Transforming East Alabama Mathematics

The East Alabama Partnership for the Improvement of Mathematics Education

TEAM-Math Curriculum Guide

DRAFT
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Chapter 1

Introduction to the TEAM-Math Curriculum Guide

Transforming East Alabama Mathematics (TEAM-Math) is a partnership between Auburn University and twelve school districts (Alexander City, Auburn City, Chambers County, Elmore County, Lanett City, Lee County, Macon County, Opelika City, Phenix City, Russell County, Tallapoosa County, and Tallassee City), along with Tuskegee University and other organizations. The goal of the partnership is to systemically improve mathematics education in this region, including increasing overall student achievement, addressing gaps in performance between demographic groups, enhancing the professional knowledge of practicing teachers, developing a cadre of knowledgeable teacher leaders, and improving the preparation of prospective teachers at the university.

In addition, the school districts in the partnership are working collaboratively with Auburn University and the other partners to develop curriculum guides and other policies that promote student learning in mathematics. This document describes the first step in this process.

Development of the Curriculum Guide

One of the first steps in the TEAM-Math process has been to develop a partnership-wide curriculum guide that can be used to guide both instruction and further decision-making for the partnership related to teaching and learning. A Curriculum Writing Team, consisting of 60 teachers from across the Partnership, met on six occasions in May, June, and July of 2003 to develop a first draft of this document. See a list of the committee members in Appendix A.

The group began with an examination of the "big ideas" to be addressed across the grades, moved to a consideration of the central concepts for each strand, and finally worked at identifying outcomes for each course and grade. Summaries of the working meetings can be found on the TEAM-Math Web site at http://TEAM-Math.net/curriculum/.

In developing this document, the group considered a number of references, including:

- *Alabama Course of Study: Mathematics*. The newest version of this document was released in April 2003, and is to be adopted in the 2003-2004 school year. In contrast to past versions, the 2004 course of study is very stripped-down, with far fewer objectives per grade level and no repeated content from year to year or course to course.

- *Principles and Standards for School Mathematics*. This document, published by the National Council of Teachers of Mathematics, provides a vision of how mathematics should be taught. It was used as the primary basis for the *Alabama Course of Study: Mathematics*. The Curriculum Team used it as a reference to supplement its use of the *Course of Study*.

- SAT-10 test description. The committee found that the SAT-10 was in good alignment with the Course of Study and *Principles and Standards for School Mathematics*. In addition, the state of Alabama will be creating an "augmented" version of the test that will be completely aligned with the *Course of Study*. It is this "augmented SAT-10" that will be used as the state-wide accountability measure. However, the national SAT-10 scores will also be reported, so the group sought to ensure that the topics covered will meet those requirements.

- Alabama High School Graduation Examination. In theory, this assessment should also be in alignment with the *Course of Study*. However, it is not currently being revised to meet the new guidelines, so the committee checked to be sure all its requirements were met.

- National Assessment of Educational Progress (NAEP) Mathematics Framework. NAEP is the "nation's report card," designed to assess the overall national progress in mathematics and other subject areas. Alabama's statewide progress is tracked using this test, therefore we also reviewed their requirements.

In general, the group found good agreement in the recommendations from these various sources. While the *Course of Study* was taken as the primary source, since those are the objectives for which the teachers and students of our state are accountable, that document was limited in a number of ways by the state requirements for the course of study. For example, only the content for which students at a particular grade are accountable was included. However, we know that this cannot be the only content that is addressed. There needs to be some revisiting of the content from the year before and also attempts to set the stage for the next year. Thus, focusing only on "testable content" will not provide an accurate description of the content to be covered. Also, the authors of the *Course of Study* (three of whom were on the Curriculum Team) were limited in the verbs they could use and in how they could say things. For example, anything that might be judged to describe instruction was not permitted, a major limitation in a document intended to guide teaching.

We did not have such limitations in developing our guides, as we made our own rules, so to speak. *Principles and Standards* become a key source in "filling in the gaps" for what was not considered in the state course of study. This worked particularly well since *Principles and Standards* guided the development of the state course of study. This document was particularly important in developing the underlying philosophy for the group, which is outlined in the next chapter.

Uses of the Curriculum Guide

This curriculum guide is designed to provide a general view of what content is critical for each grade and course to ensure that students are making the necessary mathematical progress from grades K-12. This document is intended to be used in two ways:

- To help teachers make decisions about what they should teach during the 2003-2004 school year. Each teacher must be responsible for the material in the Curriculum Guide to ensure that students are making the necessary progress.

- To serve as a basis for the textbook adoption process, which will take place during the 2003-2004 school year. TEAM-Math will be organizing a collaborative review of textbooks based on this curriculum guide.

Next Steps

This draft of the curriculum guide serves as a top-level description of what should happen in each course and grade, with little day-to-day support for teachers. Following the adoption of textbooks, which we hope will be consistent across the partnership, the Curriculum Writing Team will reconvene to begin to make more specific recommendations, incorporating references to the Partnership textbook series. Thus, we hope to have a unit-by-unit description of each course and grade for the 2004-2005 school year which will incorporate guidance on sequencing of lessons, provide sample activities, and suggest ways in which the textbook can be used as an effective resource for instruction. We also plan to begin professional development for teachers on how they can effectively implement this curriculum.

Chapter 2

Curriculum Across the Grades

The following MISSION STATEMENT was adopted by the Curriculum Writing Team as underlying the work of the Partnership:

> **To enable all students to understand, utilize, communicate, and appreciate mathematics as a tool in everyday situations in order to become life-long learners and productive citizens by Transforming East Alabama Mathematics (TEAM-Math). The mission will be met by:**
> - **Aligning the curriculum K-12**
> - **Ensuring consistency in teaching**
> - **Providing professional development**

Organizing Principles

Several important points are raised in this statement, which are summarized in the following sections. These points are consistent with the Principles found in Chapter 2 of the *Principles and Standards for School Mathematics*.

Equity: The importance of meeting the needs of "all students". The statement begins, "To enable all students…" The emphasis on the word "all" is particularly important, since there are huge gaps in performance among different groups of students, particularly between white and minority students and between poor and more affluent students. It is our responsibility to do our best to meet the needs of all of our students. Only by holding all students to the highest expectations, and giving them the support they need, can we truly improve performance across the Partnership. Indeed, under the new federal legislation, *No Child Left Behind*, a school's accountability includes the degree to which they address these gaps in performance between different groups of students.

Learning: The importance of process. In accordance with *Principles and Standards*, the document emphasizes students' understanding of mathematics and their ability to apply their knowledge, rather than focusing on rote learning and memorization. While the focus of a curriculum document tends to be the topics and ideas to be taught, it is equally important to consider how students will learn those ideas. The group repeatedly returned to this saying:

> It is not just *what* you teach; it is *how* you teach that content.

If students can only do what they are told, they will not be prepared to become productive citizens. The *Course of Study* adopted the five "process standards" described in the national *Principles and Standards*:

- Problem solving
- Reasoning and proof
- Communication
- Connections
- Representation

Teachers must pay as much attention to the "how" as they do the "what." The writers of this document did their best to incorporate attention to process throughout their work, and it is reflected in the "umbrella statement" that is given at the beginning of each of the content strands in this chapter.

> The Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation), estimation, reasonableness of answers, terminology, and technology should be integrated throughout each content strand to help students develop relational understanding (the "how" and the "why").

