GRADES 9-12 OVERVIEW

The high school mathematics course focuses on empowering students in three areas:

- meeting their postsecondary goals;
- functioning as effective citizens who can use mathematics to make responsible decisions about their own lives and about society as a whole; and
- recognizing mathematics as an inspiring, enjoyable, and significant human achievement.

Meeting these goals requires students to understand that “mathematics is more than finding answers; mathematics requires reasoning and problem-solving in order to solve real-world and mathematical problems.” (see Teaching and Learning Mathematics Position Statement on p. 7). Thus, students must be consistently engaged in the Student Mathematical Practices, which are listed as standards for every course. At the high school level, it is particularly important that students consistently use technology and other appropriate mathematical tools to explore and develop a deep understanding of the mathematics they are studying. A particular emphasis on mathematical modeling (using mathematics to solve real world problems) is also incorporated throughout the courses.

Ensuring that all students receive the preparation they deserve requires unrelenting focus on developing their deep understanding of the most critical content that they will need not simply to pass the next test or course, but also to function effectively throughout their lives. In order to ensure the necessary focus on this critical content, these standards build on “essential concepts” for high school mathematics described by the National Council of Teachers of Mathematics (NCTM) in *Catalyzing Change in High School Mathematics: Initiating Critical Conversations* (2018). These essential concepts are designed to be achieved by all students within the first three years of high school mathematics, and they form the foundation for additional coursework designed to meet students’ specific post-high school needs and interests. Note in particular the emphasis on statistics and probability, which are increasingly important in today’s world. See the complete list of essential concepts below.

Organization of Standards

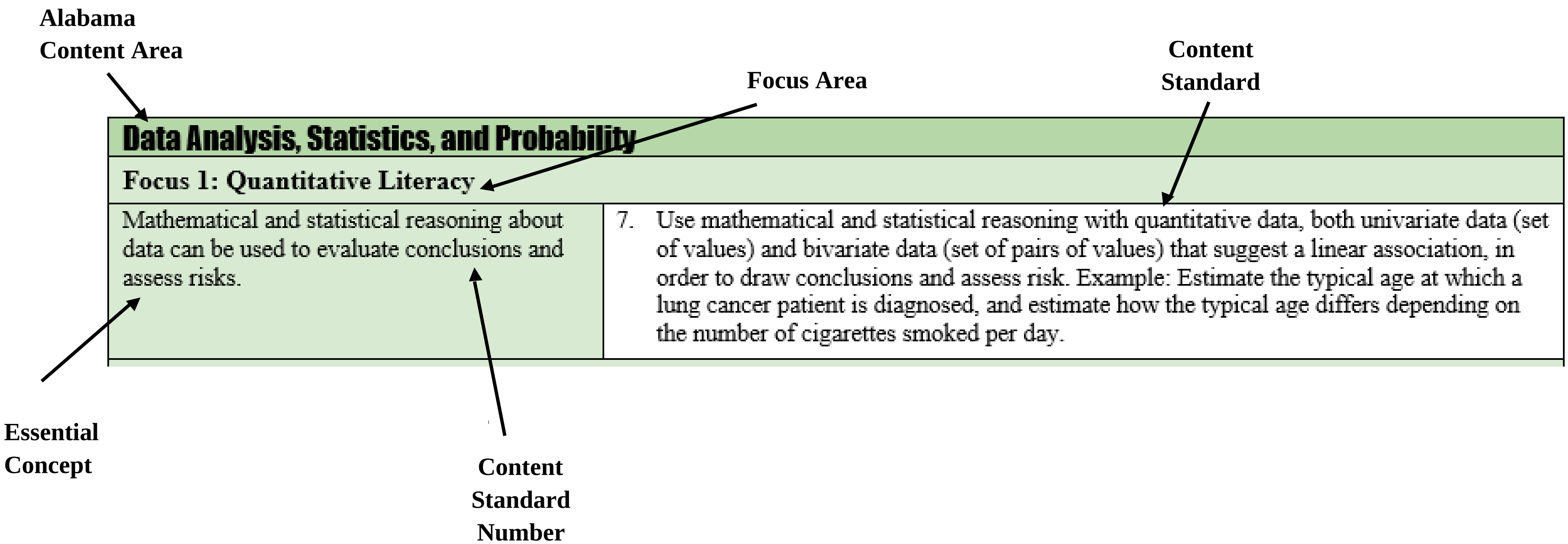
1. A set of **essential concepts** is used to organize the standards in the required courses in the high school section of the course of study. These essential concepts build on those described by the National Council of Teachers of Mathematics (2018) in *Catalyzing Change in High School Mathematics*, with some additional concepts reflecting that all Alabama students must take three courses rather than 2.5. These essential concepts include the concepts and skills that all students need to build the mathematical foundation required for the continued study of mathematics and for other future mathematical needs.
2. Essential concepts are given for four **content areas**, as shown in the table below: Number and Quantity; Algebra and Functions; Data Analysis, Statistics, and Probability; and Geometry and Measurement. A table for applicable content areas appears in each course. (The order of the content areas follows *Catalyzing Change*, whereas K-8 follows the order given in the table below.) A table for applicable content areas appears in each course. Each content area (other than Number and Quantity) is further organized into several **focus areas** which appear as subheadings in the table. Focus areas in Grades 9-12 are similar to clusters in K-8, groups of related essential concepts and standards within the specific content area. Not every focus area appears in every course. Finally, the essential concepts are listed in the left column of each table, alongside a list of content standards that support attainment of each. The standards are collectively designed as the mathematical content of a shared pathway for **all** students.

