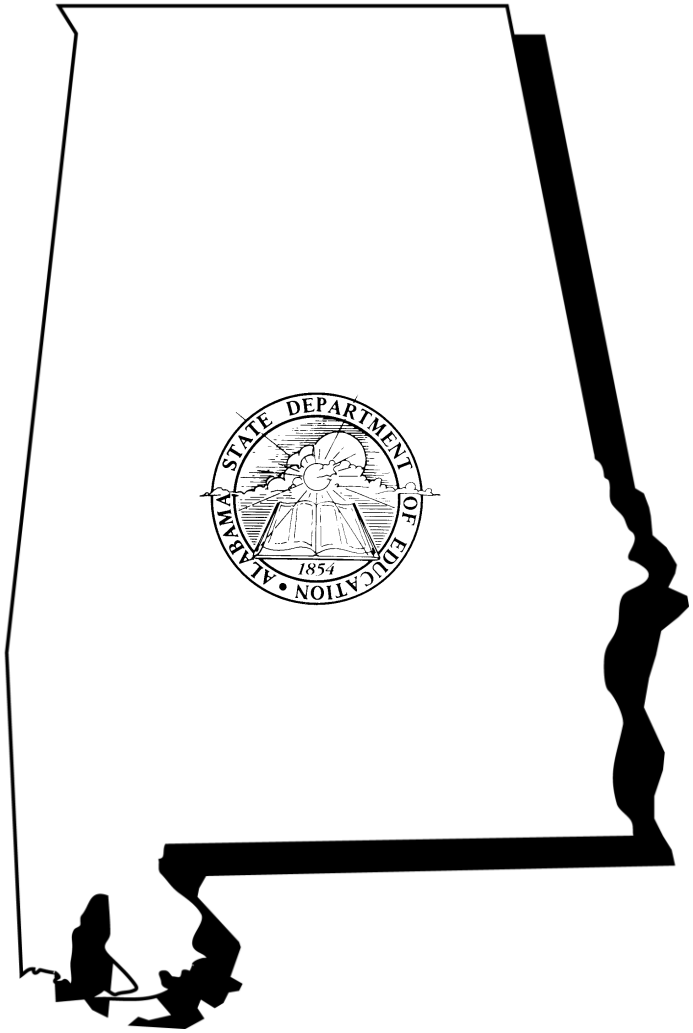
Alabama Course of Study

Mathematics



Ed Richardson
State Superintendent of Education
ALABAMA DEPARTMENT OF EDUCATION
Bulletin 2003, No. 4

STATE SUPERINTENDENT OF EDUCATION'S MESSAGE

Dear Educator:

The demands of our society and the workplace provide evidence of the need for all Alabama students to gain mathematical power. Alabama educators must reform the teaching of mathematics so that students will learn in a way that ensures adequate preparation to meet these demands and enables them to function as problem solvers, decision makers, and lifelong learners. To address this goal, the *Alabama Course of Study: Mathematics* (Bulletin 2003, No. 4) sets high standards for all students, incorporating national standards for mathematics and addressing mathematical issues affecting our state.

The *Alabama Course of Study: Mathematics*, developed by educators and business and community leaders, provides a base upon which quality mathematics programs across the state can be developed. The implementation of the content of this document through appropriate instructional techniques will enable all Alabama students to obtain the mathematical power necessary to function as effective citizens during this new century.

ED RICHARDSON
State Superintendent of Education

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Alabama Course of Study: Mathematics

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Preface

The *Alabama Course of Study: Mathematics* (Bulletin 2003, No. 4) provides the framework for the K-12 mathematics program in Alabama's public schools. Content standards and related content included in bullets in this document are minimum and required (*Code of Alabama,* 1975, §16-35-4). They are fundamental and specific but not exhaustive. In developing local curriculum, school systems may include additional content standards to reflect local philosophies and add implementation guidelines, resources, and/or activities; which, by design, are not contained in this document.

The 2002-2003 Mathematics State Course of Study Committee extensively used the document *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics, 2000). In addition, committee members attended state, regional, and national conferences; read articles in professional journals and other publications; reviewed similar curriculum documents from other states; listened to and read statements from interested individuals and groups throughout the state; used each member's academic and experiential knowledge; and discussed issues among themselves and with colleagues. Finally, the Committee reached consensus and developed what they believe to be the best possible mathematics curriculum for Alabama's K-12 students.

Acknowledgments

This document was developed by the 2002-2003 Mathematics State Course of Study Committee composed of early childhood, intermediate, middle school, high school, and college educators appointed by the State Board of Education and business and professional persons appointed by the Governor (*Code of Alabama, 1975,* §16-35-1). The Committee began work in March 2002 and submitted the document to the State Board of Education for adoption at the February 2003 meeting.

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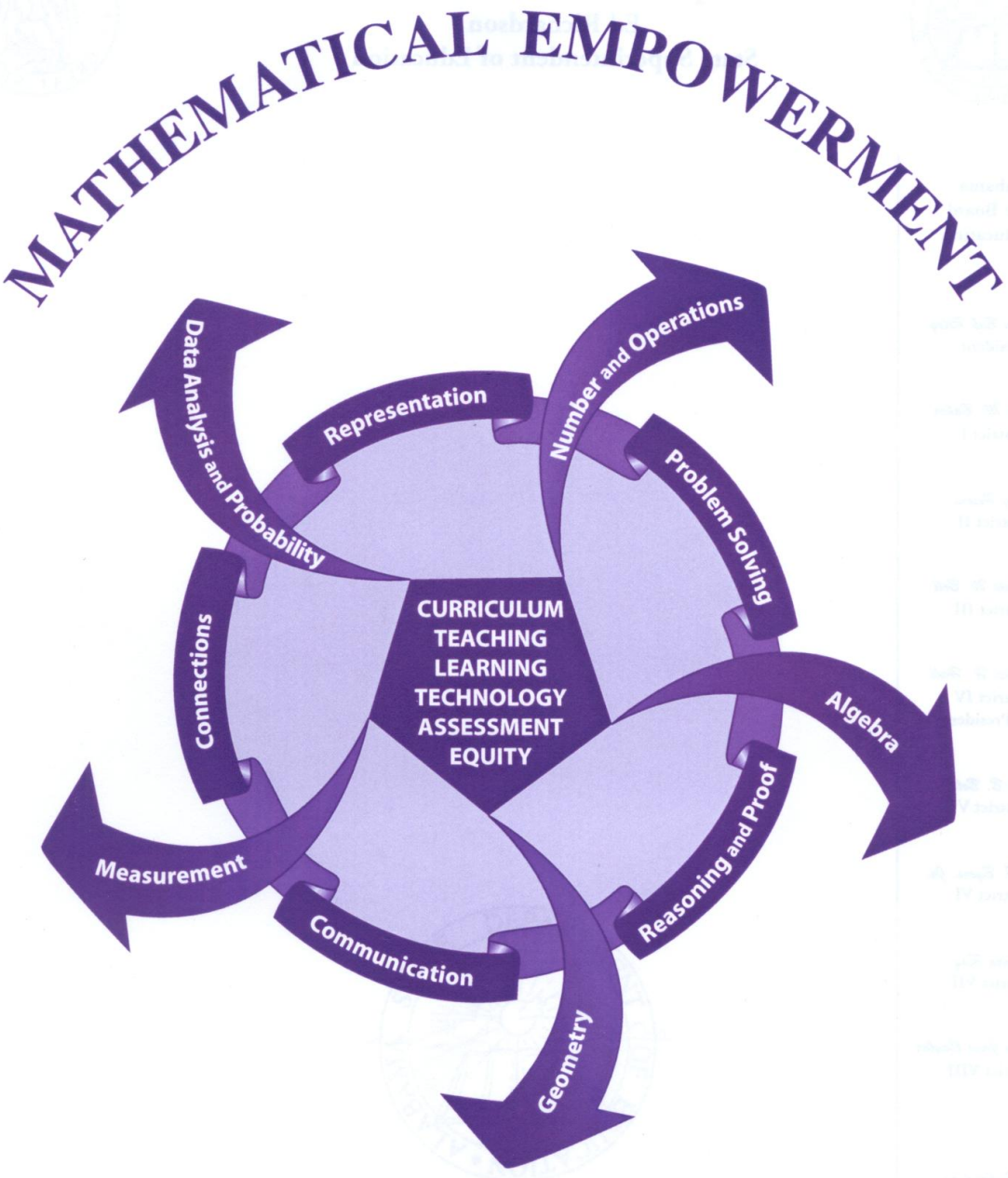
Alabama Course of Study: Mathematics
GENERAL INTRODUCTION

The goal of Alabama's K-12 mathematics program is to empower all students to live and work in the twenty-first century with the mathematical skills, understandings, and attitudes they will need to be successful in their careers and daily lives. Mathematically empowered students are flexible and resourceful problem solvers who understand and value mathematics and communicate ideas effectively. Educators, using the *Alabama Course of Study: Mathematics* as a basis for curriculum development and instructional decision-making, provide opportunities that enable all students to use mathematics in everyday life and in the workplace.

This course of study specifies a minimum foundation of mathematics to be learned by all students, including students with disabilities. Content standards are included for each grade level and course. These standards are aligned to build upon each other across the grades without repetition. School systems are encouraged to expand the content standards when appropriate to address the needs of their students.

The recommendations of the *Principles and Standards for School Mathematics* (PSSM) from the National Council of Teachers of Mathematics (NCTM) are incorporated into the conceptual framework, position statements, and content standards of this course of study. The content in each grade level and course is organized using the five PSSM content standards. These five content standards that serve as strands in this document are Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability. The PSSM process standards of Problem Solving, Reasoning and Proof, Communication, Connections, and Representation should be integrated into instruction as outlined in PSSM.

In order to effectively implement this document, local educators must use this course of study to develop local curriculum guides or local courses of study. Implementation of the *Alabama Course of Study: Mathematics* is an important step in providing students with a solid foundation of knowledge, skills, and understanding in mathematics. This foundation is an essential element in leading students toward mathematical empowerment, thereby enhancing their opportunities and options for the future.


MATHEMATICAL EMPOWERMENT
Number and Operations
Algebra
Geometry
Measurement
Data Analysis and Probability
Problem Solving
Reasoning and Proof
Communication
Connections
Representation
CURRICULUM
TEACHING
LEARNING
TECHNOLOGY
ASSESSMENT
EQUITY

Alabama's K-12 Mathematics Curriculum
The Conceptual Framework

Alabama's K-12 mathematics curriculum as depicted by the conceptual framework on the opposite page shows that the goal of the mathematics program is for students to be mathematically empowered. Recommendations from the NCTM's *Principles and Standards for School Mathematics* are incorporated into the organization of the curriculum through the use of principles, content standards, and process standards. The six principles that guided numerous decisions in the development of this course of study and that should guide local application are represented in the center pentagon. The content standards in each grade are organized by the five strands represented as arrows that extend from the center pentagon. The five mathematical processes, which are important in learning and instruction, are represented on the ribbon that flows through the arrows and connects the strands.

PRINCIPLES

The six principles represented in the center of the graphic form the foundation of a student's learning process. The **curriculum** is coherent in that the five major strands are the same for Grades K-12 and the sequence of content is aligned across the grades. Content standards provide the minimum required mathematical content for each grade and course in terms of what students should know and be able to do by the end of that grade or course. Effective **teaching** requires understanding what a child should know and how to best challenge students and support them in their learning. This **learning** requires student understanding and active involvement. Appropriate use of **technology** is essential for teaching and learning. **Assessment** provides teachers with important information to be used to direct, adjust, and improve instruction. Students should be able to use assessment as an indicator of what is considered important and where additional effort may need to be applied. To provide **equity**, administrators and teachers must hold high expectations and must provide adequate support for all students in each classroom, school, and system.

STRANDS

The strands, a prominent feature in the framework, are anchored by the principles and group Alabama's content standards into categories that are essential at all grade levels. **Number and Operations** extends from counting and adding whole numbers in Kindergarten to defining *e* and performing operations on complex numbers, matrices, and vectors in Precalculus and Algebra III with Statistics. Throughout this strand there is not only an emphasis on counting and arithmetic, but also an emphasis on number concepts, number systems, and the meanings of operations. The **Algebra** strand includes more than solving for an unknown in an equation. In Kindergarten, students are replicating patterns and sorting objects by characteristics; while in Precalculus, students are determining limits of functions. Patterns, relations, functions, and graphs are emphasized throughout the grades, as are mathematical modeling and properties of operations and numbers. The **Geometry** strand begins with recognizing simple polygons in Kindergarten and extends to graphing polar coordinates and equations and complex numbers in Precalculus. Analyzing

characteristics of two- and three-dimensional shapes, developing logical arguments for geometric generalizations, and analyzing transformations and symmetry are some of the threads that are woven throughout the Geometry strand. The strands are not mutually exclusive, and one strand that is tightly interwoven with others is **Measurement**. Kindergarten students are learning vocabulary associated with the measurement of time, length, height, volume, and weight while students in high school Geometry are measuring surface areas and volumes of solid figures. These examples illustrate the close relationship between Measurement and Geometry which continues throughout the grades. This strand also includes an understanding of units of measure and systems, processes, tools, and formulas of measurement. The final strand in the course of study is **Data Analysis and Probability**. This strand covers a broad spectrum, extending from creating simple data displays with concrete or pictorial representations in Kindergarten to hypothesis testing in Algebra III with Statistics. Students respond to questions and generate questions for data collection, analyze and interpret the data, and calculate various statistical measures for the data. Students throughout the grade levels calculate probabilities of events of varying degrees of complexity. Data Analysis and Probability is more than calculation; it includes conceptual understanding and decision-making skills as students select appropriate displays, formulas, and statistical methods.