Curriculum: The importance of alignment K-12. The Curriculum Team did its best to ensure that its recommendations will promote the mathematical growth of all students K-12. As previously mentioned earlier, the number of objectives in the new *Course of Study* has been dramatically reduced for each grade and course. This is intended to promote focus on what mathematics is important for each grade, rather than repeating the same material each year. There needs to be growth across the grades.

Thus, it is the intent of this document that all teachers do their best to help their students meet the objectives in the grades or courses they teach. In this way, students will be prepared for the next course and grade. Failure to meet those objectives means that students will not be ready for the next year, meaning that they will fall further and further behind. The Curriculum Team discussed the difficulties of dealing with students who come to a grade or course behind where they need to be. We will need to continue to deal with effective ways to deal with this issue, but hopefully the situation will improve over the next years as we all strive towards this goal.

Another result of the fewer objectives in the *Course of Study* is that there are sometimes "gaps" across the grades, since only "testable content" is included, not content that is being developed. That is, an idea or concept might be included at one grade level, where it will be tested at an introductory level, and not appear again until two or more years later, where it will be tested at a much more sophisticated level. This is a result of the way the Course of Study was designed: It only describes the content for which students at a particular grade or course are accountable. However, there needs to be a build-up across the grades to meet the objectives in the course in which the idea will be tested. As someone said, "The success of fifth-grade students is not the result of the fifth-grade teachers. It is the result of all the teachers that student has had since they entered school." Thus, the writers worked hard at establishing a smooth learning trajectory across the grades.

Technology: Appropriate uses. The use of technology (particularly calculators) raised heated discussion among the group, to say the least. Many members raised the concern that technology might become a replacement for learning the necessary basics. Others emphasized the potential

value of technology in allowing students to explore new concepts and in allowing them to address "messy" problems that don't have nice answers. While this will no doubt be an issue of continuing discussion in the next years, the group consensus was that technology should be used in ways that enhance student learning, not replace their learning. A teacher needs to make judgments about what activities will be enhanced by calculator use, and in what activities calculators will be a hindrance. However, the best research does demonstrate that calculators and other technology have the potential to greatly increase student learning. (Notes from the committee's discussion of this important issue can be found at http://team-math.net/curriculum/0604/index.htm#calc.)

Assessment: Importance of multiple methods. While the group did not spend much time on assessment, the importance of incorporating assessment beyond just quizzes and tests was discussed on several occasions. When students are engaged in doing mathematics, rather than just mimicking what the teacher does, the teacher has many opportunities to observe and assess how his or her students are progressing.

The group also discussed the possibility of devising quarterly assessments to be used across the Partnership, thus helping to determine whether students are making the progress they need.

Big Ideas K-12

The Curriculum Writing Team organized its work into four subcommittees by: K-2, 3-5, 6-8, and 9-12. This is consistent with both the state *Course of Study* and *Principles and Standards*. To ensure that the goal of K-12 alignment was met, the group worked at developing a common vision across the grades. As a part of that effort, each subcommittee identified "big ideas" for their gradeband. The subcommittees then met with each other to ensure that clear developmental paths were being established.

These "big ideas" are organized in five content strands that are used both in the *Course of Study* and *Principles and Standards*:

- Number and Operations
- Algebra
- Geometry
- Measurement
- Data Analysis and Probability

While some of these strands are more important at some levels than others, efforts were made to show how they developed across the grades. Charts for each of the strands follow.

Number Strand K-12

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	Grades 9-12
The Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation), estimation, reasonableness of answers, terminology, notation, and technology should be integrated throughout each content strand to help students develop relational understanding (the "how" and the "why").			
1. Understand place value; use money. Model with objects, pictures, and/or symbols. 2. Strong understanding of base ten and number sense.	1. Order, compare, estimate, decimal and whole numbers not to exclude the use of fractions and extend place value.		1. Order and compare real numbers emphasizing irrational numbers. 2. Concept/properties of complex numbers. 3. Distinguish between various number sets. (real, complex, rational, irrational, integers, whole)
3. Basic addition and subtraction facts with fluency and use problem solving. 4. Compose and decompose whole numbers. (Fact Families) 5. Model with objects, pictures, and/or symbols, addition and subtraction/ number patterns.	2. Have efficient and accurate methods for computing. (add, subtract, multiply, divide and equivalency)	1. Use operations involving place value, fractions, decimals, percents, irrational and rational numbers, scientific notation, integers, and estimation of a reasonable answer. -Exponents -Sets -Properties -Order of Operations -Compare and Order -Real number line	4. Simplify operations with: a. reals with radicals b.polynomial expressions c. complex numbers d. vectors e. exponential and logarithmic f. matrices g. rational expressions
6. Understand and use fractions. (1/2, ¼, 1/3)	3. Fractions; Modeling concrete examples moving toward abstract thinking.	2. Prime / composite for LCM, GCF, and reducing fractions	5. Factoring polynomials
		3. Understand and use proportional reasoning * Ratios, rates, proportions, scale drawings	

Algebra Strand K-12

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	Grades 9-12
The Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation), estimation, reasonableness of answers, terminology, notation, and technology should be integrated throughout each content strand to help students develop relational understanding (the "how" and the "why").			
1. Understand patterns, relations, functions, and properties. - Extend Patterns	1. Understand and identify properties and patterns using symbols, numbers, and non-standard units.	1. Graphing of functions a. Range and domain b. Notation: f(x) c. Patterns	1. Identify, interpret, and solve: graphically, numerically, and analytically. a. Relations as functions b. Linear, quadratic, polynomial, rational, exponential, inverse, trigonometric, absolute value, piecewise-defined*, and radical c. Parametric shifts d. Sequences and Series*
2. Use of number sentence symbols (+,-,=) - Understand use of symbols - Understand greater than (>), less than (<), equal to (=)	2. Use a variety of strategies and methods to solve mathematical situations and structures.	2. Solve simple equations and inequalities (2 variable equations)	2. Understand the meaning of equivalent forms of expression, equations, inequalities, relations, complex numbers, quadratic equations, vectors, matrices, and number theory

* Covered in Precalculus

Geometry Strand K-12

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	Grades 9-12
The Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation), estimation, reasonableness of answers, terminology, notation, and technology should be integrated throughout each content strand to help students develop relational understanding (the "how" and the "why").			
1. Analyze spatial relationships * Recognize and make connections in their environment. * Demonstrat understanding that translating, rotating, and reflecting of objects does not change shape. * Understanding use of symmetry -line symmetry -rotational symmetry * Spatial recall * Problem solving	1. Use visualization, spatial reasoning, and geometric modeling to solve problems, rotational symmetry.	1. Classify and know properties for various geometric shapes a. Plane (flat) b. 3-D c. Angles d. Transformations e. Pythagorean Theorem	1. Identify geometric figures from a verbal description of its properties.
2. Understand geometrical shapes * Recognize, build, and create 2& 3 dimensional shapes. * Sort and compare shaped by attributes. * Recognize shapes and relationships in the environment.	2. Recognize and identify angles, polygons, coordinate plans, and rotations of symmetry. 3. Analyze characteristics and properties of geometric figures.		2. Understand and analyze properties of transformations, similarity, and congruence.
3. Connections * Within math * Across the curriculum * Real world connections - Interpret simple maps and grids. - Recognize changes made in rearrangements of shapes.		2. Identify and plot points and lines on the Cartesian Plane. a. Slope b. Distance	3. Use Cartesian coordinates such as navigational, polar to analyze geometric situations: -distance - midpoint - slope

			4. Apply geometric properties and relationships in solving multi-step problems in 2 and 3 dimensions.
			5. Emphasize proof by having students communicate with each other and justify methods of solving problems.
			6. Use trig to determine lengths and angle measures.

