Grade 8 Mathematics Overview

In Grade 8, content is organized into four Alabama Content Areas outlined below: Number Systems and Operations; Algebra and Functions; Data Analysis, Statistics, and Probability; and Geometry and Measurement. Related standards are grouped into clusters, which are listed below each content area. Standards indicate what students should know or be able to do by the end of the course.

Alabama Content Areas	Number Systems and Operations	Algebra and Functions	Data Analysis, Statistics, and Probability	Geometry and Measurement
Clusters	• Understand that the real number system is composed of rational and irrational numbers.	• Apply concepts of rational and integer exponents. • Analyze the relationship between proportional and non-proportional situations. • Analyze and solve linear equations and systems of two linear equations. • Explain, evaluate, and compare functions. • Use functions to model relationships between quantities.	• Investigate patterns of association in bivariate data.	• Understand congruence and similarity using physical models or technology. • Analyze parallel lines cut by a transversal. • Understand and apply the Pythagorean Theorem. • Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

The eight Student Mathematical Practices listed in the chart below represent what students are doing as they learn mathematics. Students should regularly engage in these processes and proficiencies at every level throughout their mathematical studies. Proficiency with these practices is critical in using mathematics, both in the classroom and in everyday life. **The Student Mathematical Practices are standards to be incorporated across all grades**.

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

Content Priorities

In Grade 8, instructional time should focus on three critical areas, all of which have equal importance:

1. **Construct and reason about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations.**
   Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = k$ or $y = kx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (k) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change. Students also use a linear equation to describe the association between two quantities in bivariate data. At this grade level, fitting the model to the data and assessing its fit are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation. Students choose and implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2. **Describe the concept of a function and use functions to interpret quantitative relationships.**
   Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They describe how aspects of the function are reflected in the different representations.

3. **Analyze two- and three-dimensional figures and understand and apply the Pythagorean Theorem.**
   Students use ideas about distance and angles and how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to analyze and describe two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line. Students understand and can explain the Pythagorean Theorem and its converse. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students understand and apply properties of parallel lines cut by a transversal in order to solve problems. Students conclude their study on volume by solving problems involving cones, cylinders, and spheres.

Grade 8 Mathematics Content Standards

Each content standard completes the stem *"Students will…"*

Number Systems and Operations	
Understand that the real number system is composed of rational and irrational numbers.	1. Define the real number system as composed of rational and irrational numbers. a. Explain that every number has a decimal expansion; for rational numbers, the decimal expansion repeats or terminates. b. Convert a decimal expansion that repeats into a rational number. 2. Locate rational approximations of irrational numbers on a number line, compare their sizes, and estimate the values of the irrational numbers.

Algebra and Functions	
Apply concepts of integer exponents and radicals.	3. Develop and apply properties of integer exponents to generate equivalent numerical and algebraic expressions. 4. Use square root and cube root symbols to represent solutions to equations. a. Evaluate square roots of perfect squares (less than or equal to 225) and cube roots of perfect cubes (less than or equal to 1000). b. Explain that the square root of a non-perfect square is irrational. 5. Estimate and compare very large or very small numbers in scientific notation. 6. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. a. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. b. Interpret scientific notation that has been generated by technology.