PROCESSES

The PSSM process standards are interwoven through each of the content strands. Students develop **Problem-solving** skills to extend their mathematical knowledge and skills in all the strands. They solve problems that include real-world applications at every grade level, using various strategies to organize and execute their processes. Reasoning is necessary for problem solving and for understanding concepts and skills throughout the curriculum. **Reasoning and Proof** are essential for developing higher-order mathematical knowledge. In this course of study, students use various levels and types of reasoning, ranging from justifying the results of their work to formulating a deductive proof. Students formulate conjectures when they suggest reasons for particular outcomes from data collection. **Communication** is stressed throughout the course of study through an emphasis on vocabulary, organization of processes, and justification of results and strategies. It is essential that students learn to communicate mathematical concepts to each other and to comprehend with accuracy what they hear and read. **Connections** are made between mathematics and both real-life situations and other subject areas through applications. Connections are also made from one mathematical idea to another through challenging problems that stimulate students to relate familiar ideas. For example, students explore the relationship of subtraction to addition in the early grades, and in later grades they explore families of functions through translations that apply to different families of functions. Throughout Grades K-12, students use **Representations** to convey ideas. Students first represent mathematical ideas by using concrete objects and by drawing pictures and other symbols. As students progress, their representations of mathematical ideas expand to include numerals, equations, functions, graphs, and geometric figures.

POSITION STATEMENTS

CURRICULUM

The *Alabama Course of Study: Mathematics* should be utilized as a guide for local school system curriculum development. Alabama educators should provide students with a curriculum that connects important mathematical ideas and focuses on worthwhile content and processes. Educators should select or develop resources that help students support these important mathematical ideas and that help students connect prior knowledge, other areas of mathematics, and other content areas to topics being studied. Short- and long-term investigations that connect procedures and skills with conceptual understanding are integral components of an effective mathematics program.

TEACHING

Mathematics education of high quality requires effective mathematics teaching in all K-12 classrooms in Alabama. Effective mathematics teachers have a deep and broad understanding of the mathematics they teach, have the ability to choose worthwhile teaching strategies and tasks, and seek professional growth as they continually make instructional decisions. By making these decisions, effective teachers determine what students learn, create environments conducive to learning, and challenge students to think creatively. High expectations are set for all students, regardless of past academic performance. By providing remediation and enrichment, effective teachers help students identify and improve on their weaknesses and build on their strengths. Effective teachers determine how their own actions affect students by reflecting on lessons and classroom interactions regularly. Effective teachers are also flexible regarding the curriculum, allowing time for full development of lessons and taking advantage of unexpected learning opportunities. Engaging students in mathematical discourse and meaningful activities allows effective teachers to evaluate and expand the learning process. Student performance is significantly influenced by teacher effectiveness.

LEARNING

Students need to understand mathematics thoroughly and use it effectively. The understanding of mathematics is developed through active engagement in meaningful, worthwhile tasks. Time should be allowed for discussing mathematical ideas, reflecting on one's work, and applying mathematics in interesting, thought-provoking situations. Students make mathematical connections and communicate effectively about their learning if they are allowed to build on their mathematical knowledge. An extensive knowledge of mathematics empowers students to use mathematics with flexibility and perseverance in order to solve problems.

TECHNOLOGY

Technology enhances the mathematics curriculum in many ways, but is not intended to serve as a replacement for the teacher. The effective use of technology, however, does depend on the teacher. Teachers use technology in mathematics instruction to prepare students for an ever-changing world. The teacher makes instructional decisions about worthwhile investigative tasks that take advantage of technological aids. Technology influences the mathematics taught by providing exploratory opportunities and visual displays that would be tedious to generate by hand. Technology should be used to foster, rather than replace, the understanding of basic mathematical concepts. The use of appropriate technological tools provides support for all students to learn mathematics. Technology can be used by students and teachers to assess the understanding of meaningful mathematical concepts and to investigate more complex problems.

ASSESSMENT

Assessment provides teachers and students with information to guide and improve instruction and study; therefore, teachers should develop instructional goals and assessments concurrently. Quality assessments provide students with frequent feedback on performance, provide teachers with tools for gauging students' depth of understanding of mathematics, provide parents with information about their child's performance, and provide administrators with a means for measuring student achievement. Assessments take a variety of forms, require varying amounts of time, and allow students opportunities to demonstrate their mathematical knowledge. Assessment includes, but is not limited to, open-ended problems, constructed-response tasks, selected-response tasks, performance assessments, observations, discussions, journals, and portfolios. It is important that teachers employ multiple methods that measure student growth and support student learning of significant mathematics. Teachers should select assessment tasks worthy of students' time and attention in order to stress valued knowledge and performance.

EQUITY

All Alabama students, without exception, should participate in well-articulated, relevant, challenging mathematics programs of high quality that address students' individual needs, interests, and abilities. Access to motivating and significant mathematics instruction will be increased by highly qualified teachers with supportive administrators who have high expectations for students and who act on the belief that all students are capable of learning important mathematics. Educators should relay this message by structuring classrooms that support all students, by interacting with students and parents, and by providing reasonable accommodations that meet the needs of all students without interfering with the learning processes of others. Alabama mathematics teachers should have a strong commitment to equity, resisting beliefs or biases that may hinder accommodations for students' differences.

Directions for Interpreting the Minimum Required Content

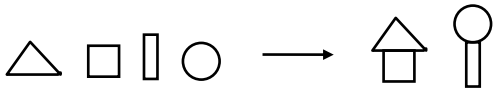
1. **CONTENT STANDARDS** are statements that define what students should know and be able to do at the conclusion of a course or grade. Content standards in this document contain minimum required content. The order in which standards are listed within a course or grade is not intended to convey a sequence for instruction. Each content standard completes the phrase "Students will…."

> *Students will:*
>
> Convert units of length, weight, or capacity within the same system (customary or metric).
>
> (Sixth Grade – Content Standard 9)

2. **BULLETS** denote content that is related to the standards and required for instruction. Bulleted content is listed under a standard and identifies additional minimum required content.

> *Students will:*
>
> Determine approximate real zeros of functions graphically and numerically and exact real zeros of polynomial functions.
> - Using the zero product property, completing the square, and the quadratic formula
> - Deriving the quadratic formula
>
> (Algebra II with Trigonometry – Content Standard 4)

3. **EXAMPLES** clarify certain components of content standards or bullets. They are illustrative but not exhaustive.

> *Students will:*
>
> Create combinations of rectangles, circles, and triangles using shapes or drawings.
>
> Example: 
>
> - Describing relative location of objects using positional terms
>
> Examples: beside, inside, outside, above, below, between, on, over, under, near, far
>
> (Kindergarten – Content Standard 6)

KINDERGARTEN – SECOND GRADE OVERVIEW

Students in Grades K-2 experience a time of profound change. This period of change demands a curriculum based upon developmentally appropriate principles. To meet this demand, the curriculum for Grades K-2 provides opportunities for students to explore important mathematical ideas in ways that allow them to develop confidence and competence in their ability to make sense of mathematics. The understanding of mathematical ideas is of primary importance, but acquisition of essential skills is also important. The curriculum for Grades K-2 represents high expectations for all students. Accommodations must be made for those students with special needs.

Students come to school with diverse mathematical backgrounds. Some have been provided numerous opportunities to make connections with real-world materials and experiences, while others lack this important foundation. Students in Grades K-2 are developing a sense of themselves, growing in motor coordination, and expanding their social skills. They are highly inquisitive and need opportunities to participate in authentic and relevant mathematical experiences using hands-on materials.

The learning environment of an early childhood classroom builds on K-2 students' natural interest in mathematical ideas and the connection of these ideas to everyday living experiences. Students are given opportunities to construct mathematical understanding while encountering ideas in context, manipulating concrete objects, using appropriate tools, and communicating about mathematical ideas. Real-life situations requiring higher-order thinking skills are emphasized. Participation in small and large groups provides opportunities for students to share and compare strategies for solutions.

Principles and Standards for School Mathematics states that "A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics, and well articulated across the grades." (NCTM, p. 14) The content of the Grades K-2 program reflects such a curriculum. Content standards are sequential, building on prior experiences and grade levels. It is not intended that the standards be taught in isolation but rather as an integrated whole. The implementation of these standards requires that students be involved in mathematics activities that encourage them to reason, communicate, and reflect; help them to make sense of their world; and prepare them for continued study. The use of this curriculum empowers students to explore ideas related to patterns, shapes, numbers, and space, thereby establishing a solid foundation for future studies.

In Grades K-2, the primary content emphasis is placed on number sense and geometry. Number sense, as included here, involves understanding the relative sizes of numbers in the base ten system of numeration and knowing how to use them in problem solving, estimation, measurement, and classification. Foundations of algebra are established through the generalization of arithmetic in which letters represent numbers or specified sets of numbers. Data analysis and probability are introduced through the collection and analysis of data. Geometry in these grades begins by having students recognize shapes according to characteristics and is extended to making and representing spatial relationships. All five content areas are interconnected in these grades in order to build a strong foundation for future success in mathematics.

K

KINDERGARTEN

During the kindergarten year, students learn to listen, share, cooperate, use materials responsibly, and follow directions in a formal school setting. Mathematics is introduced at this level through play-based opportunities that develop and deepen students' conceptual understanding. Connections are beginning to be made between the informal knowledge of mathematics and the formal system of numerical expressions. To foster these connections, the kindergarten environment should provide a variety of concrete learning experiences.

The physical arrangement of the kindergarten classroom should allow for exploration, for manipulation of objects, and for active movement. Manipulative materials enable students to count, engage in active learning, and broaden simple mathematical concepts. Students benefit from planned, thought-provoking activities that allow for active participation and provide a rich introduction to mathematical language.

In Kindergarten, mathematical concepts include recognizing patterns and shapes, demonstrating one-to-one correspondence, making comparisons, using classification skills, and ordering sets of objects. By the end of Kindergarten, students are able to recognize numbers and basic shapes, replicate simple patterns, and communicate using mathematical terms.

Number and Operations

Students will:

1. Demonstrate concepts of number sense by using one-to-one correspondence, counting in sequence by ones from 1 to 20, counting backward from 10, recognizing numerals 0-9, and comparing sets of objects up to 10 by using vocabulary terms including *more than, less than, most,* or *least*.
   Example: one-to-one correspondence—objects paired with objects, objects paired with numbers

2. Demonstrate addition by using numbers totaling 5 or less and subtraction by using numbers less than or equal to 5.
   Example: using objects, number stories, or real-life situations

3. Recognize that a whole object can be divided into parts.
   - Dividing a whole object into equal parts

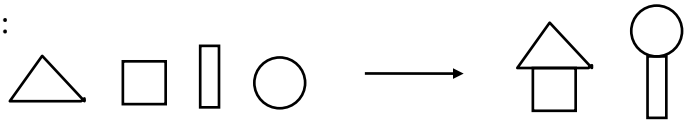
4. Identify a penny, nickel, dime, and quarter.

Algebra

5. Replicate patterns using concrete objects.
    - Sorting objects by characteristics
        Examples: color, size, shape
    - Describing characteristics of patterns and/or objects

Geometry

6. Create combinations of rectangles, squares, circles, and triangles using shapes or drawings.
    Example:



    - Describing relative location of objects using positional terms
        Examples: beside, inside, outside, above, below, between, on, over, under, near, far

7. Identify rectangles, squares, circles, and triangles.
    - Recognizing like shapes in the environment
        Examples: clock—circle, door—rectangle

Measurement

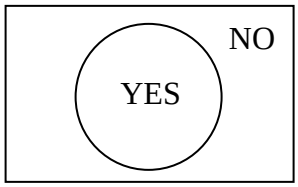
8. Use vocabulary associated with length, height, volume, and weight to compare objects.
    Examples: longer than, as long as, shorter than, as short as, taller than, as tall as, holds more, as heavy as

9. Use vocabulary associated with the measurement of time, including words related to clocks and calendars.
    Examples: before, after, first, last, hours, days, weeks, months

K

Data Analysis and Probability

10. Complete data displays such as single-loop Venn diagrams and yes/no charts using real objects, concrete representations, or pictorial representations.
    Example: recording "yes" or "no" responses to the question "Do you have a yellow pencil?" by placing students' names in the appropriate area of the Venn diagram



- Responding to questions for the purpose of data collection
  Examples: choosing favorite color, answering yes or no questions from data displays

FIRST GRADE

The focus in first grade is to provide foundational experiences and opportunities in mathematics that stimulate students to become independent thinkers and life-long problem solvers. First-grade students need a rich mathematical environment that encourages communication, introduces the use of multiple representations, and integrates mathematical concepts into everyday life. Students also need instructional time that provides reflection and justification of diverse approaches for solving mathematical problems.

Students enter first grade with a wide range of mathematical abilities and experiences. They need time to develop conceptual knowledge, to connect mathematical concepts with their own experiences, and to transfer their understanding into written expression. An effective instructional environment allows for the use of hands-on materials, in-depth reasoning, verbal communication, and visual representations. Additionally, the integration of literature, incorporation of cooperative learning strategies, and inclusion of active participation in classroom activities help students make strong connections.

By the end of first grade, students have established a foundation for future mathematical success. This foundation supports a conceptual understanding of the base ten system of numeration. It helps students to develop the ability to use the basic operations of addition and subtraction and to apply knowledge of simple data displays to organize objects and information. The establishment of a link between measurement and geometry also enables students to develop skills for describing and explaining their world mathematically.