Measurement Strand K-12

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	Grades 9-12
The Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation), estimation, reasonableness of answers, terminology, notation, and technology should be integrated throughout each content strand to help students develop relational understanding (the "how" and the "why").			
1. Use standard and nonstandard linear measurement and choose correct tool.	1. Convert one type of measurement to another within the same system. (time, capacity, length, etc.) (metric and customary)	1. Identify the appropriate measure of an object as well as which formula is appropriate. (polygons and 3-D figures) a. Stress units and conversions b. Angle measurement	1. Analyze various problems to determine which measurement and tools are appropriate. 2. Solve angle measure problems including angles of triangles and other polygons and parallel lines cut by a transversal.
2. Understand and compare measurable attributes related to weight, area, length, volume, and time.	2. Recognize, select, calculate, estimate, and use correct forms of measurement.	2. Determine the appropriate measure for area, perimeter, circumference, volume, length, and mass a. Apply formulas b. Understand error	3. Solve problems involving area, perimeter, circumference, surface area, volume, arc length, and area of a sector
3. Develop understanding of approximation.	3. Be able to calculate and understand length, area, perimeter, volume, and elapsed time.		4. Analyze accuracy and approximate error in situations.
			5. Understand properties of vectors as magnitude and direction. a. *Apply and use vectors when appropriate in solving problems.

Data Analysis and Probability Strand K-12

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	Grades 9-12
The Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation), estimation, reasonableness of answers, terminology, notation, and technology should be integrated throughout each content strand to help students develop relational understanding (the "how" and the "why").			
1. Investigate, collect, organize, and represent data * using concrete objects * use and create pictures, graphs, and tables	1. Investigate, collect, organize, and demonstrate data.	1. Represent, interpret, and compare data in various ways a. Charts, tables, graphs b. Scatterplots and line of best fit. c. Mean, median, mode, and range d. Determine most appropriate representations	1. Read and analyze various data displays graphs and tables and express the properties of these data displays as algebraic equations. a. Linear, quadratic, exponential b. Includes standard deviation c. Construct sample space d. Evaluate published reports
2. Make inferences and predictions based on reading graphs.	2. Use estimation as a tool to solve problems	2. Use estimates and predictions.	2. Making decisions and predictions based on given information: graphical or written.
3. Probability of something happening	3. Understand and apply basic concepts of probability using experiments and predictions.	3. Find probability a. Independent and dependent events b. Experimental and theoretical probability.	3. Understand concepts of probability (independent and dependent) and compute probability using several methods.

Conclusion

The Importance of the Partnership. By working together as a partnership, we can accomplish much more than any one school or district can individually. It is our hope that this document is the first step in the development of a collaborative and unified vision for mathematics education in East Alabama.

We end by noting that the members of the Curriculum Writing Team did their best in pulling together the best possible sources and their best possible professional wisdom in developing this document. However, as always seems to be the case, we were pushed for time and never got as far as we might have hoped. Thus, please send any comments or suggestions to curriculum@TEAM-Math.net.

Chapter 3

Curriculum for Kindergarten-Grade 2

"Students enter school confident in their own abilities, and they are curious and eager to learn more about numbers and mathematical objects. They make sense of the world by reasoning and problem solving, and teachers must recognize that young students can think in sophisticated ways. Young students are active resourceful individuals who construct, modify, and integrate ideas by interacting with the physical world and with peers and adults. They make connections that clarify and extend their knowledge, thus adding new meaning to past experiences. They learn by talking about what they are thinking and doing and by collaborating and sharing their ideas. Students abilities to communicate through language, pictures, and other symbolic means develop rapidly during these years." (NCTM, 2000)

"All students need adequate time and opportunity to develop, construct, test, and reflect on their increasing understanding of mathematics. Early education must build on the principle that all students can learn significant mathematics." (NCTM, 2000)

The Process Standards, which include, Problem Solving, Reasoning and Proof, Communication, Connections, and Representation are outlined in both national standards (NCTM, 2000) and in the Alabama state standards, (ALSDE, 2003). These Standards are an integral part of students reaching their educational goals and must be incorporated into the K-2 curriculum. In addition, making sense of math and recognizing the reasonableness of answers should be stressed.

In grades K-2, students should be knowledgeable of, and become increasingly comfortable with, using appropriate mathematical terminology and notation in communicating about mathematical and real-world situations.

Appropriate technology should be integrated through out the K-2 curriculum to help students explore, investigate, and solve mathematical problems. Technology should be used to enrich mathematical understanding but does not replace sound, conceptual instruction.

The initial focus for K-2 is number and operations and additional focus on geometry. The six "big ideas" focus on all content strands and include the following:

1. Develop understanding of the base ten number system including the sequence of counting, composition of number, number relationships, and place value.
2. Develop strategies for whole number computations, problems solving with addition and subtraction, and fluency of basic addition and subtraction facts.
3. Model and explain addition and subtraction of whole numbers using objects, pictures, symbols, and extending patterns.
4. Recognize basic shapes, symmetry, and movement to build a foundation for the development of visualization and spatial reasoning.

5. Compare measurable attributes of objects and use nonstandard and standard units for linear measurements.
6. Collect and represent data in various ways using concrete objects, pictures, and symbols.

The K-2 curriculum is organized into five strands that are consistent with both national and state standards: Number, Algebra, Geometry, Measurement, and Data Analysis. While these strands are useful as an organizational device, they are interconnected, and teachers should help students see those connections.

Charts are included in Chapter 2 that present the big ideas for K-2 by content strand. In the following charts, the content for each grade is organized in these five strands. Each column in the chart shows a particular course, and each row shows the relationship between concepts in the courses, thus highlighting the vertical alignment across the courses.

Number Strand, K-2

Kindergarten	Grade 1	Grade 2
1. Whole numbers a. Demonstrate one-to-one correspondence b. Count with understanding and recognize "how many" in sets of objects c. Compare sets of objects using the appropriate terminology d. Know the value of one more and one less e. Use multiple models to represent single digit numbers f. Recognize and connect numerals to quantities they represent g. Identify quarters, dimes, nickels, and pennies	1. Develop an understanding of place value/base 10 to: a. Compose and decompose whole numbers using multiple representations b. Count by ones, fives, and tens to 100 c. Know the value of 10 more or 10 less d. Know what equals 10 e. Connect number words and numerals to the quantities they represent f. Use models to develop and explain the value of a two-digit number g. Determine the monetary value of individual coins and sets of coins up to $1.00	1. Extend an understanding of place value/base 10 to: a. Develop an understanding and use of expanded notation b. Count by multiples to 100 including 3's c. Know the value of 100 more or 100 less d. Represent whole numbers to 1000 e. Develop an understanding of the relationship between ordinal numbers and cardinal numbers f. Use models to develop and explain the value of a 3-digit number g. Determine the monetary value of sets of coins and bills up to $5.00
2. Develop an understanding of addition and subtraction to: a. Relate real life situations to the operations of joining and separating sets b. Use multiple models to compose and decompose single digit whole numbers c. Recognize missing numbers in simple groupings up to 5 d. Model single-digit (numbers to 5) addition and subtraction	2. Develop an understanding of the operations of addition and subtraction to: a. Represent real life number stories to the actions of joining and separating sets using numbers b. Model and explain addition and subtraction with manipulatives, pictures, and symbols c. Demonstrate an understanding of fact families and the commutative property d. Demonstrate computational fluency	2. Extend an understanding of the operations of addition and subtraction to: a. Develop computational fluency with sums through 18 and differences with minuends through 18 b. Solve problems using separation (take-away), comparison (finding the difference), and part-whole (missing addends) c. Use two or three digit addition and subtraction to solve problems