Overview of Alabama Mathematics Content Areas

<table>
<tr><th>NAEP Content Areas</th><th>Kindergarten</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>High School</th></tr>
<tr><td rowspan="3">Number Properties and Operations</td><td>Foundations of Counting</td><td colspan="9"></td></tr>
<tr><td colspan="6">Operations with Numbers: Base Ten</td><td colspan="3">Proportional Reasoning</td><td rowspan="2">Number</td></tr>
<tr><td colspan="3"></td><td colspan="3">Operations with Numbers: Fractions</td><td colspan="3">Number Systems and Operations</td></tr>
<tr><td>Algebra</td><td colspan="6">Operations and Algebraic Thinking</td><td colspan="4">Algebra and Functions</td></tr>
<tr><td>Data Analysis, Statistics, and Probability</td><td colspan="6">Data Analysis</td><td colspan="4">Data Analysis, Statistics, and Probability</td></tr>
<tr><td>Measurement</td><td colspan="6">Measurement</td><td colspan="4" rowspan="2">Geometry and Measurement</td></tr>
<tr><td>Geometry</td><td colspan="6">Geometry</td></tr>
</table>

3. **Content standards** are written in the right column of each content area table and numbered as shown in the illustration below. The content standards support the attainment of the essential concepts listed on the left. Standards define what students should understand (know) and be able to do at the conclusion of a course or grade. Content standards in this document contain minimum required content. Some have sub-standards**,** indicated with *a, b, c, d,* which are extensions of the content standards and are also required. Some standards include examples, which are not required to be taught. The order in which standards are listed within a course or grade is not intended to convey a sequence for instruction. Each content standard completes the stem "*Students will...*"

4. Some related standards appear across multiple high school courses. In many cases, there is a bold-print statement to indicate the scope of the standard to align the content that is taught across the courses. The full scope of every standard should be addressed during instruction.
5. The specialized courses taken after *Algebra II with Statistics* are organized in ways related to their specific subject matter, which extend beyond the essential concepts and directly support students' professional and personal goals. The standards indicating what students should know or be able to do are listed in the right columns of the content area tables. Important concepts within these content areas are described in the left columns, and focus areas within the tables are indicated.



Essential Concepts

All essential concepts used in the high school course of study are listed below. The required courses in which the essential concepts appear are noted in the column on the right.