Number and Operations

Students will:

1. Demonstrate concepts of number sense by counting forward and backward by ones, twos, fives, and tens up to 100; counting forward and backward from an initial number other than 1; and using multiple representations for a given number.
    - Identifying position using the ordinal numbers 1^{st} through 10^{th}
    - Using vocabulary, including the terms *equal, all,* and *none,* to identify sets of objects
    - Recognizing that the quantity remains the same when the spatial arrangement changes
    - Determining the value of the digit in the ones place and the value of the digit in the tens place in a numeral
    - Determining the value of a number given the number of tens and ones
      Example: one ten and four ones = 14
    - Determining the value of a number that is 10 more or 10 less than a given number
    - Determining the monetary value of individual coins and sets of like coins up to $1.00

2. Demonstrate conceptual understanding of addition and subtraction by telling number stories; joining, separating, and comparing sets of objects; and applying signs (+ and −) to the actions of joining and separating sets.
    - Solving simple word problems using a variety of strategies and distinguishing between relevant and irrelevant information
        Example: strategies—counting all, counting on, counting back
    - Solving problems requiring the addition and subtraction of one- or two-digit numerals without regrouping
    - Using three or more addends

3. Demonstrate computational fluency of basic addition and subtraction facts by identifying sums to 10 and differences with minuends of 10 or less.
    Example: giving an oral or written response to 3 + 2 = ___ or $\begin{array}{r} 3 \\ \underline{+2} \end{array}$

4. Identify parts of a whole with two, three, or four equal parts.
    - Dividing an object into equal parts

Algebra

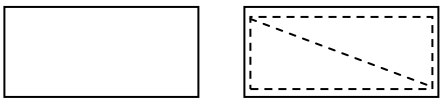
5. Create repeating patterns.
    - Describing characteristics of patterns
    - Extending patterns including number patterns
    - Identifying patterns in the environment

6. Solve problems using the identity and commutative properties of addition.

7. Demonstrate relationships between operations.
    Example: addition and subtraction fact families—
    5 + 2 = 7 7 – 2 = 5
    2 + 5 = 7 7 – 5 = 2

Geometry

8. Differentiate among plane shapes, including circles, squares, rectangles, and triangles.
    - Describing similarities and differences between plane and solid shapes
      Examples: round, flat, curved, straight
    - Transferring shape combinations from one representation (dimension) to another
      Examples: making a particular grouping of blocks by using a drawing of the grouping, making a drawing of a specific arrangement of blocks
    - Recognizing real-life examples of line symmetry
      Example: recognizing a line of symmetry in a piece of folded paper or an orange cut in half
    - Changing the position of objects or shapes by sliding (translation) and turning (rotation)
    - Combining shapes to fill in the area of a given shape
      Example: covering a rectangle with two triangles



9. Identify solid shapes in the environment, including cubes, rectangular prisms, cones, spheres, and cylinders.

Measurement

10. Compare objects according to length, weight, and capacity.
    - Measuring the length of objects using a variety of nonstandard units
      Examples: using objects of unequal length—finding number of pencils needed to measure length of desk,
      using objects of equal length—comparing number of equally-sized paper clips needed to measure length of desk
    - Ordering according to attributes

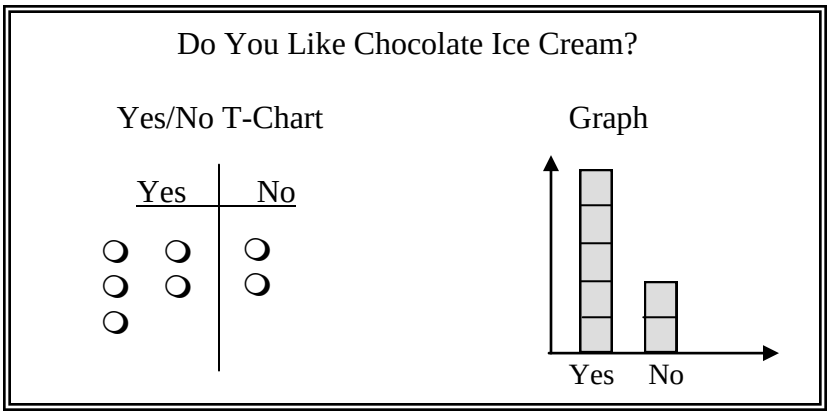
11. Identify the hour using analog and digital clocks.
    - Identifying the half hour using analog and digital clocks

12. Locate days, dates, and months on a calendar.
    Examples: locating the third Thursday of the month on a calendar; recognizing that today is Tuesday, January 24

    - Using vocabulary associated with a calendar
      Example: using the words yesterday, today, tomorrow, day before, day after

Data Analysis and Probability

13. Organize objects or information into predetermined and labeled data displays, including pictographs, tally charts, bar graphs, or double-loop Venn diagrams.
    - Generating simple questions for data collection
      Example: "Do you like chocolate ice cream?"
    - Creating displays with appropriate labels
      Example:



SECOND GRADE

Students in second grade are able to solve increasingly challenging problems, explore mathematical ideas in a variety of ways, and consider multiple solutions to problems. They begin to evaluate their own thinking as well as that of others in classroom discourse about mathematical ideas.

The second-grade learning environment should reflect the developmental changes of students while focusing on the need for fundamental mathematics, interactive exploration, reflection, and justification of findings. The learning environment should allow students to investigate practical applications as they work to solve real-life problems. Students gain confidence and flexibility in problem solving as they demonstrate understanding of mathematical concepts using extended project investigations.

The content in second grade focuses on fluency with numbers, place value, reasoning, and problem solving. Algorithms for addition and subtraction may be formally introduced. Additionally, concepts such as using standard units of measure, creating and extending patterns, describing plane and solid figures through geometry, and collecting data are included. Learning with understanding is enhanced by students' use of concrete objects and a variety of mathematical tools.

Number and Operations

Students will:

1. Demonstrate concepts of number sense by using multiple representations of whole numbers up to 1000, counting forward and backward by threes from a given number, identifying a number that is 100 more or 100 less than a given number, and differentiating between odd and even numbers.
   Examples: 251, two hundred fifty-one, 200 + 50 + 1

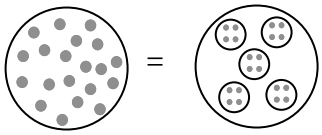
   - Identifying position using ordinal numbers to 100th
   - Determining the value of a digit in the ones, tens, hundreds, and thousands place
   - Determining the value of a number expressed in expanded notation
     Example: 700 + 70 + 3 = 773

2nd

2. Apply the operations of addition and subtraction to solve problems involving two-digit numerals, using multiple strategies with and without regrouping.
   Example: using concrete objects, mental calculations, or paper-and-pencil activities

   - Demonstrating computational fluency for basic addition and subtraction facts with sums through 18 and differences with minuends through 18, using horizontal and vertical forms
   - Interpreting multiplication as repeated addition and division as equal groupings
     Examples: 3 x 5 = 5 + 5 + 5 =  + +

     20 ÷ 4 = 5

     
   - Solving multistep addition and subtraction problems originating from real-life experiences
     Example: There were 5 students on the bus after the first stop. Three students got on at the second stop. The bus made one more stop before arriving at school. When the bus arrived at school, 18 students got off. How many students got on at the last stop?
   - Justifying the strategy used to solve addition and subtraction problems
   - Using an estimate to determine if an answer is reasonable

3. Label equal parts of a whole using $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.

4. Determine the monetary value of sets of coins and bills up to $2.00.
   - Exchanging coins of equivalent value
   - Applying monetary symbols, including dollar ($), cent (¢), and decimal point (.)
   - Recognizing the decimal numbers .10, .25, .50, and .75 as related to money

Algebra

5. Create growing patterns.
   Examples: □, □□, □□□; a b, a a b, a a a b

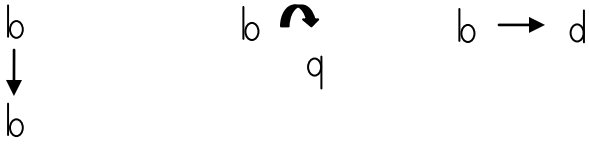
6. Solve problems using the associative property of addition.

7. Describe change over time in observable (qualitative) and measurable (quantitative) terms.
   Examples: recognizing that a plant grew taller (qualitative, requiring observation); recognizing that a plant grew three inches (quantitative, requiring measurement)

8. Describe attributes of two-dimensional (plane) and three-dimensional (solid) figures using the terms *side*, *surface*, *edge*, *vertex*, and *angle*.
    - Identifying quadrilaterals, pentagons, hexagons, or octagons
    - Identifying line symmetry in plane geometric figures
    - Creating designs that exhibit line symmetry
    - Recognizing the results of changing the position (transformation) of objects or shapes by sliding (translation), turning (rotation), or flipping (reflection)

      Examples:

      sliding (vertically) turning flipping (horizontally)



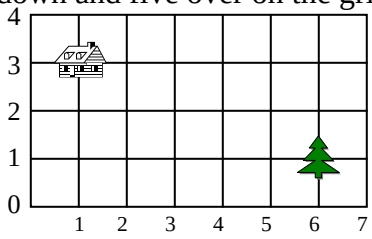
9. Describe the route from one location to another by applying concepts of direction and distance.

   Examples: direction—left, right, north, south, east, west;
   distance (nonstandard)—twenty-five steps from the library;
   distance (standard)—ten feet from the walkway

    - Following multistep directions to locate objects
    - Reading maps of the school environment

      Example: using a school map to tell how to get from the classroom to the office
    - Using grids for movement between points

      Example: moving from the house ( ) to the tree ( ) by moving two down and five over on the grid



2nd

Measurement

10. Measure length in customary units, including inches, feet, and yards.
    - Using metric units
    - Using appropriate tools, including rulers, yard sticks, meter sticks, or tape measures

11. Estimate weight and capacity by making comparisons with familiar objects.
    Examples: a desk weighing more than a pencil, a cup holding less than a bucket

12. Tell time to the minute using analog and digital clocks.

Data Analysis and Probability

13. Create displays, including appropriate labels, for a given set of data using pictographs, tally charts, bar graphs, or single- or double-loop Venn diagrams.
    - Interpreting graphic displays

14. Determine if one event related to everyday life is more likely or less likely to occur than another event.
    Example: determining if it is more likely to rain or snow on July 4th in Alabama

THIRD - FIFTH GRADE
OVERVIEW

The mathematics program in Grades 3-5 focuses on building on students' prior knowledge to allow them to progress from the foundation gained in early mathematics experiences to actively constructing new knowledge. In these grades, students develop mathematical skills and insights and use them in solving meaningful problems.

Students in Grades 3-5 are primarily concrete learners; however, they are developing skills to make the transition into abstract thinking through pictorial models and symbols. By nature they are inquisitive, respond well to genuine praise, and experience increased social and emotional development. They begin to make many of their own decisions and may progress from teacher dependency into a self-guided stage as they learn to evaluate their own thinking and the thinking of others. As students become empowered with the ability to interpret their world, they show enthusiasm and interest in mathematics.

The environment for students in Grades 3-5 encourages them to become independent thinkers as they relate mathematics to the real world. This environment is active, problem-rich, and stimulating. Students work together to build a community of mathematical learners as their ideas become a source of learning. A well-balanced mathematics curriculum provides materials for learning, technology for teaching, and opportunities for students to engage in cooperative learning. This environment includes on-going assessments with a focus on student understanding and procedural skills. Teaching practices reflect a commitment to both equity and excellence.

Students in Grades 3-5 encounter a range of representations and problem-solving situations that empower them to move from the concrete to the abstract. The curriculum emphasizes computational fluency in basic operations, problem solving, reasoning, and number sense. It also promotes student acquisition of the skills and strategies necessary to comprehend new and challenging mathematical concepts.

THIRD GRADE

Students in third grade are active and inquisitive. They are primarily concrete learners, acquiring knowledge through hands-on experiences. Instructional tasks that relate to their personal lives stimulate their interest.

Third-grade students need a classroom environment that helps them learn to work together as a community of learners. This environment provides an atmosphere in which students are recognized as individuals whose ideas are valued, and one in which opportunities are provided for all individuals in the classroom to work together as members of a team. In such an environment, students feel less threatened about making mistakes and have a more positive attitude toward receiving ideas for improvement.

Third-grade students enjoy intellectually stimulating activities that promote enthusiasm and capture their interest. Such activities better enable students to make sense of mathematics. Students compare and order whole numbers, identify two-dimensional figures based on attributes, expand their knowledge of measurement and data analysis, and strengthen computational fluency by applying problem-solving strategies. The third-grade content enables students to use mathematics in other disciplines and to connect mathematics to the real world.

Number and Operations

Students will:

1. Demonstrate number sense by comparing, ordering, and expanding whole numbers through 9999.
    - Comparing numbers using the symbols >, <, =, and ≠
    - Identifying the place value of any digit within a four-digit number
    - Writing a four-digit number in words and locating it on a number line
    - Determining the value of a number written in expanded notation to the ten-thousands place
      Example: 3,000 + 400 + 20 + 1 = 3,421
    - Rounding whole numbers to the nearest ten and hundred and money values to the nearest dollar

2. Solve addition and subtraction problems, including word problems, involving two- and three-digit numbers with and without regrouping.
    - Estimating sums and differences by using compatible numbers, front-end estimation, and rounding

      Examples: compatible numbers— 24 + 26 = 25 + 25

      front-end estimation— 72 is approximately 70
      -36 -30

      rounding— 172 is approximately 200
      +369 +400

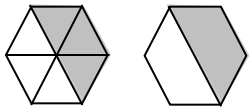
    - Demonstrating computational fluency in addition and subtraction

3. Multiply whole numbers with and without regrouping using single-digit multipliers.
    - Applying concepts of multiplication through the use of manipulatives, number stories, arrays, repeated addition, or problem situations
    - Applying basic multiplication facts through 9 x 9 by using manipulatives, solving problems, and writing number stories
    - Recognizing properties of multiplication

4. Divide whole numbers using two-digit dividends and one-digit divisors.
    - Recognizing division as repeated subtraction

5. Model equivalent fractions with concrete objects or pictorial representations.

   Example: pattern blocks—



6. Use coins to make change up to $1.00.
    - Determining monetary values of sets of unlike coins and bills up to $5.00

Algebra

7. Complete a given numeric or geometric pattern.

   Examples: geometric pattern—△ □ △ △ □ △ △ ___ □;
   numeric pattern—20, 27, 34, 41, ____

3rd

Geometry

8. Identify geometric representations for points, lines, perpendicular lines, parallel lines, angles, and rays.
    - Recognizing real-life examples of points, lines, perpendicular lines, and parallel lines
    - Drawing points, lines, and perpendicular lines

9. Specify locations on a coordinate grid by using horizontal and vertical movements.

Measurement

10. Measure length in metric units.

11. Determine elapsed time to the day with calendars and to the hour with a clock.
    - Calculating elapsed time to the minute within the same hour
    - Applying vocabulary associated with time using *a.m.*, *p.m.*, *noon,* or *midnight*

Data Analysis and Probability

12. Recognize data as either categorical or numerical.
    Examples: categorical—gender, race, languages spoken, genre;
    numerical—age, height, weight

    - Comparing related data sets

13. Determine the likelihood of different outcomes in a simple experiment.
    Example: determining that the spinner is least likely to land on red in this diagram

FOURTH GRADE

Students in fourth grade are intrigued with mathematics. To nurture this interest, students at this grade level need to be involved in an active learning process rather than one that only builds on memorization of concepts and procedures. Concrete experiences are also important at this stage of development. Such experiences allow students to develop and strengthen the skills needed to communicate, reason, solve mathematical problems, and reach higher levels of cognitive reasoning.