	with basic addition and subtraction facts through 10 e. Solve story problems and determine relevant/irrelevant information f. Use three or more addends g. Solve addition/subtraction problems using 1 or 2-digit numbers	d. Model and explain multiplication as repeated addition with manipulatives, pictures, and symbols e. Model division as equal groupings with manipulatives, pictures, and symbols f. Solve story problems and distinguish relevant/irrelevant information
3. Develop an understanding of fractions to: a. Recognize that objects and sets can be divided into parts b. Compare parts of objects and parts of sets c. Identify parts of objects and parts of sets that appear equal	3. Develop an understanding of fractions to: a. Connect everyday situations to common fractions b. Compare and represent fractions in multiple ways using manipulatives, pictures, and words (1/2, 1/3, ¼) c. Solve real life fraction problems using figures, sets of objects, and linear models d. Identify parts of a whole with two, three, or four equal parts e. Divide an object or set of objects into equal parts	3.Demonstrate an understanding of fractions to: a. Label parts of a whole using fraction notation including ½, 1/3, 1/4 b. Transfer fraction representation from one form to another c. Identify parts of a set as a fractional ratio(3 parts out of 4) d. Represent parts of a whole as a quotient using real life situations (2 cookies divided among 4 people)

Algebra Strand, K-2

Kindergarten	Grade 1	Grade 2
1. Build knowledge and experience with patterns, relations, and functions to: a. Sort objects by color, shape, size, or other properties b. Identify, explain, and extend repeating patterns and recognize the patterns using different materials c. Interpret a pattern in more than one way d. Create patterns	1. Understand patterns, relations, and functions to: a. Sort, classify, and order by size, number, and other properties b. Recognize, describe, and extend shape-patterns, numeric-patterns, and simple functions c. Use graphic organizers to solve problems involving number patterns and functions d. Identify patterns in the environment e. Create a pattern f. Translate patterns from one representation to another	1. Apply an understanding of patterns, relations, and functions to: a. Interpret and explain numeric patterns • Sequence addition (If 32+18=50 and 33+18=51, what would 35+18 be?) • Paired subtraction (If 24-15=9, what is 24-16? b. Use mathematical models to represent and understand quantitative relationships c. Identify missing elements in given patterns d. Extend a growing pattern
2. Use one-to-one correspondence and understanding of likenesses and differences to: a. Determine and explain elements that belong in a pattern, and those that do not belong b. Identify and explain equality using concrete materials (example: six green triangles in pattern blocks are "the same as" one yellow hexagon)	2. Represent number sentences using algebraic symbols a. Understand the use of symbols (+, -, =, <, and >) b. Solve problems using identity (+0) and commutative property	2. Extend use and understanding of number sentences using algebraic symbols: a. Apply concepts of > and < b. Introduce concepts of x and / c. Solve problems using associative and commutative properties d. Solve missing addend problems
	3. Describe qualitative change (students growing taller)	3. Describe change over time (qualitative and quantitative)

Geometry Strand, K-2

Kindergarten	Grade 1	Grade 2
1. Recognize and name two-dimensional shapes to: a. Identify shapes in the environment b. Create combinations of rectangles, squares, circles, and triangles using drawings or concrete materials	1. Describe characteristics and properties of two and three-dimensional geometric shapes to: a. Understand similarities and differences between plane and solid shapes (sort by attribute) b. Recognize and name shapes in the environment c. Build 3D shapes using 2D picture d. Investigate putting together and taking apart two and three-dimensional shapes	1. Analyze geometric relationships using 2D and 3D geometric shapes to: a. Describe attributes of 2-dimensional (plane) and 3-dimensional (solid) figures using terms: side, surface, edge, vertex, angle b. Categorize 2D and 3D shapes and explain groupings according to the properties c. Predict the results of putting together and taking apart 2D and 3D shapes
2. Develop an understanding of movement: a. Demonstrate knowledge of relative position and use vocabulary such as over, under, near, far, between, and other appropriate terminology b. Recognize movement of objects from one location to another c. Follow simple directions to move from one location to another	2. Develop an understanding of positions, directions, and distance to: a. Describe and name relative positions in space using positional terms b. Describe movement using directional terms c. Draw or build maps of familiar space d. Describe movement of objects from one place to another	2. Apply concepts of positions, directions, and distance to: a. Describe the route from one location to another b. Follow multi-step directions to locate objects c. Create and read simple maps d. Use grids to show movement between intersecting points

3. Develop an understanding of transformation and symmetry to: a. Solve puzzles and manipulate shapes in combinations b. Experiment and predict results of folding and cutting two-dimensional materials	3. Use transformations and symmetry to: a. Identify and create shape compositions b. Demonstrate the concept that changing position does not change the properties of a shape or an object c. Identify real-life examples of line symmetry	3. Analyze mathematical situations by applying transformations and using symmetry to: a. Apply slides, flips, or turns to create designs that exhibit line symmetry b. Recognize and create lines of symmetry using everyday objects and geometric figures
4. Develop visualization and spatial reasoning to: a. Recognize the number in simple groupings up to five without counting (example: domino dots) b. Locate items in the environment from physical descriptions	4. Use visualization and spatial reasoning to: a. Create mental images of geometric shapes using spatial memory and visualization b. Recognize and represent shapes from a different perspective (puzzles) c. Locate shapes and structures in the environment	4. Demonstrate visualization and spatial reasoning to: a. Identify images of a simple 3D structure from different perspectives b. Predict resulting image of manipulated figures and objects

Measurement Strand, K-2

Kindergarten	Grade 1	Grade 2
1. Compare objects according to length, height, weight, and volume	1. Compare measurable attributes of objects to: a. Demonstrate and use nonstandard and standard units of linear measurement b. Compare objects according to weight, area, length, and volume	1. Apply appropriate techniques, tools and formulas in measurement to: a. Measure using nonstandard, standard customary and metric units b. Understand the comparison of customary units and metric units to familiar objects c. Demonstrate use of customary and metric units in linear measurement d. Compare and order objects according to related attributes of weight, area, length and volume
2. Use vocabulary associated with the measurement of time, including words related to clocks and calendars	2. Analyze and use analog and digital clocks to: a. Identify hour and half hour	2. Tell time to the minute using analog and digital clocks • Hour, half hour, quarter, 5 minutes (intervals) • Elapsed time 3. Compare everyday experiences to reinforce concepts of time (Example: It takes about the same amount of time to watch a movie as it does to watch a football game.)
	3. Use calendar math a. Identify day, date, month, day before, day after, yesterday, today, tomorrow	