Analyze the relationship between proportional and non-proportional situations.	7. Determine whether a relationship between two variables is proportional or non-proportional. 8. Graph proportional relationships. a. Interpret the unit rate of a proportional relationship, describing the constant of proportionality as the slope of the graph which goes through the origin and has the equation $y = mx$ where m is the slope. 9. Interpret $y = mx + b$ as defining a linear equation whose graph is a line with m as the slope and b as the y-intercept. a. Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in a coordinate plane. b. Given two distinct points in a coordinate plane, find the slope of the line containing the two points and explain why it will be the same for any two distinct points on the line. c. Graph linear relationships, interpreting the slope as the rate of change of the graph and the y-intercept as the initial value. d. Given that the slopes for two different sets of points are equal, demonstrate that the linear equations that include those two sets of points may have different y-intercepts. 10. Compare proportional and non-proportional linear relationships represented in different ways (algebraically, graphically, numerically in tables, or by verbal descriptions) to solve real-world problems.
Analyze and solve linear equations and systems of two linear equations.	11. Solve multi-step linear equations in one variable, including rational number coefficients, and equations that require using the distributive property and combining like terms. a. Determine whether linear equations in one variable have one solution, no solution, or infinitely many solutions of the form $x = a$, $a = a$, or $a = b$ (where a and b are different numbers). b. Represent and solve real-world and mathematical problems with equations and interpret each solution in the context of the problem. 12. Solve systems of two linear equations in two variables by graphing and substitution. a. Explain that the solution(s) of systems of two linear equations in two variables corresponds to points of intersection on their graphs because points of intersection satisfy both equations simultaneously. b. Interpret and justify the results of systems of two linear equations in two variables (one solution, no solution, or infinitely many solutions) when applied to real-world and mathematical problems.

Explain, evaluate, and compare functions.	13. Determine whether a relation is a function, defining a function as a rule that assigns to each input (independent value) exactly one output (dependent value), and given a graph, table, mapping, or set of ordered pairs. 14. Evaluate functions defined by a rule or an equation, given values for the independent variable. 15. Compare properties of functions represented algebraically, graphically, numerically in tables, or by verbal descriptions. a. Distinguish between linear and non-linear functions.
Use functions to model relationships between quantities.	16. Construct a function to model a linear relationship between two variables. a. Interpret the rate of change (slope) and initial value of the linear function from a description of a relationship or from two points in a table or graph. 17. Analyze the relationship (increasing or decreasing, linear or non-linear) between two quantities represented in a graph.

Data Analysis, Statistics, and Probability	
Investigate patterns of association in bivariate data.	18. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities, describing patterns in terms of positive, negative, or no association, linear and non-linear association, clustering, and outliers. 19. Given a scatter plot that suggests a linear association, informally draw a line to fit the data, and assess the model fit by judging the closeness of the data points to the line. 20. Use a linear model of a real-world situation to solve problems and make predictions. a. Describe the rate of change and *y*-intercept in the context of a problem using a linear model of a real-world situation. 21. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects, using relative frequencies calculated for rows or columns to describe possible associations between the two variables.

Geometry and Measurement	
Understand congruence and similarity using physical models or technology.	22. Verify experimentally the properties of rigid motions (rotations, reflections, and translations): lines are taken to lines, and line segments are taken to line segments of the same length; angles are taken to angles of the same measure; and parallel lines are taken to parallel lines. a. Given a pair of two-dimensional figures, determine if a series of rigid motions maps one figure onto the other, recognizing that if such a sequence exists the figures are congruent; describe the transformation sequence that verifies a congruence relationship. 23. Use coordinates to describe the effect of transformations (dilations, translations, rotations, and reflections) on two-dimensional figures. 24. Given a pair of two-dimensional figures, determine if a series of dilations and rigid motions maps one figure onto the other, recognizing that if such a sequence exists the figures are similar; describe the transformation sequence that exhibits the similarity between them.
Analyze parallel lines cut by a transversal.	25. Analyze and apply properties of parallel lines cut by a transversal to determine missing angle measures. a. Use informal arguments to establish that the sum of the interior angles of a triangle is 180 degrees.
Understand and apply the Pythagorean Theorem.	26. Informally justify the Pythagorean Theorem and its converse. 27. Apply the Pythagorean Theorem to find the distance between two points in a coordinate plane. 28. Apply the Pythagorean Theorem to determine unknown side lengths of right triangles, including real-world applications

Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. *Note: Students must select and use the appropriate unit for the attribute being measured when determining length, area, angle, time, or volume.*	29. Informally derive the formulas for the volume of cones and spheres by experimentally comparing the volumes of cones and spheres with the same radius and height to a cylinder with the same dimensions. 30. Use formulas to calculate the volumes of three-dimensional figures (cylinders, cones, and spheres) to solve real-world problems.