An effective classroom environment provides intellectually stimulating instruction and developmentally appropriate opportunities for students to learn mathematical concepts. This classroom environment fosters an atmosphere in which students are encouraged to find solutions through a variety of methods and feel less threatened about making and correcting mistakes. Instruction includes opportunities for students to communicate their mathematical thinking by talking, writing, and sharing with each other.

Fourth-grade content builds a foundation of basic number sense, operations, quantitative reasoning, patterns, relationships, geometric and spatial reasoning, measurement, and probability and statistics. The content builds on and expands students' conceptual understanding of mathematics. Through the interweaving of mathematical concepts and processes, students learn to value mathematics, display confidence in their mathematical ability, solve problems, and make connections between mathematics and other subjects.

Number and Operations

Students will:

1. Demonstrate number sense by comparing and ordering decimals to hundredths and whole numbers to 999,999.
    - Identifying a number when given a pictorial representation of tenths and hundredths or groups of ones, tens, hundreds, and thousands
    - Writing a number in expanded notation through the hundred-thousands
      Example: 914,682 = 900,000 + 10,000 + 4,000 + 600 + 80 + 2
    - Determining the place value of a digit in a whole number through the hundred-thousands and in a decimal to the hundredths

2. Write money amounts in words and dollar-and-cent notation.
    - Identifying equivalent units of money

3. Rename improper fractions as mixed numbers and mixed numbers as improper fractions.
    - Using a number line to simplify, compare, and order fractions and mixed numbers
    - Writing equivalent forms of fractions

4. Demonstrate addition and subtraction of fractions with common denominators.

5. Round whole numbers to the nearest ten, hundred, or thousand and decimals to the nearest tenth.

6. Solve problems, including word problems, that involve addition and subtraction of four-digit numbers with and without regrouping.
    - Estimating sums and differences of whole numbers by using appropriate strategies such as rounding, front-end estimation, and compatible numbers
    - Adding and subtracting decimals and money amounts

7. Solve problems, including word problems, involving the basic operations of multiplication and division on whole numbers through two-digit multipliers and one-digit divisors.
    - Estimating products and quotients of whole numbers by using appropriate strategies such as rounding, front-end estimation, and compatible numbers
    - Identifying information needed to determine the appropriate operation to solve a problem
    - Demonstrating computational fluency in multiplication and division fact families through 12

8. Recognize equivalent forms of commonly used fractions and decimals.

    Examples: $\frac{1}{4}$ = .25, $\frac{1}{4}$ of a dollar = $.25 (25 cents)

Algebra

9. Write number sentences for word problems that involve multiplication or division.

10. Complete addition and subtraction number sentences with a missing addend or subtrahend.

Geometry

11. Identify triangles, quadrilaterals, pentagons, hexagons, or octagons based on the number of sides, angles, and vertices.
    - Demonstrating slides (translations), flips (reflections), and turns (rotations) using triangles, quadrilaterals, pentagons, hexagons, or octagons
    - Drawing lines of symmetry in triangles, quadrilaterals, pentagons, hexagons, or octagons

12. Find locations on a map or grid using ordered pairs.

Measurement

13. Calculate elapsed time in hours and minutes.

14. Measure length, width, weight, and capacity, using metric and customary units, and temperature in degrees Fahrenheit and degrees Celsius.
    - Estimating perimeter and area of irregular shapes using unit squares and grid paper
    - Estimating area using unit squares

Data Analysis and Probability

15. Represent categorical data using tables and graphs, including bar graphs, line graphs, and line plots.
    - Collecting data using observations, surveys, or experiments
    - Creating tally charts to represent data collected from real-life situations

16. Determine if outcomes of simple events are likely, unlikely, certain, equally likely, or impossible.

17. Represent numerical data using tables and graphs, including bar graphs and line graphs.

FIFTH GRADE

Students in fifth grade experience increased social and emotional development. They become more aware of their independence, opinions, and level of thinking as compared to others. Students enjoy and benefit from content presented in a way that allows for in-depth understanding, heightens interest and enthusiasm, and provides relevance to real-world situations.

In fifth grade, students need a positive learning environment that encourages and challenges student effort and progress toward learning mathematics. This environment is supported through the use of active learning experiences and content-related questions that foster mathematical communication.

The mathematics curriculum in fifth grade emphasizes fluency in computing and problem solving with whole numbers, decimals, and fractions. Students apply basic operations to problem-solving situations with a greater understanding of the meanings of operations and how they relate to one another. By actively acquiring new knowledge of symbolic representation, fifth-grade students move toward an abstract level of thinking.

Number and Operations

Students will:

1. Demonstrate number sense by comparing, ordering, rounding, and expanding whole numbers through millions and decimals to thousandths.
    - Relating percents to parts out of 100 by using equivalent fractions and decimals
    - Determining the value of a digit to thousandths

2. Solve problems involving basic operations on whole numbers, including addition and subtraction of seven-digit numbers, multiplication with two-digit multipliers, and division with two-digit divisors.
    - Estimating products and quotients
    - Determining divisibility by 2, 3, 4, 5, 6, 9, and 10
    - Demonstrating computational fluency with addition, subtraction, multiplication, and division of whole numbers

3. Solve word problems that involve decimals, fractions, or money.
    - Solving word problems involving elapsed time

4. Determine the sum and difference of fractions with common and uncommon denominators.
    - Changing mixed numbers to improper fractions
    - Solving problems involving addition and subtraction of fractions with common and uncommon denominators
    - Using least common multiples
    - Estimating sums and differences of fractions

5. Identify numbers less than zero by extending the number line.
   Example: identifying negative temperatures (below 0^{o}) on a thermometer

Algebra

6. Demonstrate the commutative, associative, and identity properties of addition and multiplication of whole numbers.

7. Write a number sentence for a problem expressed in words.

Geometry

8. Identify regular polygons and congruent polygons.
   - Identifying angles as right, obtuse, acute, or straight
   - Classifying triangles as equilateral, isosceles, or scalene
   - Identifying figures that have rotational symmetry
   - Predicting the results of a flip (reflection), turn (rotation), or slide (translation)

9. Identify components of the Cartesian plane, including the x-axis, y-axis, origin, and quadrants.

10. Identify the center, radius, and diameter of a circle.

Measurement

11. Estimate perimeter and area of irregular shapes using unit squares and grid paper.

12. Calculate the perimeter of rectangles from measured dimensions.

13. Convert a larger unit of measurement to a smaller unit of measurement within the same system (customary or metric).
    Examples: 4 cups = 32 fluid ounces, 2 meters = 200 centimeters,
    2 miles = 10,560 feet

Data Analysis and Probability

14. Analyze data collected from a survey or experiment to distinguish between what the data show and what might account for the results.
    - Evaluating different representations of the same data to determine how well each representation shows important aspects of the data
    - Using given measures of central tendency (mean, median, and mode) to analyze data

15. Use common fractions to represent the probability of events that are neither certain nor impossible.
    Example: finding the probability of stopping on a vowel when using a spinner with three vowels and five consonants

SIXTH – EIGHTH GRADE
OVERVIEW

Students in Grades 6-8 mature and progress at varied rates and are sensitive to peer perceptions; therefore, a supportive classroom environment where students feel comfortable sharing ideas is a priority. Classroom learning experiences are enhanced through interactions in which students learn to develop reasoning skills and evaluate their own thinking and the thinking of others.

The main focus of the mathematics program in the middle grades is to provide a coherent, integrated curriculum that enables all students in Grades 6-8 to recognize and apply mathematics in contexts outside the classroom. Middle school students acquire a solid foundation for high school mathematics by making a transition from concrete topics to abstract concepts. Through the use of manipulatives, social interaction, mathematical discourse, and a variety of technological tools, students engage in mathematical investigations, propose ideas and conjectures, and make generalizations. A challenging curriculum and a supportive environment encourage middle school students to be actively involved in their own mathematical learning. The mathematics program in Grades 6-8 plays a key role in preparing students for high school mathematics and further study. This curriculum integrates algebraic and geometric concepts into other mathematical topics. By enabling students to make connections between these topics, algebraic and geometric thinking skills are developed. Instruction focuses on rational numbers and algebraic, geometric, and proportional reasoning concepts in order to provide students with the necessary prerequisite skills for success in high school mathematics courses.

Embedded in the content standards of Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability are the important process standards of Problem Solving, Reasoning and Proof, Communication, Connections, and Representation. These process standards are integrated throughout the middle grades curriculum to deepen students' understanding of mathematical concepts. Students become good problem solvers with a mathematical foundation that allows them to choose problem-solving techniques appropriate for a situation, communicate the reasoning for these choices, and identify the methods used to determine the results. The teacher plays a key role in helping students develop the skills needed for reasoning and proof. Students are better able to make conjectures and arguments when they are encouraged to verbalize, illustrate, or record their mathematical thought processes. By listening to or reading the mathematical thinking processes of their classmates, students are encouraged to communicate and to learn from each other.

Mathematical discussion becomes more complex in the middle grades. Students are expected to use mathematical vocabulary as they explain their reasoning. Students who are taught the connectedness of mathematical concepts will learn to use these concepts to build upon their own mathematical knowledge, rather than attempt to memorize many isolated facts/formulas, an exhaustive and perhaps impossible task in the middle grades. Representing mathematical concepts in various ways allows students to use modeling to solve complex problems. When students realize that algebra makes the problem-solving process much more efficient, they see the interconnectedness of mathematics with the real world. Through this curriculum, middle-grades students form positive attitudes about mathematics that contribute to decisions to pursue further study of mathematics and ultimately enhance their life opportunities.

The content of the mathematics program for Grade 7, Grade 8, and Algebra I is significantly different from one grade or course to another. School systems may offer Algebra I in Grade 8. However, eighth-grade students taking Algebra I need an in-depth knowledge of the mathematical concepts taught in Grades 7 and 8. Careful consideration should be given before placing Grade 8 students in Algebra I rather than requiring them to complete the Grade 8 mathematics course.

SIXTH GRADE

Students in sixth grade are changing physically, socially, and cognitively. The sixth-grade classroom environment addresses these changes by providing balance between elementary- and middle-level practices. While these changes are leading to emotional and academic independence, students in this grade continue to need guidance. Sixth-grade students also need an environment that challenges them and provides support as they become more responsible individuals.

The sixth-grade curriculum is designed to maximize student learning through the use of manipulatives, social interaction, and technology. The curriculum assists students as they begin the transition of mathematical thought processes from the concrete to the abstract. Opportunities are provided for students to gain a thorough understanding of decimals and fractions while integrating these number sense concepts into the other mathematical strands.

Number and Operations

Students will:

1. Demonstrate computational fluency with addition, subtraction, multiplication, and division of decimals and fractions.
    - Comparing rational numbers written as fractions, decimals, mixed numbers, and percents
    - Converting fractions and mixed numbers to decimals and percents
    - Converting terminating decimals and percents to fractions and mixed numbers
    - Writing decimal numbers in expanded notation

      Example: $52.37 = 50 + 2 + \frac{3}{10} + \frac{7}{100}$
    - Using prime factorizations
    - Identifying prime and composite numbers
    - Using greatest common factor (GCF) to simplify fractions
    - Formulating algorithms using basic operations on fractions and decimals

      Example: determining a systematic set of steps that can be used to divide fractions
    - Applying the distributive property to compute with fractions and decimals

      Example: $4 \times (8\frac{1}{2}) = (4 \times 8) + (4 \times \frac{1}{2}) = 32 + 2 = 34$
    - Using least common multiple (LCM) to add and subtract fractions with unlike denominators

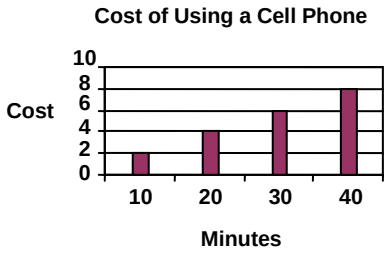
6th

2. Solve problems involving decimals, percents, fractions, and proportions.
   Example: determining the sale price of a pair of jeans that regularly sells for $25 to be $22.50 if they are on sale at 10 percent off the regular price

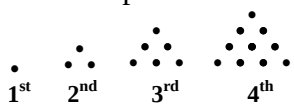
   - Estimating with fractions and decimals

Algebra

3. Solve problems using numeric and geometric patterns.
   Examples: (a) predicting the cost of using a cell phone for 60 minutes when given a bar graph



   (b) continuing a pattern for the 5th and 6th numbers when given the first four numbers in the pattern



   - Determining a verbal rule for a function given the input and output
     Example:

Number of Hours Worked	1	2	3	4	5
Number of Dollars Earned	5	10	15	20	25

   (Rule: number of dollars earned is five times number of hours worked)

Geometry

4. Identify two-dimensional and three-dimensional figures based on attributes, properties, and component parts.
   - Classifying quadrilaterals based on their attributes
   - Identifying line and rotational symmetries of polygons
   - Classifying triangles as right, obtuse, or acute

5. Plot coordinates on grids, graphs, and maps.
    - Identifying the coordinates of a point on the Cartesian plane
    - Comparing parallel and perpendicular lines

Measurement

6. Classify angles as acute, obtuse, right, or straight.
    - Estimating angle measures using 45 degrees, 90 degrees, 180 degrees, 270 degrees, or 360 degrees as referents
    - Measuring angles

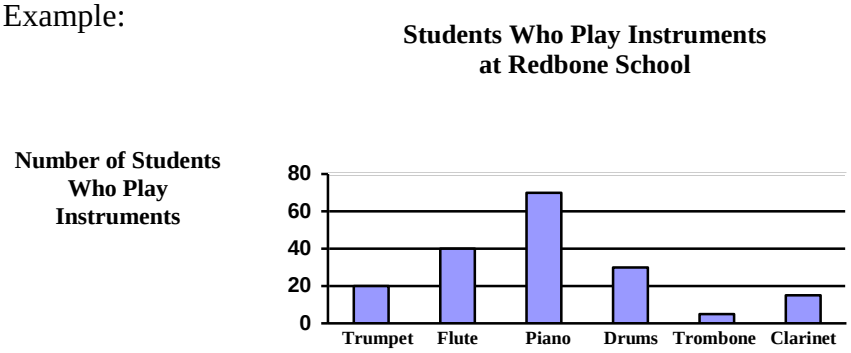
7. Solve problems involving perimeter and area of parallelograms and rectangles.
    - Estimating perimeter and area
    - Developing formulas to determine perimeter and area of parallelograms and rectangles

8. Determine the distance between two points on a scale drawing or a map using proportional reasoning.
    - Using different forms of notation to symbolize ratios and rates

9. Convert units of length, weight, or capacity within the same system (customary or metric).

Data Analysis and Probability

10. Interpret information from bar graphs, line graphs, and circle graphs.
    Example:



Possible conclusions—Twice as many students play flute as trumpet. Redbone needs more trombone players.

