CED, A-REI) helps students understand the idea in new ways.
- **Look for and make use of structure** (MP.7). For example, writing $49x^2 + 35x + 6$ as $(7x)^2 + 5(7x) + 6$, a practice many teachers refer to as "chunking," highlights the structural similarity between this expression and $z^2 + 5z + 6$, leading to a factorization of the original: ((7*x*) + 3) ((7*x*) + 2) (A-SSE, A-APR).
- **Look for and express regularity in repeated reasoning** (MP.8). Creating equations or functions to model situations is harder for many students than working with the resulting expressions. An effective way to help students develop the skill of describing general relationships is to work through several specific examples and then express what they are doing with algebraic symbolism (A-CED). For example, when comparing two different text messaging plans, many students who can compute the cost for a given number of minutes have a hard time writing general formulas that express the cost of each plan for *any* number of minutes. Constructing these formulas can be facilitated by methodically calculating the cost for several different input values and then expressing the steps in the calculation, first in words and then in algebraic symbols. Once such expressions are obtained, students can find the break-even point for the two plans, graph the total cost against the number of messages sent, and make a complete analysis of the two plans.

Fluency Recommendations

A/G Algebra I students become fluent in solving characteristic problems involving the analytic geometry of lines, such as writing down the equation of a line given a point and a slope. Such fluency can support them in solving less routine mathematical problems involving linearity, as well as in modeling linear phenomena (including modeling using systems of linear inequalities in two variables).

A-APR.A.1 Fluency in adding, subtracting, and multiplying polynomials supports students throughout their work in algebra, as well as in their symbolic work with functions. Manipulation can be more mindful when it is fluent.

A-SSE.A.1b Fluency in transforming expressions and chunking (seeing parts of an expression as a single object) is essential in factoring, completing the square, and other mindful algebraic calculations.