Number and Quantity	
• Together, irrational numbers and rational numbers complete the real number system, representing all points on the number line, while there exist numbers beyond the real numbers called complex numbers.	Geometry with Data Analysis Algebra I with Probability Algebra II with Statistics
• Quantitative reasoning includes, and mathematical modeling requires attention to units of measurement.	Geometry with Data Analysis
• Matrices are a useful way to represent information.	Algebra II with Statistics
Algebra and Functions	
Focus 1: Algebra	
• Expressions can be rewritten in equivalent forms by using algebraic properties, including properties of addition, multiplication, and exponentiation, to make different characteristics or features visible.	Algebra I with Probability Algebra II with Statistics
• Finding solutions to an equation, inequality, or system of equations or inequalities requires the checking of candidate solutions, whether generated analytically or graphically, to ensure that solutions are found and that those found are not extraneous.	Algebra I with Probability Algebra II with Statistics
• The structure of an equation or inequality (including, but not limited to, one-variable linear and quadratic equations, inequalities, and systems of linear equations in two variables) can be purposefully analyzed (with and without technology) to determine an efficient strategy to find a solution, if one exists, and then to justify the solution.	Geometry with Data Analysis Algebra I with Probability Algebra II with Statistics

• Expressions, equations, and inequalities can be used to analyze and make predictions, both within mathematics and as mathematics is applied in different contexts – in particular, contexts that arise in relation to linear, quadratic, and exponential situations.	Geometry with Data Analysis Algebra I with Probability Algebra II with Statistics
Focus 2: Connecting Algebra to Functions	
• Functions shift the emphasis from a point-by-point relationship between two variables (input/output) to considering an entire set of ordered pairs (where each first element is paired with exactly one second element) as an entity with its own features and characteristics.	Algebra I with Probability
• Graphs can be used to obtain exact or approximate solutions of equations, inequalities, and systems of equations and inequalities – including systems of linear equations in two variables and systems of linear and quadratic equations (given or obtained by using technology).	Geometry with Data Analysis Algebra I with Probability Algebra II with Statistics
Focus 3: Functions	
• Functions can be described by using a variety of representations: mapping diagrams, function notation (e.g., $f(x) = x^2$), recursive definitions, tables, and graphs.	Algebra I with Probability Algebra II with Statistics
• Functions that are members of the same family have distinguishing attributes (structure) common to all functions within that family.	Algebra I with Probability Algebra II with Statistics
• Functions can be represented graphically, and key features of the graphs, including zeros, intercepts, and, when relevant, rate of change and maximum/minimum values, can be associated with and interpreted in terms of the equivalent symbolic representation.	Algebra I with Probability Algebra II with Statistics
• Functions model a wide variety of real situations and can help students understand the processes of making and changing assumptions, assigning variables, and finding solutions to contextual problems.	Algebra I with Probability Algebra II with Statistics

Data Analysis, Statistics, and Probability	
Focus 1: Quantitative Literacy	
• Mathematical and statistical reasoning about data can be used to evaluate conclusions and assess risks.	Geometry with Data Analysis Algebra I with Probability Algebra II with Statistics
• Making and defending informed data-based decisions is a characteristic of a quantitatively literate person.	Algebra I with Probability Algebra II with Statistics
Focus 2: Visualizing and Summarizing Data	
• Data arise from a context and come in two types: quantitative (continuous or discrete) and categorical. Technology can be used to "clean" and organize data, including very large data sets, into a useful and manageable structure – a first step in any analysis of data.	Geometry with Data Analysis Algebra I with Probability
• Distributions of quantitative data (continuous or discrete) in one variable should be described in the context of the data with respect to what is typical (the shape, with appropriate measures of center and variability, including standard deviation) and what is not (outliers), and these characteristics can be used to compare two or more subgroups with respect to a variable.	Geometry with Data Analysis Algebra II with Statistics
• The association between two categorical variables is typically represented by using two-way tables and segmented bar graphs.	Algebra I with Probability
• Scatterplots, including plots over time, can reveal patterns, trends, clusters, and gaps that are useful in analyzing the association between two contextual variables.	Geometry with Data Analysis
• Analyzing the association between two quantitative variables should involve statistical procedures, such as examining (with technology) the sum of squared deviations in fitting a linear model, analyzing residuals for patterns, generating a least-squares regression line and finding a correlation coefficient, and differentiating between correlation and causation.	Geometry with Data Analysis
• Data-analysis techniques can be used to develop models of contextual situations and to generate and evaluate possible solutions to real problems involving those contexts.	Geometry with Data Analysis Algebra II with Statistics