11. Find the probability of a simple event.
    - Expressing probabilities as ratios, percents, and decimals

SEVENTH GRADE

Students in seventh grade display a wide range of differences in intellectual development and emotional maturity. As students mature, they experiment with new mathematical approaches and concepts. The seventh-grade mathematics classroom environment encourages communication, exploration, and risk taking that are critical as students become more confident and learn to exist in an ever-changing world.

The seventh-grade curriculum addresses a number of important mathematical concepts. One of the key topics is rational number operations. Seventh-grade students become fluent in rational number operations and establish skills needed to become successful problem solvers. Solving equations is another major focus of the curriculum as students prepare for further study of algebra. Students continue to engage in thoughtful activities, using hands-on materials and technology to explore important mathematical concepts included in the seventh-grade curriculum.

Number and Operations

Students will:

1. Demonstrate computational fluency with addition, subtraction, and multiplication of integers.
    - Developing algorithms for performing operations on integers
        Example: determining a systematic set of steps that can be used to subtract integers
    - Using inverse properties of addition and of multiplication

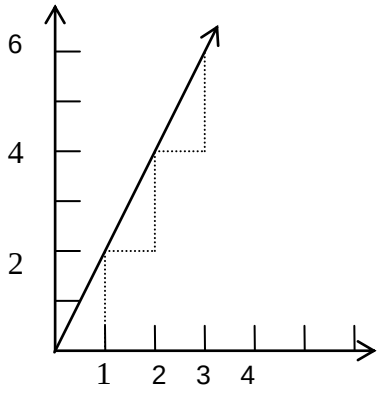
2. Use order of operations to evaluate numerical expressions.
    - Computing absolute values
    - Finding square roots of perfect squares through 225
    - Evaluating powers
    - Applying properties of operations to compute with integers, fractions, and decimals

3. Solve problems requiring the use of operations on rational numbers.
    - Describing the method used
    - Determining the reasonableness of results
    - Using percents to solve problems, including problems involving discounts, taxes, commissions, and simple interest

4. Express a pattern shown in a table, graph, or chart as an algebraic equation.
    - Recognizing the relationships between numerical patterns in tables and their respective graphs in the coordinate plane

      Example: recognizing the pattern illustrated in both the table and graph as $y = 2x$

x	y
1	2
2	4
3	6
4	8



    - Determining if a constant rate of change exists in a pattern

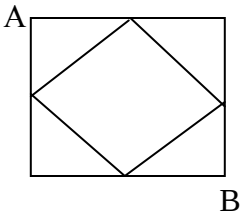
5. Translate verbal phrases into algebraic expressions and algebraic expressions into verbal phrases.
    - Exhibiting understanding of a variable as an unknown quantity

6. Solve one- and two-step equations.
    - Solving inequalities in one variable
    - Graphing solution sets of inequalities on a number line
    - Recognizing properties of equality

Geometry

7. Determine the transformation(s), including translations, reflections, or rotations, used to alter the position of a polygon on the coordinate plane.
    - Determining the type of symmetry (rotational or line) found in a reflection or rotation
    - Graphing transformations of quadrilaterals on the Cartesian plane by plotting the vertices
    - Graphing figures which are similar to other figures using dilations

8. Recognize geometric relationships among two-dimensional and three-dimensional objects.
    - Drawing geometric figures when given specified components, including base and height
    - Investigating properties and relationships among congruent figures
    - Identifying geometric ideas in settings outside the mathematics classroom
        Examples: recognizing Escher drawings as examples of tessellations, the geodesic dome as an example of triangulation, and architecture as an example of constructing three-dimensional shapes; identifying landscape design as an example of area
    - Using networks to represent and solve problems
        Example: Find the number of paths from point A to point B.



Measurement

9. Solve problems involving circumference and area of circles.
    - Estimating circumference, diameter, and area
    - Determining appropriate units of measure to describe circumference, diameter, and area
    - Measuring circumference and diameter using customary and metric units
    - Using circumference and diameter to approximate the value of π
    - Identifying π as an irrational number
    - Developing formulas for determining circumference and area

10. Find the perimeter of polygons and the area of triangles and trapezoids.
    - Developing formulas for determining perimeter and area of triangles and trapezoids

11. Solve problems involving ratios or rates, using proportional reasoning.
    - Determining the unit rate
    - Converting rates from one unit to another
        Example: determining the number of minutes in three days
    - Converting units of length, weight, or capacity from metric to customary and from customary to metric

12. Determine measures of central tendency (mean, median, and mode) and the range using a given set of data or graphs, including histograms, frequency tables, and stem-and-leaf plots.
    - Creating histograms

13. Determine the probability of a compound event.
    Example: finding the probability of selecting at random a hamburger and lemonade when choosing a sandwich and drink from two sandwich choices and three drink choices

    - Representing outcomes as a list, chart, picture, or tree diagram
    - Determining the number of possible outcomes by using the fundamental counting principle or other techniques
    - Modeling the probability of events through simulations with random numbers
      Example: determining the probability of a baby being a boy by generating random numbers, using a number cube with odd numbers representing a boy, to simulate the outcomes

EIGHTH GRADE
(Pre-Algebra)

Students in Grade 8 are independent thinkers. They can apply prior knowledge to new situations but may need to be guided through the learning process by continuing the use of hands-on materials, mathematical discourse, and technology. These students have the ability to take ownership of their own mathematical learning and need opportunities to explore and investigate mathematical concepts. Students in Grade 8 also need to be provided with instruction that includes a balance between skill development and mathematical understanding.

The major focus of the eighth-grade curriculum is the integration of new and prior knowledge to solve problems dealing with all mathematical strands, with particular emphasis on algebra, geometry, and proportional reasoning. This curriculum offers a more in-depth study of algebraic concepts than in years past. Therefore, this course is subtitled Pre-Algebra. Students who successfully complete the eighth grade have a thorough knowledge of the skills and concepts necessary for the study of Algebra I. High school credit may not be awarded for this course.

Number and Operations

Students will:

1. Use various strategies and operations to solve problems involving real numbers.
    - Using alternative representations of rational numbers
      Examples: models, drawings, grids, graphs
    - Applying GCF, LCM, and prime and composite numbers, including justification for the reasonableness of results, when working with rational numbers
      Example: A new music store is having a grand opening. Every 20^{th} customer gets a free compact disk (CD). Every 35^{th} customer gets a free tote bag. The first customer to receive both gifts will be the 140^{th} customer, because 140 is the LCM of 20 and 35. The answer (140^{th}) is reasonable because it is larger than both 20 and 35. To say that the 5^{th} customer, which is the GCF of 20 and 35, receives the gift is not reasonable because it is smaller than 20 and 35.
    - Applying proportional reasoning
      Example: The amount of rainfall recorded for a certain town in a 24-hour period is 16 inches. Since the rain fell 2 inches every 3 hours, 24 inches of rain will fall in $1\frac{1}{2}$ days if the rain continues at the same rate.
    - Using vocabulary associated with sets, including *union* and *intersection*
    - Determining whether a number is rational or irrational
    - Demonstrating computational fluency with operations on rational numbers

2. Simplify expressions containing natural number exponents by applying one or more of the laws of exponents.
    - Writing numbers using scientific notation

3. Use order of operations to evaluate and simplify algebraic expressions.
    - Applying the substitution principle
    - Applying the properties of operations on rational numbers to evaluate and simplify algebraic expressions

Algebra

4. Graph linear relations by plotting points or by using the slope and y-intercept.
    - Determining slopes and y-intercepts of lines
    - Calculating the slope of a linear relation given as a table or graph
    - Exhibiting conceptual understanding of various uses of variables

5. Solve problems involving linear functions.
    - Identifying functions from information in tables, sets of ordered pairs, equations, graphs, and mappings
    - Determining the rule that defines a function

Example:

Cars Washed Input (x)	Money Made Output (y)
1	$4.50
2	$9.00
3	$13.50
4	$18.00

(Rule: $y = 4.5x$)

    - Classifying variables in a function as independent or dependent
    - Classifying relations as linear or nonlinear by examining tables, graphs, or simple equations

6. Solve multistep linear equations, including equations requiring the use of the distributive property.

    Example: solving $-3(x - 5) - 6x = 2 + 4x$

8th

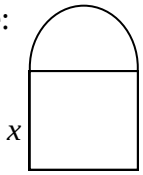
Geometry

7. Solve problems using the Pythagorean Theorem.
    - Applying the Triangle Inequality Theorem
      Example: determining if a triangle can be formed with sides of 1 inch, 2 inches, and 5 inches
    - Verifying the Pythagorean Theorem
    - Applying the Pythagorean Theorem to determine if a triangle is a right triangle
    - Applying the Pythagorean Theorem to find the missing length of a side of a right triangle
    - Calculating distances on the coordinate plane using the Pythagorean Theorem

8. Compare quadrilaterals, triangles, and solids, using their properties and characteristics.
    - Developing mathematical arguments about the relationships among types of quadrilaterals and triangles
    - Identifying angle bisectors, perpendicular bisectors, congruent angles, and congruent figures
    - Constructing congruent and similar polygons, congruent angles, congruent segments, and parallel and perpendicular lines

Measurement

9. Determine the measures of special angle pairs, including adjacent, vertical, supplementary, and complementary angles, and angles formed by parallel lines cut by a transversal.

10. Find the perimeter and area of regular and irregular plane figures.
    Example:
    

    If x represents the length of a side of the square, write expressions that represent the perimeter and area of the figure at the left.

11. Determine the surface area and volume of rectangular prisms, cylinders, and pyramids.
    - Estimating surface area and volume of solid figures
    - Determining the appropriate units of measure to describe surface area and volume
    - Developing formulas for determining surface area and volume of rectangular prisms, cylinders, and pyramids

12. Determine the lengths of missing sides and measures of angles in similar and congruent figures.
    - Applying proportional reasoning
    - Using dilations on the coordinate plane to determine measures of similar figures
    - Finding the ratios of the perimeters and areas of similar triangles, trapezoids, and parallelograms

13. Interpret data from populations, using given and collected data.
    - Representing the data with the most appropriate graph, including box-and-whisker plot, circle graph, and scatterplot
    - Making predictions by estimating the line of best fit from a scatterplot
    - Comparing data sets involving two populations
    - Determining the measure of center that is the most appropriate for a given situation

14. Determine the theoretical probability of an event.
    - Calculating the probability of complementary events and mutually exclusive events
    - Comparing experimental and theoretical probability
    - Computing the probability of two independent events and two dependent events
    - Determining the probability of an event through simulation
      Example: using random numbers to find the probability of a basketball player making six baskets in six attempts if he makes 60 percent of his shots from the court and shoots 20 times during a game

NINTH – TWELFTH GRADE OVERVIEW

As the range of career choices for students broadens, the mathematics program in Grades 9-12 must be both rigorous and comprehensive to provide students with the mathematical power necessary to meet the needs of these careers. Whether planning to pursue postsecondary education or to enter the workforce, all Alabama students must earn four credits in mathematics, including Algebra I and Geometry. Students are encouraged to go beyond basic requirements, enrolling in courses above the level of Geometry with the goal of reaching their maximum potential.