Data Analysis and Probability Strand, K-2

Kindergarten	Grade 1	Grade 2
1. Develop an understanding of data collection to: a. Respond to prepared data collection models (yes/no charts, single Venn diagrams, bar graphs, and other models) b. Use real objects, representative concrete objects, pictures, or symbols to gather data from one's immediate environment c. Sort and classify data collected from the environment d. Make observations about data collected e. Pose questions about oneself or one's surroundings that can be answered with the collection of data	1. Collect, organize, and display data collected from one's environment to: a. Collect data for given questions using multiple display models (yes/no charts; single, double, and double over-lapping Venn diagrams, bar graphs, tallies, and other models) b. Organize and display data with many materials including real objects, representative concrete objects, pictures/drawings, symbols, and numbers c. Make observations, identify patterns, pose additional questions, and make predictions from data collected d. Generate questions and determine the data needed to arrive at answers	1. Collect, organize, and display data in multiple ways from self-generated questions to: a. Use multiple display models (yes/no charts; single, double, and double over-lapping Venn Diagrams; circle graphs; vertical/horizontal bar graphs, frequency tables; tallies; and other models) b. Organize, plan, collect, and interpret data to answer self-generated questions or to make decisions c. Recognize patterns in data collected d. Represent data in multiple ways
2. Communicate possible and impossible outcomes in a given concrete situation	2. Communicate events and outcomes of everyday events and simple investigations as possible/impossible; or as likely/unlikely	2. Communicate events and outcomes in appropriate probability terminology (certain, likely, equally likely, unlikely, possible, impossible, fair)
		3. Evaluate and redefine predictions using cognitive benchmarks

Chapter 4

Curriculum for Grades 3-5

"Most students enter grade 3 with enthusiasm for, and interest in, learning mathematics. They find it practical and believe that what they are learning is important. Instruction at this level must be active and intellectually stimulating and must help students make sense of mathematics. In grades 3-5, multiplicative reasoning, equivalence, and computational fluency should be the focus. (NCTM, 2000)

The Process Standards, which include Problem Solving, Reasoning and Proof, Communication, Connections, and Representation, are outlined in both the national standards (NCTM, 2000) and in the Alabama state standards (ALDSE, 2003). These standards are an integral part of students reaching their educational goals and must be incorporated into the 3-5 curriculum. In addition, estimation and recognizing the reasonableness of answers should be stressed.

In grades 3-5, students should become knowledgeable of and begin the use of appropriate mathematical terminology in communicating about mathematical and real-world situations.

Appropriate technology should be integrated throughout the 3-5 curriculum to help students see the real-world connections of the mathematics they are studying and to develop understanding of the mathematical concepts. This will also help prepare them for the demands of technology in the workplace.

The 3-5 group identified the following big ideas that should guide instruction in those grades:

1. Establish computational fluency, equivalency, and multiplicative reasoning (Algebra, Number & Operations)
2. Correlate patterns between geometry, algebra, and other areas. (Algebra, Geometry, Connections)
3. Use questioning, justifying, and communicating to develop mathematical reasoning. (Reasoning, Communication, Connections, Problem Solving)
4. Investigate, collect, organize, and demonstrate data. (Data Analysis, Communication, Representation, Number & Operations, Measurement)
5. Understand measurable attributes of objects, unit systems, and the process of measurement. (Measurement, Geometry, Algebra, Number & Operations, Reasoning, Connections)
6. Recognize, identify, and classify geometric figures. (Geometry, Connections, Reasoning, Representation, Communication)

The 3-5 curriculum is organized into five strands that are consistent with both national and state standards: Number, Algebra, Geometry, Measurement, and Data Analysis. While these strands

are useful as an organizational device, they are interconnected, and teachers should help students see those connections.

Number Strand, 3-5

Grade 3	Grade 4	Grade 5
1. Order, compare… a. Compare, order, round, and expand whole numbers to thousands b. Demonstrate and understand place value from hundredths to 9999 by using words, models, and pictorial representations, including the use of coins to make change. c. Understand the use of decimals when writing dollar amounts d. Demonstrate computational fluency in addition, subtraction, and basic multiplication and division e. Demonstrate and understand addition and subtraction of fractions with like denominators	1. Order, compare… a. Compare, order, and expand whole numbers to millions b. Understand and demonstrate place value from hundredths through hundred thousands using words, models, and pictorial representation, including money in dollars and cents c. Determine place value in a decimal through hundredths d. Demonstrate an understanding and use of equivalency in fractions and decimals e. Rename improper fractions as mixed numbers and mixed numbers as improper fractions f. Demonstrate and understand addition and subtraction of fractions with like and unlike denominators	1. Compare, order… a. Compare, order, round, and expand whole numbers through millions and decimals to the thousandths b. Determine the value of a whole number to the millions and decimals to the thousandths c. Determine equivalency between fractions, decimals, and percents d. Identify numbers less than zero on a number line and in real life situations
2. Computation a. Regroup two and three digit numbers in addition and subtraction and multiply two digit numbers by a one digit number b. Divide two digit dividends by one digit divisors with and without remainders c. Solve real life problems involving numerical and/or rounding concepts and using estimation, mathematical reasoning, appropriate and non-routine strategies	2. Computation a. Demonstrate computational fluency in basic addition, subtraction, multiplication, and division b. Regroup in subtraction and addition problems with hundreds, through hundred thousands c. Divide using one digit divisors with and without remainders d. Multiply using two digit multipliers	2. Computational Methods a. Identify and use relationships between operations such as inverse operations b. Multiply larger whole numbers with two digit multipliers c. Divide larger whole numbers by two digit divisors d. Multiply and divide decimals
3. Estimate sums and differences by using compatible numbers and front-end estimation	3. Round whole numbers to nearest ten, hundred, and thousands	3. Fractions a. Adding, subtracting, and multiplying

		fractions with common and uncommon denominators b. Changing mixed numbers to improper fractions and improper fractions to mixed numbers c. Simplifying fractions, making equivalent fractions d. Identify and use order of operation rules
		4. Number Theory a. Find and use the least common multiple (LCM) by listing multiples of the numbers involved and greatest common factor (GCF) by listing factors of the numbers involved b. Determine divisibility of numbers 2, 3, 4, 5, 6, 9, and 10 c. Introduce prime and composite numbers
4. Demonstrate number sense by comparing, ordering, and expanding whole numbers	4. Solve real life problems using: • Basic operations • Estimating • Reasoning	5. Problem solving • Solve problems using basic operations on whole numbers, fractions, and decimals • Solve problems by estimating sums, differences, products, and quotients
5. Fractions • Introduce representations for common fractions of 10 x 10 grids and interpret display as decimals and percents (10^{th} and 100^{th}) • Recognize understanding and use of equivalency sentences and fractions	5. Extend to notions of equivalence (50/100 = ½ = 50%)	6. Convert fractions to decimals and percents
6. Introduce ratios in problem solving situations	6. Extend the understanding of ratios and develop the concept of proportions in problem solving: • Equivalent fractions • Unit rate • Factor of change	7. Use ratios and proportions in real life applications such as scale drawings: • Equivalent fractions • Unit rate • Factor of change

Algebra Strand, 3-5

Grade 3	Grade 4	Grade 5
1. Identify properties of operations, such as commutative, associative, and distributive and use them to compute whole numbers, including the inverse relationships between addition/subtraction and multiplication/division 2. Complete numeric, geometric, and symbolic patterns	1. Understand and use the associative, distributive, and commutative properties to solve problems 2. Complete and extend patterns with symbols, numbers, and units	1. Demonstrate the use of commutative, distributive, associative, and identity properties of addition and multiplication
3. Model problem situations with objects and use representation such as graphs, tables, and equations to draw conclusions	3. Write a number sentence for a problem expressed in words	2. Write a number sentence or sentences for a problem expressed in words involving multiple steps
4. Complete an addition or subtraction number sentence with missing addend or subtrahend	4. Solve number sentences for a missing addend, subtrahend, or factor	3. Realize a variable is an unknown quantity represented by a letter or a symbol 4. Solve simple algebraic equations 5. Express mathematical relationships using equations 6. Find the output of functions (number machines)