Focus 3: Statistical Inference	
• Study designs are of three main types: sample survey, experiment, and observational study.	Algebra II with Statistics
• The role of randomization is different in randomly selecting samples and in randomly assigning subjects to experimental treatment groups.	Algebra II with Statistics
• The scope and validity of statistical inferences are dependent on the role of randomization in the study design.	Algebra II with Statistics
• Bias, such as sampling, response, or nonresponse bias, may occur in surveys, yielding results that are not representative of the population of interest.	Algebra II with Statistics
• The larger the sample size, the less the expected variability in the sampling distribution of a sample statistic.	Algebra II with Statistics
• The sampling distribution of a sample statistic formed from repeated samples for a given sample size drawn from a population can be used to identify typical behavior for that statistic. Examining several such sampling distributions leads to estimating a set of plausible values for the population parameter, using the margin of error as a measure that describes the sampling variability.	Algebra II with Statistics
Focus 4: Probability	
• Two events are independent if the occurrence of one event does not affect the probability of the other event. Determining whether two events are independent can be used for finding and understanding probabilities.	Algebra I with Probability
• Conditional probabilities – that is, those probabilities that are “conditioned” by some known information – can be computed from data organized in contingency tables. Conditions or assumptions may affect the computation of a probability.	Algebra I with Probability

Geometry and Measurement	
Focus 1: Measurement	
• Areas and volumes of figures can be computed by determining how the figure might be obtained from simpler figures by dissection and recombination.	Geometry with Data Analysis
• Constructing approximations of measurements with different tools, including technology, can support an understanding of measurement.	Geometry with Data Analysis
• When an object is the image of a known object under a similarity transformation, a length, area, or volume on the image can be computed by using proportional relationships.	Geometry with Data Analysis Algebra II with Statistics
Focus 2: Transformations	
• Applying geometric transformations to figures provides opportunities for describing the attributes of the figures preserved by the transformation and for describing symmetries by examining when a figure can be mapped onto itself.	Geometry with Data Analysis
• Showing that two figures are congruent involves showing that there is a rigid motion (translation, rotation, reflection, or glide reflection) or, equivalently, a sequence of rigid motions that maps one figure to the other.	Geometry with Data Analysis
• Showing that two figures are similar involves finding a similarity transformation (dilation or composite of a dilation with a rigid motion) or, equivalently, a sequence of similarity transformations that maps one figure onto the other.	Geometry with Data Analysis
• Transformations in geometry serve as a connection with algebra, both through the concept of functions and through the analysis of graphs of functions as geometric figures.	*This essential concept is not noted in any of the required courses. However, it is addressed within the Algebra and Functions Content Area.*

Focus 3: Geometric Arguments, Reasoning, and Proof	
• Proof is the means by which we demonstrate whether a statement is true or false mathematically, and proofs can be communicated in a variety of ways (e.g., two-column, paragraph).	Geometry with Data Analysis
• Using technology to construct and explore figures with constraints provides an opportunity to explore the independence and dependence of assumptions and conjectures.	Geometry with Data Analysis
• Proofs of theorems can sometimes be made with transformations, coordinates, or algebra; all approaches can be useful, and in some cases one may provide a more accessible or understandable argument than another.	Geometry with Data Analysis
Focus 4: Solving Applied Problems and Modeling in Geometry	
• Recognizing congruence, similarity, symmetry, measurement opportunities, and other geometric ideas, including right triangle trigonometry in real-world contexts, provides a means of building understanding of these concepts and is a powerful tool for solving problems related to the physical world in which we live.	Geometry with Data Analysis Algebra II with Statistics
• Experiencing the mathematical modeling cycle in problems involving geometric concepts, from the simplification of the real problem through the solving of the simplified problem, the interpretation of its solution, and the checking of the solution's feasibility, introduces geometric techniques, tools, and points of view that are valuable to problem solving.	Geometry with Data Analysis