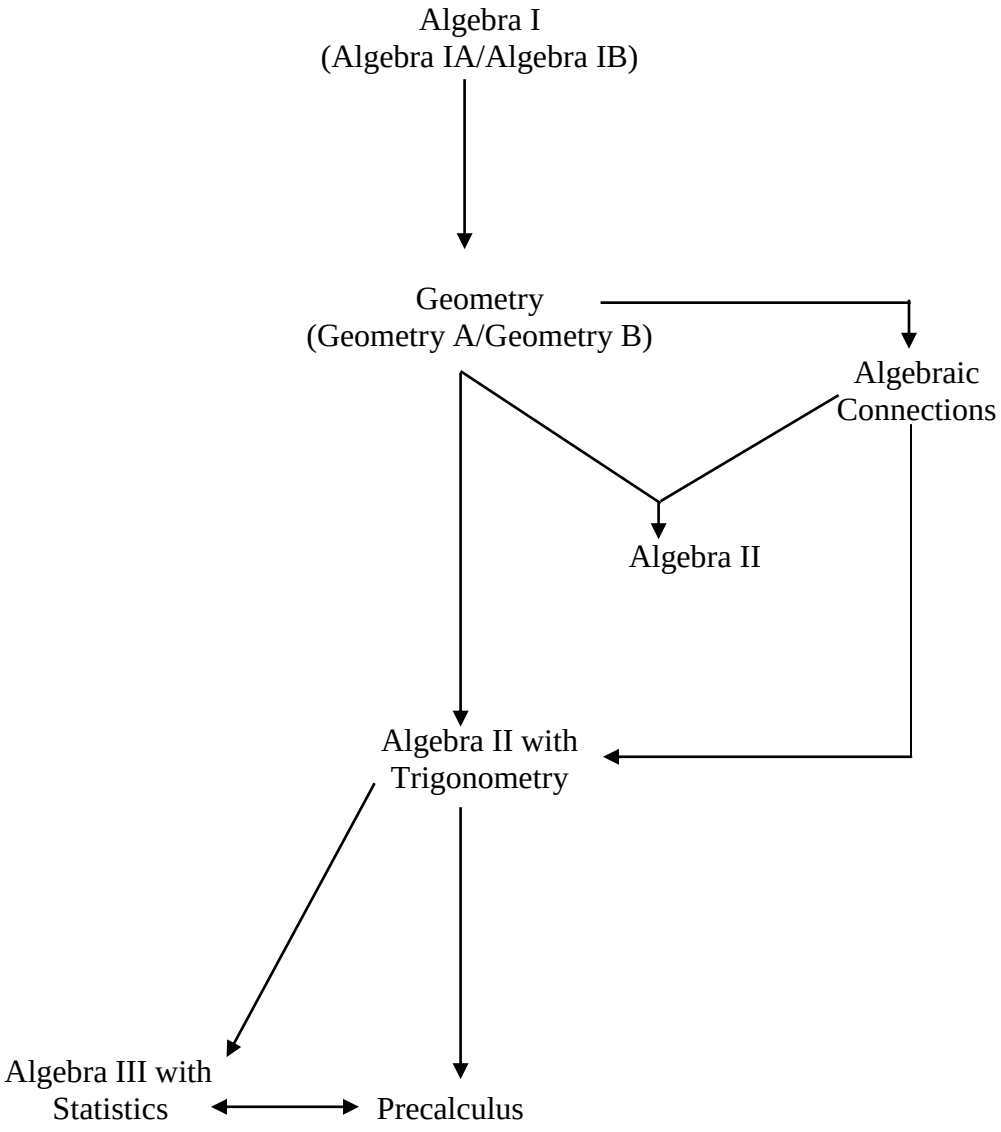
To accommodate the needs of all students, the content following Geometry has been structured into the following courses: Algebraic Connections, Algebra II, Algebra II with Trigonometry, Algebra III with Statistics, and Precalculus. School systems are encouraged to expand upon the required content presented in this document and to provide advanced mathematics courses such as Advanced Placement Calculus or Advanced Placement Statistics for students desiring to continue their study of mathematics after Precalculus. In addition, systems may organize their programs in other ways, including courses such as Technical Algebra I or Technical Geometry, as long as the courses meet the minimum content requirements established by the course of study for Algebra I or Geometry.

Throughout their high school experience, students observe the interaction of algebra, geometry, statistics, probability, and discrete mathematics. Moreover, in recognizing the importance of process skills in the development of mathematical ability, students need ongoing opportunities for problem solving. To meet this need, each Grades 9-12 course offering included in this course of study emphasizes the use of varied problem-solving techniques. When engaged in the problem-solving process, students should be encouraged to express their thinking in both oral presentations and in written form.

Teachers in Grades 9-12 are encouraged to incorporate the use of technology into instruction. Due to the fact that technology has changed many aspects of "doing" mathematics, mathematics education must reflect this reality. Technology should be used to enhance classroom instruction, not merely to replace manual computation. Teachers are also encouraged to move beyond the use of paper-and-pencil activities to incorporate multiple types of assessments, including the use of appropriate technology and other alternative approaches.

Together, teachers and high school students form a team, working to provide every student with the foundation required to make important connections between theory and reality. In this way, mathematics extends beyond mathematical facts and computational skills, becoming a powerful tool for solving real-life problems.

Course Progression in Grades 9-12



Possible Course Sequences

There are several pathways by which a student can earn four credits in mathematics for graduation. Local school systems may determine which pathways lead to specific diploma completion, provided the minimal Alabama State Board of Education requirements are followed. Some pathways for Grades 9-12 are indicated below.

Algebra I A
Algebra I B
Geometry A
Geometry B

Algebra I A
Algebra I B
Geometry
Algebra II

Algebra I A
Algebra I B
Geometry
Algebraic Connections

Algebra I A
Algebra I B
Geometry
Algebra II with Trigonometry

Algebra I
Geometry
Algebra II with Trigonometry
Algebra III with Statistics

Algebra I
Geometry
Algebra II with Trigonometry
Precalculus

Algebra I
Geometry A
Geometry B
Algebra II

Algebra I
Geometry A
Geometry B
Algebraic Connections

Algebra I
Geometry A
Geometry B
Algebra II with Trigonometry

Algebra I
Geometry
Algebraic Connections
Algebra II

Algebra I
Geometry
Algebraic Connections
Algebra II with Trigonometry

Some pathways for students who complete Algebra I in the eighth grade are indicated below.

Geometry
Algebra II with Trigonometry
Algebra III with Statistics
Precalculus

Geometry
Algebra II with Trigonometry
Precalculus
Algebra III with Statistics

Geometry
Algebra II with Trigonometry
Precalculus
Advanced Placement (AP) Mathematics Course

Geometry A
Geometry B
Algebra II with Trigonometry
Algebra III with Statistics

Geometry A
Geometry B
Algebra II with Trigonometry
Precalculus

Geometry A
Geometry B
Algebraic Connections
Algebra II

Geometry A
Geometry B
Algebraic Connections
Algebra II with Trigonometry

Geometry
Algebraic Connections
Algebra II with Trigonometry
Algebra III with Statistics

Geometry
Algebraic Connections
Algebra II with Trigonometry
Precalculus

ALGEBRA I

Algebra I is a formal, in-depth study of algebraic concepts and the real number system. In this course students develop a greater understanding of and appreciation for algebraic properties and operations. Algebra I reinforces concepts presented in earlier courses and permits students to explore new, more challenging content which prepares them for further study in mathematics. The course focuses on the useful application of course content and on the development of student understanding of central concepts. Appropriate use of technology allows students opportunities to work to improve concept development. As a result, students are empowered to perform mathematically, both with and without the use of technological tools.

Because of its importance in the development of mathematical empowerment, Algebra I is required for all students. The content is also a central component of formal state-level assessments at the secondary level. To better meet the needs of students of varying abilities, school systems may offer Algebra I (140 hours/one credit) or Algebra IA and IB (280 hours/two credits). If systems choose to offer Algebra I in the eighth grade, the course must include the minimum required content as prescribed in this course of study.

Number and Operations

Students will:

1. Simplify numerical expressions using properties of real numbers and order of operations, including those involving square roots, radical form, or decimal approximations.

   Example: Express $\sqrt{27} + \sqrt{75}$ in simplified form.

   - Applying laws of exponents to simplify expressions, including those containing zero and negative integral exponents

Algebra

2. Analyze linear functions from their equations, slopes, and intercepts.
   - Finding the slope of a line from its equation or by applying the slope formula
   - Determining the equations of linear functions given two points, a point and the slope, tables of values, graphs, or ordered pairs
   - Graphing two-variable linear equations and inequalities on the Cartesian plane

Algebra I

3. Determine characteristics of a relation, including its domain, range, and whether it is a function, when given graphs, tables of values, mappings, or sets of ordered pairs.
   - Finding the range of a function when given its domain
     Example: finding the range of $f(x) = -x^2 + 2x - 3$ when given the domain {-4, -2, 0, 2, 4}

4. Represent graphically common relations, including x = constant, y = constant, y = x, $y = \sqrt{x}$, $y = x^2$, and $y = |x|$.
   - Identifying situations that are modeled by common relations, including x = constant, y = constant, y = x, $y = \sqrt{x}$, $y = x^2$, and $y = |x|$

5. Perform operations of addition, subtraction, and multiplication on polynomial expressions.
   - Dividing by a monomial

6. Factor binomials, trinomials, and other polynomials using GCF, difference of squares, perfect square trinomials, and grouping.

7. Solve multistep equations and inequalities including linear, radical, absolute value, and literal equations.
   Examples: solving for x in problems such as $\sqrt{x} - 4 = 0$, $\sqrt{x-4} < 2$, $|x| = 6$, $|x+3| \geq 10$, and $y = mx + b$
   - Writing the solution of an equation or inequality in set notation
     Example: finding the solution of $|x+3| \geq 10$ to be $\{x | x \geq 7 \text{ or } x \leq -13\}$
   - Graphing the solution of an equation or inequality
   - Modeling real-world problems by developing and solving equations and inequalities, including those involving direct and inverse variation

8. Solve systems of linear equations and inequalities in two variables graphically or algebraically.
   - Modeling real-world problems by developing and solving systems of linear equations and inequalities

9. Solve quadratic equations using the zero product property.
   - Approximating solutions graphically and numerically

Geometry

10. Calculate length, midpoint, and slope of a line segment when given coordinates of its endpoints on the Cartesian plane.
    - Deriving the distance, midpoint, and slope formulas

Measurement

11. Solve problems algebraically that involve area and perimeter of a polygon, area and circumference of a circle, and volume and surface area of right circular cylinders or right rectangular prisms.
    - Applying formulas to solve word problems
      Example: finding the radius of a circle with area 75 square inches

Data Analysis and Probability

12. Compare various methods of data reporting, including scatterplots, stem-and-leaf plots, histograms, box-and-whisker plots, and line graphs, to make inferences or predictions.
    - Determining effects of linear transformations of data
      Example: The mean score on an algebra test is 78. If the teacher adds five points to each student's grade, the mean score will be 83.
    - Determining effects of outliers
    - Evaluating the appropriateness of the design of a survey

13. Identify characteristics of a data set, including measurement or categorical and univariate or bivariate.
    Example: conducting a survey of 100 students to determine whether boys and girls prefer to watch the same genres of movies to get a bivariate, categorical data set

14. Use a scatterplot and its line of best fit or a specific line graph to determine the relationship existing between two sets of data, including positive, negative, or no relationship.

15. Estimate probabilities given data in lists or graphs.
    - Comparing theoretical and experimental probabilities

GEOMETRY

Geometry provides students with knowledge about shapes and properties and assists with the development of spatial sense, critical for further study in mathematics and for everyday life. Because of its importance in the development of mathematical empowerment, this course is required for all students. To better meet the needs of students of varying abilities, school systems may offer Geometry (140 hours/one credit) or Geometry A and B (280 hours/two credits).

Traditionally, writing proofs has been a major emphasis in Geometry. While in recent years this focus has diminished, Geometry continues to provide an excellent context for developing students' abilities to reason and write proofs. In this course, students are engaged in problematic situations in which they form conjectures, determine the validity of these conjectures, and defend their conclusions to classmates. Emphasis is placed on the power of deductive reasoning, expressed either informally or formally in a variety of formats. The use of technology as a powerful mathematical tool is also encouraged. Technology may be used for exploring geometric situations or may be incorporated into technological applications such as dynamic geometry software to support classroom instruction.

Algebra

Students will:

1. Determine the equation of a line parallel or perpendicular to a second line through a given point.

Geometry

2. Justify theorems related to pairs of angles, including angles formed by parallel and perpendicular lines, vertical angles, adjacent angles, complementary angles, and supplementary angles.
   Example: proving vertical angles congruent

3. Verify the relationships among different classes of polygons by using their properties.
   Example: showing that a square has all the properties of both a rectangle and a rhombus

   - Determining the missing lengths of sides or measures of angles in similar polygons

4. Determine the measure of interior and exterior angles associated with polygons.
    - Verifying the formulas for the measures of interior and exterior angles of polygons inductively and deductively

5. Solve real-life and mathematical problems using properties and theorems related to circles, quadrilaterals, and other geometric shapes.
    Example: finding the center of a solid wooden wheel using the perpendicular bisectors of two chords

    - Determining the equation of a circle given its center and radius

6. Apply the Pythagorean Theorem to solve application problems, expressing answers in simplified radical form or as decimal approximations, using Pythagorean triples when applicable.

7. Use the ratios of the sides of special right triangles to find lengths of missing sides.
    - Deriving the ratios of the sides of 30-60-90 and 45-45-90 triangles

8. Deduce relationships between two triangles, including proving congruence or similarity of the triangles from given information, using the relationships to solve problems and to establish other relationships.
    - Determining the geometric mean to find missing lengths in right triangles

9. Use inductive reasoning to make conjectures and deductive reasoning to justify conclusions.
    - Recognizing the limitations of justifying a conclusion through inductive reasoning

10. Find the missing measures of sides and angles in right triangles by applying the right triangle definitions of sine, cosine, and tangent.

11. Determine the areas and perimeters of regular polygons, including inscribed or circumscribed polygons, given the coordinates of vertices or other characteristics.

12. Apply distance, midpoint, and slope formulas to solve problems and to confirm properties of polygons.
    Examples: finding the area of a rectangle given the coordinates of its vertices, showing that the median of a trapezoid is half the sum of the bases

13. Identify the coordinates of the vertices of the image of a given polygon that is translated, rotated, reflected, or dilated.
    Example: rotating a triangle a given number of degrees around a specific point, comparing the vertices of the image and preimage

14. Classify polyhedrons according to their properties, including the number of faces.
    Example: identifying a polyhedron having 6 vertices and 12 edges

    - Identifying Euclidean solids

Geometry

Measurement

15. Calculate measures of arcs and sectors of a circle from given information.
    Examples: finding the area of a sector given its arc length and radius, finding the arc length of a sector given its area and radius, finding the area or arc length given the measure of the central angle and the radius

16. Calculate surface areas and volumes of solid figures, including spheres, cones, and pyramids.
    - Developing formulas for surface area and volume of spheres, cones, and pyramids
    - Calculating specific missing dimensions of solid figures from surface area or volume
    - Determining the relationship between the surface areas of similar figures and volumes of similar figures

Data Analysis and Probability

17. Analyze sets of data from geometric contexts to determine what, if any, relationships exist.
    Example: Collect data and create a scatterplot comparing the perimeter and area of various rectangles. Determine whether a line of best fit can be drawn.