Geometry Strand, 3-5

Grade 3	Grade 4	Grade 5
1. Identify, compare, classify, and analyze attributes of two and three dimensional shapes: • Congruency and similarity • Horizontal, vertical, and diagonal lines and line segments • Lines of symmetry within given shapes	1. Identify, compare, classify, and analyze geometric solid and plane figures including: • Symmetry (rotational and mirror for plane figures) • Congruency	1. Identify figures that have a rotational symmetry 2. Identify and explore geometric shapes in terms of their angles and sides: • Identify angles as right, obtuse, acute or straight • Classify triangles as equilateral, isosceles, or scalene • Components of a circle: center, radius, diameter, and introduce circumference
2. Predict and describe the results of sliding, flipping, and turning two-dimensional shapes	2. Identify reflection (flip), rotation (turn), and translation (slide) and make predictions	3. Use either transformations (slides, flips, or turns) or measurements to determine the congruence of angles, line segments, and polygons
3. Find the distance between points along horizontal and vertical lines on a coordinate system 4. Describe location and movement using common language and geometric vocabulary	3. Locate and name coordinates on a grid (ordered pairs): • Parallel and perpendicular lines • Edges • Vertices • Angles • Surfaces	4. Identify the x-axis, y-axis, origin, and quadrants on the Cartesian Plane 5. Locate points on the coordinate grid using ordered pairs
5. Build and draw geometric shapes	4. Identify and build a three-dimensional object from a two-dimensional object	6. Identify the nets (combination of two-dimensional shapes to make three-dimensional shapes) for three-dimensional shapes
6. Problem solving using geometric models in other areas of mathematics	5. Solve problems using: • Predicting • Estimating • Spatial reasoning	7. Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life

Measurement Strand, 3-5

Grade 3	Grade 4	Grade 5
1. Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems 2. Select and apply appropriate units and tools of measurement based on given attributes (length, area, weight, volume)	1. Identify appropriate units and tools of measurement in customary and metric units	1. Use appropriate units and tools of measurement in customary and metric units
3. Carry out simple unit conversions (cm-m) within a system	2. Convert units of measurement within the same system	2. Convert a larger unit of measurement into a smaller unit of measurement and vice versa (length, capacity, time, weight)
4. Find and estimate perimeter and area of given geometric shapes	3. Determine and use estimated and exact measurement of perimeter and area in real life situations	3. Develop and use formulas to find and/or estimate the perimeter of all shapes and area of parallelograms 4. Calculate the area and perimeter of measured dimensions
5. Solve problems involving elapsed time, temperature, spatial reasoning, and calendar concepts	4. Calculate elapsed time, minutes, hours, days, and so forth to solve problems	5. Solve problems using elapsed time and money

Data Analysis and Probability Strand, 3-5

Grade 3	Grade 4	Grade 5
1. Collect and represent data using a variety of tables, graphs, and charts	1. Collect, represent, interpret, and analyze data using a variety of tables, graphs, charts, and grids 2. Develop an understanding of mean, median, and range	1. Collect data through investigating and be able to organize and demonstrate the data in a variety of ways: charts, tables, graphs, and grids 2. Analyze data using measures of central tendency: mean, median, mode, and range
2. Recognize data as either categorical or numerical	3. Determine if an outcome of simple events are likely, certain, or impossible	
3. Predict the probability of outcomes of simple experiments and test the predictions	4. Understand the concept of probability and use it to predict outcomes of a given situation	3. Apply and understand concepts of probability using experiments and predictions

Chapter 5

Curriculum for Grades 6-8

"Middle grades students experience physical, emotional, and intellectual changes that mark the middle grades as a significant transition point in their lives. During this time, many students will solidify conceptions about themselves as learners of mathematics – about their competence, their attitude, and their interest and motivation. These conceptions will influence how they approach the study of mathematics in later years, which will in turn influence their life opportunities." (NCTM 2000).

The Process Standards, which include Problem Solving, Reasoning and Proof, Communication, Connections, and Representation are outlined in both national standards (NCTM 2000) and in the Alabama state standards (ALSDE 2003). These standards must be integrated into the 6-8 curriculum in order to "deepen students' understanding of mathematical concepts." (ALSDE 2003). Along with these standards, estimating and recognizing the reasonableness of answers should be stressed.

Students in grades 6-8 should be expected to use appropriate mathematical terminology when communicating about mathematics and explain their reasoning. Students should be encouraged to "verbalize, illustrate, or record their mathematical thought processes" (ALSDE 2003).

Appropriate technology should be integrated throughout the 6-8 curriculum to help students see the real-world connections of the mathematics they are studying and to develop understanding of the mathematical concepts. This will also help prepare them for the demands of technology in the workplace.

Five "big ideas" provide focus for the 6-8 curriculum. Through their study in these courses, students should be able to:

1. Represent numbers in a variety of ways.
2. Apply proportional reasoning in a variety of contexts including unit rates and slope.
3. Solve linear and nonlinear equations.
4. Recognize and classify geometric figures.
5. Interpret, analyze, compare, and represent data using probability and statistics.

The 6-8 curriculum is organized into five strands that are consistent with both national and state standards: Number, Algebra, Geometry, Measurement, and Data Analysis. While these strands are useful as an organizational device, they are interconnected, and teachers should help students see those connections.

Number Strand, 6-8

Grade 6	Grade 7	Grade 8 (Pre-algebra)
1. Use operations involving place value, fractions, decimals, common percents, rational numbers, and determine reasonableness of an answer: • Exponents • Distributive • Real number line (including integers) • Integers (add) • Order of operations (+, -, x, /) • Compare and order	1. Use operations involving fractions, decimals, percents, introduce irrationals, scientific notation, integers, and determine reasonableness of an answer: • Exponents • Sets • Properties • Order of operations • Compare and order • Real number line	1. Use operations involving real numbers, percents, scientific notation, and determine the reasonableness of an answer: • Exponents • Sets • Properties (substitution principle) • Order of operations • Compare and order • Real number line
2. Introduce prime factorization 3. Use divisibility rules or prime factorization to determine if a number is prime or composite	2. Use prime factorization to find LCM and GCF	2. Apply LCM, GCF, and prime/composite in various contexts: • Simplifying fractions • Simplifying algebraic expressions • Solving real world problems
4. Convert terminating decimals to fractions and percents 5. Solve problems involving decimals, fractions, percents, and proportions	3. Extend computation to percents greater than 100 and less than 1 4. Expand problem solving situations to include: • Discounts • Taxes • Commissions • Simple interest	3. Determine percent of change 4. Apply percents and proportions to real world situations and in multi-step problems
6. Extend strategies for solving proportions to using cross products 7. Select appropriate strategies for solving proportions	5. Use proportional reasoning to solve problems	5. Apply proportional reasoning to real world situations: • Ratios and rates • Properties • Comparing quantities • Scaling ratios up or down • Similarity

Algebra Strand, 6-8

Grade 6	Grade 7	Grade 8 (Pre-algebra)
1. Determine a verbal rule for a function when given the input and output 2. Solve problems using geometric and numeric patterns	1. Explore Functions • Represent and determine a rule for data that appears with tables, graphs, charts, and mappings • Determine the range and domain • Investigate the role of functions in real world situations	1. Extend working knowledge of Functions: • Determine the range for a given domain • Introduce and use function notation: f(x) • Patterns • Independent/dependent variables • Apply to real world situations 2. Relations • Linear; slope, and y-intercepts • Nonlinear
3. Solve one-step equations	2. Solve one and two step equations and inequalities 3. Inequalities-graph on number line	3. Solve multi-step equations and inequalities, including the distributive property