    - Distinguishing between conclusions drawn when using deductive and statistical reasoning
    - Calculating probabilities arising in geometric contexts
      Example: finding the probability of hitting a particular ring on a dart board whose rings are formed by equally spaced concentric circles

18. Construct with precision a circle graph to represent data from given tables or classroom experiments.

ALGEBRAIC CONNECTIONS

Algebraic Connections is a course that provides students with a bridge to courses beyond the level of Algebra I and Geometry and to the mathematical empowerment needed to make responsible financial and economic decisions. It is designed for students who need additional mathematical experiences prior to enrollment in Algebra II, with or without Trigonometry, and for students for whom this will be a culminating high school mathematics course.

Algebraic Connections extends the scope of content of the prerequisite courses, integrating topics from algebra, geometry, measurement, and probability and statistics with an emphasis on real-world applications. This course provides opportunities to incorporate the use of technology through its emphasis on using functions to make real-life predictions and to calculate outcomes. The wide range of applied problems may lend itself to organizing the content into thematic units.

Algebra

Students will:

1. Use algebraic and geometric techniques to make financial and economic decisions, including those involving banking and investments, insurance, personal budgets, credit purchases, recreation, and deceptive and fraudulent pricing and advertising.
   Examples: banking—determining the best choice of certificates of deposit, savings accounts, checking accounts, or loans;
   credit purchases—comparing the costs of fixed- or variable-rate mortgage loans, comparing the costs associated with various credit cards;
   personal budgets—determining the best plan for long distance phone service

   - Generating, manually or with technological tools, graphs and tables related to personal finance and economics
     Example: using computer software to create an amortization table for a mortgage loan or a circle graph for a personal budget

2. Solve problems using direct, inverse, and joint variation.

3. Use formulas or equations of functions to calculate outcomes of exponential growth or decay.
   Example: problems involving compound interest, bacterial growth, carbon-14 dating, depreciation, cooling point in chemistry

Algebraic Connections

4. Determine maximum and minimum values of a function using linear programming procedures.
   Example: Given the boundaries $x \geq 0$, $y \geq 0$, $2x - 3y + 15 \geq 0$, and $x \leq 9$, find the maximum and minimum values of $f(x,y) = 3x + 5y$.

5. Approximate rates of change of nonlinear relationships from graphical and numerical data.
   - Graphing information from tables, equations, or classroom-generated data to model consumer costs and to predict future outcomes

6. Use the extreme value of a given quadratic function to solve applied problems.
   Example: determining the cost needed to maximize profit

7. Make predictions based upon tables or graphs from societal contexts.
   Example: making predictions about population change or employment rate

Geometry

8. Determine missing information in an application-based situation by using the properties of right triangles, including trigonometric ratios.
   Example: application—construction or landscaping problem

9. Analyze the aesthetics of real-life situations using line symmetry, rotational symmetry, or the golden ratio.
   Example: identifying the symmetry found in nature, art, or architecture

10. Use arc length and sector area to solve applied problems.

Measurement

11. Critique the appropriateness of measurements in terms of precision, accuracy, and approximate error.
    Example: determining whether one candidate has a significant lead over another candidate when given their current standings in a poll and the margin of error

12. Use ratios of perimeters, areas, and volumes of similar figures to solve applied problems.
    Example: using a blueprint or scale drawing of a house to determine the amount of carpet to be purchased

13. Model a set of data by estimating the equation of a curve of best fit from tables of values or scatterplots.
    Example: predicting or analyzing election results, population change, inflation rate, employment rate, or cholesterol count

14. Estimate probabilities given a frequency distribution.
    - Making decisions on the basis of probabilities

ALGEBRA II

Algebra II is a course designed to extend students' algebraic knowledge and skills. Students are encouraged to solve problems using a variety of methods that promote the development of improved communication skills and foster a deeper understanding of the subject matter. To help students appreciate the power of algebra, applications involving real-life situations are incorporated throughout the course. The use of appropriate technology is also encouraged.

In contrast to Algebra II with Trigonometry, Algebra II does not meet the graduation requirements for the *Alabama High School Diploma with Advanced Academic Endorsement* because it does not contain an in-depth study of trigonometry. Furthermore, it does not provide sufficient background to prepare students to pursue higher-level mathematics courses such as Algebra III with Statistics or Precalculus. It should, therefore, be considered a terminal high school mathematics course.

The prerequisites for Algebra II are Algebra I and Geometry. Students cannot receive credit for both Algebra II and Algebra II with Trigonometry.

Number and Operations

Students will:

1. Determine the relationships among the subsets of complex numbers.
   Example: using Venn diagrams or tree diagrams to show how subsets of complex numbers are related

2. Simplify expressions involving complex numbers, using order of operations and including conjugate and absolute value.
   Examples: simplifying $\sqrt{-8}$, $(4-2i)^2$, and $\frac{3+i}{3-i}$

3. Analyze families of functions, including shifts, reflections, and dilations of $y = \frac{k}{x}$ (inverse variation), $y = kx$ (direct variation/linear), $y = x^2$ (quadratic), $y = a^x$ (exponential), and $y = \log_a x$ (logarithmic).
   Example: comparing the graphs of $y = 2^x$, $y = 2^x + 1$, $y = 2^{x+1}$, and $y = -2^x$

   - Identifying the domain and range of a relation given its graph, a table of values, or its equation, including those with restricted domains
     Example: finding the domain of $y = \frac{1}{x-3}$ or $y = \sqrt{x-2}$
   - Identifying real-world situations corresponding to families of functions

4. Determine approximate real zeros of functions graphically and numerically and exact real zeros of polynomial functions.
   - Using completing the square, the zero product property, and the quadratic formula

5. Identify the characteristics of quadratic functions from their roots, graphs, or equations.
   - Writing an equation when given its roots or graph
   - Graphing a function when given its equation
     Examples: graphing equations of the form $y = a(x-h)^2 + k$, graphing equations of the form $y = ax^2 + bx + c$
   - Determining the nature of the solutions of a quadratic equation
   - Determining the maximum or minimum values of quadratic functions both graphically and algebraically

6. Perform operations on functions, including addition, subtraction, multiplication, division, and composition.
   - Determining the inverse of a function or a relation
   - Performing operations on polynomial and rational expressions containing variables
     Example: simplifying $\frac{3}{x+5} + \frac{5}{x^2+6x+5}$
   - Constructing graphs by analyzing their functions as sums or differences

7. Solve equations, inequalities, and applied problems involving absolute values, radicals, and quadratics over the complex numbers, as well as exponential and logarithmic functions.
   Example: solving $x^2 - 4 > 0$ or $3^x = 81$

   - Solving equations using laws of exponents, including rational and irrational exponents
   - Expressing the solution of an equation, inequality, or applied problem as a graph on a number line or by using set or interval notation

Algebra II

8. Solve systems of linear equations or inequalities in two variables using algebraic techniques, including those involving matrices.
   Example: using the matrix operations of a calculator to solve a system of linear equations

   - Evaluating the determinant of a 2x2 or 3x3 matrix
   - Solving word problems involving real-life situations

Geometry

9. Solve coordinate geometry problems using algebraic techniques.
   Examples: finding missing coordinates of vertices of polygons, determining properties of polygons given the coordinates of their vertices, determining perpendicularity of sides of a polygon on a coordinate plane

Data Analysis and Probability

10. Use different forms of representation to compare characteristics of data gathered from two populations.
    - Evaluating the appropriateness of the design of an experimental study
    - Describing how sample statistics reflect values of population parameters

11. Determine an equation of linear regression from a set of data.
    - Examining data to determine if a linear or quadratic relationship exists and to predict outcomes

12. Calculate probabilities of events using the laws of probability.
    - Using permutations and combinations to calculate probabilities
    - Calculating conditional probability
    - Calculating probabilities of mutually exclusive events, independent events, and dependent events

ALGEBRA II WITH TRIGONOMETRY

Algebra II with Trigonometry focuses on problem-solving skills that use a variety of methods to encourage the development of improved communication skills and foster a deeper understanding of the content area. In order to provide students with an appreciation of the power of algebra, applications involving real-life situations are incorporated throughout the course. The use of appropriate technology is also encouraged.

Algebra II with Trigonometry is required for all students seeking the *Alabama High School Diploma with Advanced Academic Endorsement*. Although this course is valuable for all students, it is strongly recommended for students who intend to pursue postsecondary studies. Prerequisites for the course are Algebra I and Geometry. Credit cannot be awarded for both Algebra II with Trigonometry and Algebra II.

Number and Operations

Students will:

1. Determine the relationships of subsets of complex numbers.
   Example: using Venn diagrams or tree diagrams to show how subsets of complex numbers are related

2. Simplify expressions involving complex numbers, using order of operations and including conjugate and absolute value.
   Examples: simplifying $\sqrt{-8}$, $(4-2i)^2$, and $\frac{3+i}{3-i}$

Algebra

3. Analyze families of functions, including shifts, reflections, and dilations of $y = \frac{k}{x}$ (inverse variation), $y = kx$ (direct variation/linear), $y = [x]$ (greatest integer), $y = x^2$ (quadratic), $y = a^x$ (exponential), and $y = \log_a x$ (logarithmic).
   Example: comparing the graphs of $y = 2^x$, $y = 2^x + 1$, $y = 2^{x+1}$, and $y = -2^x$

   - Identifying the domain and range of a relation given its graph, a table of values, or its equation, including those with restricted domains
     Example: finding the domain of $y = \frac{1}{x-3}$ or $y = \sqrt{x-2}$
   - Identifying real-world situations corresponding to families of functions

4. Determine approximate real zeros of functions graphically and numerically and exact real zeros of polynomial functions.
    - Using the zero product property, completing the square, and the quadratic formula
    - Deriving the quadratic formula

5. Identify the characteristics of quadratic functions from their roots, graphs, or equations.
    - Generating an equation when given its roots or graph
    - Graphing a function when given its equation
        Examples: graphing equations of the form $y = a(x-h)^2 + k$; graphing equations of the form $y = ax^2 + bx + c$
    - Determining the maximum or minimum values of quadratic functions both graphically and algebraically
    - Applying functions to real-world problems

6. Perform operations on functions, including addition, subtraction, multiplication, division, and composition.
    - Determining the inverse of a function or a relation
    - Performing operations on polynomial and rational expressions containing variables
        Example: simplifying $\frac{3}{x+5} + \frac{5}{x^2+6x+5}$
    - Constructing graphs by analyzing their functions as sums, differences, or products

7. Solve equations, inequalities, and applied problems involving absolute values, radicals, and quadratics over the complex numbers, as well as simple trigonometric, exponential, and logarithmic functions.
    Example: solving $x^2 - 8x > -12$, $3^x = 81$, $2\sin^2 x + \sin x = 0$, or $\log_x 2 = 5$
    - Solving equations using laws of exponents, including rational and irrational exponents
    - Expressing the solution of an equation, inequality, or applied problem as a graph on a number line or by using set or interval notation

8. Solve systems of linear equations or inequalities in two or three variables using algebraic techniques, including those involving matrices.
    Example: solving a system of linear equations using augmented matrices and row operations, matrix operations of a graphing calculator, or substitution
    - Evaluating the determinant of a 2x2 or 3x3 matrix
    - Solving word problems involving real-life situations

9. Graph trigonometric functions of the form $y=a\sin(bx)$, $y=a\cos(bx)$, and $y=a\tan(bx)$.
    - Determining period and amplitude of sine, cosine, and tangent functions from graphs or basic equations
        Example: solving problems involving harmonic motion
    - Determining specific unit circle coordinates associated with special angles

Geometry

10. Solve general triangles, mathematical problems, and real-world applications using the Law of Sines and the Law of Cosines.
    - Deriving formulas for Law of Sines and Law of Cosines
    - Determining area of oblique triangles

11. Define the six trigonometric functions using ratios of the sides of a right triangle, coordinates on the unit circle, and the reciprocal of other functions.

12. Verify simple trigonometric identities using Pythagorean and/or reciprocal identities.
    Example: verifying $\cos^2 \alpha + \tan^2 \alpha \cos^2 \alpha = 1$

Data Analysis and Probability

13. Use different forms of representation to compare characteristics of data gathered from two populations.
    - Evaluating the appropriateness of the design of an experimental study
    - Describing how sample statistics reflect values of population parameters

14. Determine an equation of linear regression from a set of data.
    - Examining data to determine if a linear, quadratic, or exponential relationship exists and to predict outcomes

15. Calculate probabilities of events using the laws of probability.
    - Using permutations and combinations to calculate probabilities
    - Calculating conditional probability
    - Calculating probabilities of mutually exclusive events, independent events, and dependent events

ALGEBRA III WITH STATISTICS

Algebra III with Statistics offers students the opportunity to expand their algebraic knowledge. It also provides a structured introduction to probability and statistics, an important area of emphasis in most postsecondary studies. Given the increased importance of statistics in understanding and evaluating the vast amounts of data encountered in everyday life, a strong emphasis is placed on collecting, organizing, analyzing, and interpreting data.

In addition to the focus on probability and statistics, real-life mathematical situations are analyzed through the study of vectors, polar graphing, linear programming, and trigonometric and exponential equations. The use of advanced technological tools can assist with statistical, numerical, and graphical analysis.

Algebra III with Statistics provides valuable experiences for students who plan to pursue postsecondary studies. It is recommended as a terminal course for students not planning studies in mathematics or science-related fields, and as a supplementary course for students planning studies in these areas. The successful completion of Algebra II with Trigonometry is a prerequisite for this course.

Number and Operations

Students will:

1. Utilize matrices to solve problems manually or with technological tools.
    - Performing operations of addition, subtraction, and multiplication of matrices
    - Solving matrix equations
    - Using augmented matrices

Algebra

2. Solve problems involving maximum or minimum values of functions by using linear programming procedures.

3. Graph conic sections, centered at and rotated about the origin, given the equations.
    - Determining equations of conic sections from their graphs

4. Graph polynomial functions.
    - Approximating zeros using Descartes' Rule of Signs and the bisection method
    - Describing the end behavior of a polynomial function given its degree and leading coefficient

5. Solve systems of linear and quadratic equations and inequalities.

6. Approximate solutions of trigonometric and exponential equations from tables and graphs.

7. Expand powers of binomials using the Binomial Theorem.
   - Using Pascal's triangle

Geometry

8. Plot points in a polar coordinate system given their coordinates in polar form, a table of values, or an equation.

Data Analysis and Probability

9. Compare summary statistics for sets of data represented in a graph, a stem-and-leaf chart, a box-and-whisker graph, a histogram, a linear or quadratic equation of best fit of a scatterplot, and a frequency distribution.

10. Calculate descriptive statistics of univariate data, including measures of central tendency, measures of dispersion, and measures of position.
    - Defining vocabulary associated with probability and statistics, including descriptive and inferential statistics
    - Comparing descriptive statistics for samples of varying sizes generated by simulation

11. Interpret relationships of bivariate data using linear or quadratic regression and linear correlation.
    Example: making a scatterplot in order to determine the relationship between the age of an automobile and the annual expenses for its maintenance

    - Testing a hypothesis by displaying a scatterplot of experimental data, determining the regression coefficient and equation, and determining the correlation coefficient

12. Test a hypothesis for a study that involves one or two populations, generating the appropriate descriptive statistics.
    - Designing a study
      Example: designing a study to determine if the males at a particular school watch more television than the females at that school, generating the appropriate descriptive statistics, and testing the hypothesis
    - Critiquing the appropriateness of the instrument used in a study
    - Using z-scores in a study
    - Using a t-test, when appropriate, to test a hypothesis

13. Calculate probabilities of mutually exclusive, independent, and dependent events using permutations, combinations, and laws of probability.
    - Using situations involving conditional probabilities

14. Determine the probability of an event using a frequency distribution curve.
    - Comparing the terms of a binominal expansion to the terms of a binomial probability distribution

15. Analyze the data from a student-designed study to create a distribution curve and to determine the resulting confidence interval.
    - Using data in quality control applications

16. Analyze differences among experimental, simulation, and theoretical probability techniques, including the advantages and disadvantages of each.
    - Evaluating data-based reports by examining the design of the study, appropriateness of data analysis, and validity of conclusions

PRECALCULUS

Precalculus is designed primarily for those students considering careers in mathematical or scientific fields of study. Following the successful completion of Algebra II with Trigonometry, students are prepared for this challenging curriculum that includes an expanded study of polynomial functions, conic sections, logarithmic and exponential equations, and the real-life applications of these topics.

Students are challenged to defend and support their conclusions from problematic situations. Working in both individual and group settings, students apply a variety of problem-solving strategies, incorporating the use of graphing calculators or other technological tools that extend beyond the traditional paper-and-pencil drill and practice.

Number and Operations

Students will:

1. Perform the vector operations of addition, scalar multiplication, and absolute value.
   - Determining coincidence, parallelism, collinearity, or perpendicularity of vectors
   - Using vectors to model real-life and mathematical situations

2. Define e using the limit forms of $\sum_{n=0}^{\infty} \frac{1}{n!}$, $\lim_{n\to\infty} \left(1+\frac{1}{n}\right)^{n}$, and $\lim_{n\to 0} \left(1+n\right)^{\frac{1}{n}}$.

Algebra

3. Graph conic sections, including parabolas, hyperbolas, ellipses, circles, and degenerate conics, from second-degree equations.
   Example: graphing $x^2 - 6x + y^2 - 12y + 41 = 0$ or $y^2 - 4x + 2y + 5 = 0$

   - Formulating equations of conic sections from their determining characteristics
     Example: writing the equation of an ellipse with center (5, -3), horizontal major axis of length 10, and minor axis of length 4

4. Analyze the graphs of rational, logarithmic, exponential, trigonometric, and piecewise-defined functions by determining the domain and range; identifying any vertical, horizontal, or oblique asymptotes; and classifying the function as increasing or decreasing, continuous or discontinuous, and noting the type of discontinuity if one exists.
   - Approximating rates of change using the difference quotient

Precalculus

5. Analyze the effects of parameter changes on the graphs of trigonometric, logarithmic, and exponential functions.
   Example: explaining the relationship of the graph of $y = e^{x-2}$ to the graph of $y = e^{x}$

   - Determining the amplitude, period, phase shift, domain, and range of trigonometric functions and their inverses

6. Apply the laws of logarithms to simplify expressions and to solve equations using common logarithms, natural logarithms, and logarithms with other bases.

7. Solve trigonometric equations and inequalities using sum, difference, and half- and double-angle identities.
   - Verifying trigonometric identities

8. Use parametric equations to represent real-life and mathematical situations.

9. Solve applied problems involving sequences with recurrence relations.
   - Determining characteristics of arithmetic and geometric sequences and series, including those defined with recurrence relations, first terms, common differences or ratios, n^{th} terms, limits, or statements of convergence or divergence
   - Expanding binomials raised to a whole number power using the Binomial Theorem

10. Find limits of functions at specific values and at infinity numerically, algebraically, and graphically.
    - Applying limits in problems involving convergence and divergence

Geometry

11. Convert coordinates, equations, and complex numbers in Cartesian form to polar form and from polar form to Cartesian form.
    - Graphing simple polar equations in the polar coordinate plane
      Example: graphing $r = 2+2\cos\phi$ or $r = 2 + \sin 3\phi$
    - Graphing polar coordinates and complex numbers

Data Analysis and Probability

12. Determine the equation of a curve of best fit from a set of data by using exponential, quadratic, or logarithmic functions.

APPENDIX A

Alabama High School Graduation Requirements

(Alabama Administrative Code 290-3-1-02(8)(a) (b) and (c))

1. COURSE REQUIREMENTS

The Alabama courses of study shall be followed in determining minimum required content in each discipline. Students seeking the Alabama High School Diploma with Advanced Academic Endorsement shall complete advanced level work in the core curriculum. Students seeking the Alternate Adult High School Diploma shall complete the prescribed credits for the Alabama High School Diploma and pass the test of General Education Development (GED).

COURSE REQUIREMENTS	Alabama High School Diploma Credits	Alabama High School Diploma with Advanced Academic Endorsement Credits	Alternate Adult High School Diploma Credits
ENGLISH LANGUAGE ARTS	**4**	**4**	**4**
Four credits to include the equivalent of:			
English 9	1	1	1
English 10	1	1	1
English 11	1	1	1
English 12	1	1	1
MATHEMATICS	**4**	**4**	**4**
Four credits to include the equivalent of:			
Algebra I	1	1	1
Geometry	1	1	1
Algebra II with Trigonometry		1	
Mathematics Elective(s)	2	1	2
SCIENCE	**4**	**4**	**4**
Four credits to include the equivalent of:			
Biology	1	1	1
A physical science	1	1	1
Science Electives	2	2	2
SOCIAL STUDIES*	**4**	**4**	**4**
Four credits to include the equivalent of:			
Grade 9 Social Studies	1	1	1
Grade 10 Social Studies	1	1	1
Grade 11 Social Studies	1	1	1
Grade 12 Social Studies	1	1	1
PHYSICAL EDUCATION	**1**	**1**	**1**
HEALTH EDUCATION	**0.5**	**0.5**	**0.5**
ARTS EDUCATION	**0.5**	**0.5**	**0.5**
COMPUTER APPLICATIONS**	**0.5**	**0.5**	**0.5**
FOREIGN LANGUAGE***		**2**	
ELECTIVES	**5.5**	**3.5**	**5.5**
Local boards shall offer foreign languages, fine arts, physical education, wellness education, career/technical education, and driver education as electives.			
TOTAL CREDITS	**24**	**24**	**24**

* All four required credits in Social Studies shall comply with the current *Alabama Course of Study*.

** May be waived if competencies outlined in the computer applications course are demonstrated to qualified staff in the local school system. The designated one-half credit shall then be added to the electives credits, making a total of six electives credits.

*** Students earning the diploma with the advanced academic endorsement shall successfully complete two credits in the same foreign language.

2. ASSESSMENT REQUIREMENTS

Pass the required statewide assessment for graduation.

APPENDIX A

Alabama High School Graduation Requirements (continued)

(Alabama Administrative Code 290-8-9-.10(9)(a))

1. COURSE REQUIREMENTS

Effective for students with disabilities as defined by the Individuals with Disabilities Education Act (Public Law 101-476) who begin the tenth grade in the 1997-98 school year, students must earn the course credits outlined in Ala. Admin. Code r. 290-3-1-.02(8)(g)1. and successfully complete an approved occupational portfolio in order to be awarded the Alabama Occupational Diploma.

COURSE REQUIREMENTS	Alabama Occupational Diploma Credits
ENGLISH LANGUAGE ARTS	**4**
Four credits to include the equivalent of:	
Employment English I	1
Employment English II	1
Employment English III	1
Employment English IV	1
MATHEMATICS	**4**
Four credits to include the equivalent of:	
Job Skills Math I	1
Job Skills Math II	1
Job Skills Math III	1
Consumer Mathematics IV	1
SCIENCE	**4**
Four credits to include the equivalent of:	
Life Skills Science I	1
Life Skills Science II	1
Life Skills Science III	1
Science Connections IV	1
SOCIAL STUDIES	**4**
Four credits to include the equivalent of:	
Career Preparation I	1
Career Preparation II	1
Career Preparation III	1
American Government/Economics IV	1
CAREER/TECHNICAL EDUCATION	**2**
COORDINATED STUDIES	**1**
COOPERATIVE CAREER/TECHNICAL EDUCATION	**1**
HEALTH EDUCATION	**0.5**
PHYSICAL EDUCATION	**1**
ARTS EDUCATION	**0.5**
ELECTIVES	**2**
Existing laws require LEAs to offer arts education, physical education, wellness education, career/technical education, and driver education as electives.	
TOTAL CREDITS	**24**

2. ASSESSMENT REQUIREMENTS

Complete successfully an approved Alabama Occupational Diploma Portfolio for graduation.

Guidelines and Suggestions for Local Time Requirements and Homework

Total Instructional Time

The total instructional time of each school day in all schools and at all grade levels shall be not less than 6 hours or 360 minutes, exclusive of lunch periods, recess, or time used for changing classes (*Code of Alabama,* 1975, §16-1-1).

Suggested Time Allotments for Grades 1 - 6

The allocations below are based on considerations of a balanced educational program for Grades 1-6. Local school systems are encouraged to develop a general plan for scheduling that supports interdisciplinary instruction. Remedial and/or enrichment activities should be a part of the time schedule for the specific subject area.

Subject Area	Grades 1-3	Grades 4-6
Language Arts	150 minutes daily	120 minutes daily
Mathematics	60 minutes daily	60 minutes daily
Science	30 minutes daily	45 minutes daily
Social Studies	30 minutes daily	45 minutes daily
Physical Education	30 minutes daily*	30 minutes daily*
Health	60 minutes weekly	60 minutes weekly
Computer Education	60 minutes weekly	60 minutes weekly
Character Education	10 minutes daily**	10 minutes daily**
Arts Education		
Dance Music Theatre Visual Arts	*Daily instruction with Arts specialists in each of the Arts disciplines is the most desirable schedule. However, schools unable to provide daily Arts instruction in each discipline are encouraged to schedule in Grades 1 through 3 two 30- to 45-minute Arts instruction sessions per week and in Grades 4 through 6 a minimum of 60 minutes of instruction per week. Interdisciplinary instruction within the regular classroom setting is encouraged as an alternative approach for scheduling time for Arts instruction when Arts specialists are not available.*	

*Established by the State Department of Education in accordance with *Code of Alabama*, 1975, §16-40-1

**Established by the State Department of Education in accordance with *Code of Alabama*, 1975, §16-6B-2(h)

Kindergarten

In accordance with *Alabama Administrative Code* r. 290-5-1-.01(5) Minimum Standards for Organizing Kindergarten Programs in Alabama Schools, the daily time schedule of the kindergartens shall be the same as the schedule of the elementary schools in the systems of which they are a part since kindergartens in Alabama operate as full-day programs. There are no established time guidelines for individual subject areas for the kindergarten classroom. The emphasis is on large blocks of time that allow children the opportunity to explore all areas of the curriculum in an unhurried manner.

In accordance with *Alabama Administrative Code* r. 290-5-1-.01(6), the guide for program planning in kindergarten is *Alabama Kindergartens,* Bulletin 1987, No. 28. Criteria to be used in scheduling are listed on pages 45-46 of this guide. The full-day program should be organized utilizing large blocks of time for large group, small groups, center time, lunch, outdoor activities, snacks, transitions, routines, and afternoon review. Individual exploration, small-group interest activities, interaction with peers and teachers, manipulation of concrete materials, and involvement in many other real-world experiences are needed to provide a balance in the kindergarten classroom.

APPENDIX B

Grades 7-12

A minimum of 140 clock hours of instruction is required for one unit of credit and a minimum of 70 clock hours of instruction is required for one-half unit of credit.

In those schools where Grades 7 and 8 are housed with other elementary grades, the school may choose the time requirements listed for Grades 4-6 or those listed for Grades 7-12.

Character Education

For all grades, not less than 10 minutes instruction per day shall focus upon the students' development of the following character traits: courage, patriotism, citizenship, honesty, fairness, respect for others, kindness, cooperation, self-respect, self-control, courtesy, compassion, tolerance, diligence, generosity, punctuality, cleanliness, cheerfulness, school pride, respect of the environment, patience, creativity, sportsmanship, loyalty, and perseverance.

Homework

Homework is an important component of every student's instructional program. Students, teachers, and parents should have an understanding of homework objectives and their role in the total learning experience. Homework reflects practices that have been taught in the classroom and provides reinforcement and/or remediation for students. Homework should be student-managed, and the amount should be age-appropriate. Homework should encourage learning through problem solving and practice. Parental support and supervision reinforce the quality of practice or product as well as skill development.

Each local board of education shall establish a policy on homework consistent with the State Board of Education resolution adopted February 23, 1984. (Action Item #F-2)

Homework is an important component of each student's instructional program. Students, teachers, and parents should have a clear understanding of the objectives to be accomplished through homework and the role it plays in meeting curriculum requirements. At every grade level, homework should be meaning-centered and mirror classroom activities and experiences. Independent and collaborative projects that foster creativity, problem-solving abilities, and student responsibility are appropriate.

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