Geometry Strand, 6-8

Grade 6	Grade 7	Grade 8 (Pre-algebra)
1. Based on attributes, properties, and component parts (sides, angles, parallel and perpendicular lines) identify and classify: • Quadrilaterals and triangles • Circles • Prisms and pyramids • Cylinders and cones	1. Recognize, compare, and draw two-dimensional and three-dimensional objects 2. Investigate properties and relationships among similar and congruent figures	1. Develop mathematical arguments about the relationships among types of quadrilaterals and triangles: • Identify angle bisectors, perpendicular bisectors, congruent angles, and congruent figures • Constructing congruent and similar polygons, congruent angles, congruent segments, and parallel and perpendicular lines
2. Identify transformations on coordinate plane	3. Graph the transformations and dilation of geometric figures in the Cartesian plane	

3. Identify line and rotational symmetries of polygons	4. Determine the types of symmetry (rotational or line) found in a reflection or rotation	
	5. Use networks to represent and solve problems	
		2. Derive, justify, and apply the Pythagorean Theorem (distance formula)

Measurement Strand, 6-8

Grade 6	Grade 7	Grade 8 (Pre-algebra)
1. Convert units of length, width, or capacity within the same system (Example: cups to gallons)	1. Convert units of length, width, or capacity from metric to customary and from customary to metric 2. Determine unit rates	1. Convert between systems 2. Convert between units in area and volume
2. Estimate, measure, and classify angles	3. Determine the measures of special angle pairs including: • Adjacent • Vertical • Supplementary • Complementary	3. Investigate the measures of special angle pairs formed by two or more lines cut by a transversal including: • Corresponding • Alternate Interior • Alternate Exterior • Consecutive Interior/Exterior
3. Develop and apply formulas (perimeter and area): • Triangles and trapezoids • Understand error 4. Develop and apply the volume of a rectangular prism (area of base multiplied by height)	4. Develop and apply the concept of pi and the formulas for circumference and area for circles 5. Develop and apply the formula for the volume of a prism and cylinder	4. Find the perimeter and area of regular and irregular plane figures 5. Develop and apply the surface area and volume of prisms, cylinders, pyramids, and cones
5. Use scale drawings and proportions to determine distance	6. Determine the lengths of missing sides and measures of angles in similar and congruent figures	6. Apply concept of similar and congruent figures to real world situations, such as indirect measurement

Data Analysis and Probability Strand, 6-8

Grade 6	Grade 7	Grade 8 (Pre-algebra)
1. Interpret and represent data from charts and tables in bar graphs, line graphs, and circle graphs (1/2 and ¼ of a circle) 2. Find the mean, median, mode, and range from a list of data	1. Interpret and represent data using and creating histograms, frequency tables, stem-and-leaf, and circle graphs (using angle measures) 2. Determine measures of central tendency (mean, median, and mode) and the range, given a set of data or graphs	1. Interpret, represent, and compare data sets: • Box-and-whisker plots • Scatter plot • Circle graph • Determine the measure of center that is most appropriate for a given situation
3. Make estimates or predictions based on given data	3. Determine the validity of data, estimation, and predictions	2. Make predictions and estimations for a set of data, including using the line of best fit
4. Find the probability of a simple event using ratios, percents, and decimals	4. Determine the probability of compound events: • Represent outcomes as a list, chart, picture, or tree diagram (fundamental counting principle) • Model problem	3. Determine the theoretical probability of events: • Complementary and mutually exclusive events • Two independent or two dependent events 4. Determine the experimental probability of an event through simulation and compare the theoretical probabilities

Chapter 6

Curriculum for 9-12

"The high school years are a time of major transition. Students enter high school as young teenagers, grappling with issues of identity and with their own mental and physical capacities. In grades 9–12, they develop in multiple ways—becoming more autonomous and yet more able to work with others, becoming more reflective, and developing the kinds of personal and intellectual competencies that they will take into the workplace or into postsecondary education." (NCTM, 2000)

The Process Standards, which include Problem Solving, Reasoning and Proof, Communication, Connections, and Representation, are outlined in both national standards (NCTM, 2000) and in the Alabama state standards (ALSDE, 2003). These Standards are an integral part of students reaching their educational goals and must be incorporated into the 9-12 curriculum. In addition, estimation and recognizing the reasonableness of answers should be stressed.

In grades 9-12, students should be knowledgeable of, and become increasingly comfortable with, using appropriate mathematical terminology and notation in communicating about mathematical and real-world situations.

Appropriate technology should be integrated throughout the 9-12 curriculum to help students see the real-world connections of the mathematics they are studying and to develop understanding of the mathematical concepts. This will also help prepare them for the demands of technology in the workplace.

The initial focus of this chapter is on Algebra I, Geometry, and Algebra II with Trigonometry, as the basic foundation for high school mathematics. At a later point, this chapter will be extended to include additional courses as needed.

Six "big ideas" provide focus for Algebra I, Geometry, and Algebra II with Trigonometry. Through their study in these courses, students should be able to:

1. Analyze and graph relations and functions, including direct and indirect variation, trigonometric relationships, and exponential functions.
2. Solve linear and nonlinear equations and inequalities in one, two, and three variables, including applications of matrices.
3. Explore the properties of and relationships among number systems (whole numbers through real and imaginary numbers), among types of geometric figures (two- and three-dimensional), and among families of functions (including trigonometric identities).
4. Explore geometric patterns and relationships, including transformations, similarity, and congruence.
5. Interpret, compare, analyze, and represent data using probability and statistics.

6. Solve problems using estimation and measurement, algebraic notation, modeling, and other techniques, enhancing students' ability to justify answers and prove results.

The 9-12 curriculum is organized into five strands that are consistent with both national and state standards: Number, Algebra, Geometry, Measurement, and Data Analysis. While these strands are useful as an organizational device, they are interconnected, and teachers should help students see those connections.

Charts are included in Chapter 2 that present the big ideas for 9-12 by content strand. In the following charts, the content for each course is organized in these five strands. Each column in the chart shows a particular course, and each row shows the relationship between concepts in the courses, thus highlighting the vertical alignment across the courses.

Number Strand, 9-12

Algebra I	Geometry	Algebra II with Trigonometry
1. Order and compare real numbers emphasizing irrational numbers.		
		2. Distinguish between various number sets: Complex (Course of Study #1)
3. Distinguish between number sets: real, rational, irrational, whole, integer.		3. Understand and apply concepts and properties of complex numbers (Course of Study #2)
4. Perform operations involving • Real numbers including radicals • Exponents (Course of Study #1)	4. Apply operations involving radicals and introduce operations with vectors.	4. Perform operations involving: • Reals with radicals • Complex numbers (Course of Study #2) • Common logarithms • Rational expressions (Course of Study #6) • Calculate a determinate for a 2x2 and 3x3 matrix (Course of Study #8)

Algebra Strand, 9-12

Algebra I	Geometry	Algebra II with Trigonometry
1. A. Identify and graphically represent: (Course of Study #4) • x=constant • y=constant • y=x (identity) • y=$\sqrt{x}$ • y=x^2 • y=$\lvert x \rvert$ B. Investigate and translate vertically and horizontally: • x=constant	1. A. Extend solving equations and inequalities to applications. B. Reinforce and apply operations on polynomials	1. A. Identify and graphically represent: (Course of Study #3) • y=kx • y=a^x • y=k/x • y=x^3 • y=$\log_a x$ • y=[x] • y=sin x • y=cos x • y=tan x • Constructing graphs by analyzing their

• y=constant • y=x (identity) • y=$\sqrt{x}$ • y=x^2 • y=$\lvert x \rvert$ C. Analyze linear functions from their slopes, equations, and intercepts: (Course of Study # 2) • Find slope of a line form equation or using slope formula. • Determine the equations of linear functions given 2 points, a point and slope, tables of values, graphs, and ordered pairs. • Graph two-variable linear equations and inequalities on the Cartesian plane. D. Determine the equation of a line parallel or perpendicular to a second line through a given point (Course of Study # 7) E. Determine the characteristics of a relation, including: (Course of Study #3) • Domain • Range • Whether it is a function when given graphs, tables of functions, mappings, or sets of ordered pairs. F. Solve equations and inequalities including: (Course of Study #7) • Multi-step linear • Radical • Absolute value • Literal • Linear systems in two variables (Course of Study #8)		functions as sums, differences, or products (Course of Study #6 c) B. Translate, rotate, dilate, and reflect linear, quadratic, cubic, rational, exponential, logarithmic, trigonometric, absolute value, and radical functions. (Course of Study #3) C. Analyze families of functions including: • Domain (Course of Study #3) • Range • Restricted domains • Roots (Course of Study #4) • Maximum and minimum values (Course of Study #5) Given a graph, table of values, or its equation. D. Determine period and amplitude of sine, cosine, and tangent functions from graphs or basic equations. (Course of Study #9) E. Solve equations and inequalities including: • Quadratics • Absolute value • Radical • Exponential • Common logarithmic • Linear systems in 2 and 3 variables, including matrices. (Course of Study # 8) • Develop quadratic formula

• Factorable quadratics (Course of Study #9) • Using the quadratic formula G. Write in set notation and graph solutions of an equation or inequality (Course of Study #7)		
2. Model real world problems by developing and solving equations and inequalities including inverse and direct variation, systems of equations, and simple number theory. (Course of Study #7 & #8)		2. Solving word problems involving real life situations. (Course of Study #8)
3. Perform operations on polynomial expressions: (Course of Study #5)` • + • - • x • / by a monomial • factor (not sum and difference of cubes)	3. Applying factoring when problem solving.	3. Perform operations on functions: • + • - • x • / • Composition • Inverse • Factor polynomials including sum and difference of cubes (Course of Study #6)

Geometry Strand, 9-12

Algebra I	**Geometry**	**Algebra II with Trigonometry**
	1. Identify geometric figures from a verbal description of its properties. (Course of Study #3 & #14)	
	2. Understand and analyze properties of transformations, similarity, and congruence. (Course of Study #8 & #13)	
3. Calculate length, midpoint, and slope of a line segment given coordinates. (Course of Study #10)	3. Apply distance, midpoint, and slope formulas to solve problems and to confirm properties of polygons. (Course of Study #12)	
	4. Apply geometric properties and relationships in solving multi-step problems in 2 & 3 dimensions. (Course of Study #5 & #6)	

5. Derive the distance, midpoint, and slope formulas. (Course of Study #10)	5. Emphasize proof by having students communicate with each other and justify theorems and methods of solving problems. (Course of Study #2 & #8)	5. Verify simple trigonometric identities using Pythagorean and/or reciprocal identities. (Course of Study #12)
	6. Determine lengths of sides and angle measures of triangles (including the use of trigonometry) (Course of Study #4 bullet & Course of Study #7 & Course of Study #10)	6. 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 (Course of Study #10) 7. 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. (Course of Study #11)

Measurement Strand, 9-12

Algebra I	**Geometry**	**Algebra II with Trigonometry**
1. Analyze various problems to determine which measurement and tools are appropriate in relation to Algebra I topics, including analyzing accuracy and approximate error.	1. Analyze various problems to determine which measurement and tools are appropriate in relation to Geometry topics, including analyzing accuracy and approximate error.	1. Analyze various problems to determine which measurement and tools are appropriate in relation to Algebra II topics, including analyzing accuracy and approximate error.
	2. 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 (Course of Study #4)	
3. Solve problems algebraically that involve area and perimeter of a polygon, area and	3. Determine the areas and perimeters of regular polygons, including inscribed or	

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 (Course of Study #11)	circumscribed polygons, given the coordinates of vertices or other characteristics.(Course of Study #11) 4. 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 (Course of Study #15) 5. 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 (Course of Study #16)	
	6. Identify the coordinates of the vertices of the image of a given polygon that is translated, rotated, reflected, or dilated. Example: using a translation vector, rotating a triangle a given number of degrees around a specific point (Course of Study #13)	

Data Analysis and Probability Strand, 9-12 **Tuesday, June 24, 2003**

Algebra I	Geometry	Algebra II with Trigonometry
1. 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 • Determining effects of outliers • Evaluating the appropriateness of the design of a survey (Course of Study #12)		
	2. Distinguishing between conclusions drawn when using deductive and statistical reasoning (Course of Study #17a)	2. 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 (Course of Study #13)
3. 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. (Course of Study #14)	3. Construct with precision a circle graph to represent data from given tables or classroom experiments. (Course of Study #18)	3. 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 (Course of Study #14)
4. Identify characteristics of a data set, including measurement or categorical and univariate or bivariate. (Course of Study #13)	4. Analyze sets of data from geometric contexts to determine what, if any, relationships exist. (Course of Study #17a)	
5. Estimate probabilities given data in lists or graphs. • Comparing theoretical and experimental probabilities	5. Calculating probabilities arising in geometric contexts (Course of Study #17b)	5. Calculate probabilities of events using the laws of probability. • Using permutations and combinations to calculate probabilities

(Course of Study #15)		• Calculating conditional probability • Calculating probabilities of mutually exclusive events, independent events, and dependent events (Course of Study #15)

Appendix A

Members of the Curriculum Writing Team

According to TEAM-Math records, the following persons attended at least *two* of the Curriculum Writing Team's meetings:

Name	District	Name	District
Michele Barnes	Chambers County	Carol McDaniel	Tallassee City
Sara Boone	Lee County	Angelika McGuire	Auburn City
Evelyn Boyd	Elmore County	Sharon Minnifield	Macon County
Karen Brooks	Phenix City	Donna Nall	Alexander City
Teresa Burns	Tallapoosa County	Pam Norris	Opelika City
Terrica Carlisle	Tallassee City	Kimberly Nunes-Bufford	Opelika City
Shirley Carter	Lanett City	Barbara Pickard	Tallassee City
Frazelma Crittenden-Lynn	Opelika City	Beverly Price	Tallapoosa County
Tammy Culbertson	Chambers County	Equvia Rhodes	Opelika City
Donna Cunningham	Tallassee City	Jeannie Riddle	Alexander City
Jackie Deen	Lanett City	Stacy Royster	Opelika City
Christie Drury	Lee County	Greg Sanders	Russell County
Leigh Ann Flemming	Phenix City	Becky Scarborough	Auburn City
Lew Germann	Phenix City	Melissa Smith	Lanett City
Kimberly Harris	Lee County	Theressa Stanford Barnes	Chambers County
Donna Henderson	Lanett City	Rosa Stokes	Elmore County
Beth Hickman	Lee County	Rhonda Strickland	Alexander City
Lasisi Hooks	Macon County	Darrell Thomas	Auburn City
Amy Hopkins	Russell County	Vanessa Tolbert	Tallapoosa County
Jackie Jackson	Chambers County	Allison Tuthill	Phenix City
Yvette Johnson	Elmore County	Bertha Walker	Macon County
Catherine Jones	Elmore County	Nancy Washburn	Alexander City
Debbie Kielwein	Alexander City	Cynthia Weaver	Phenix City
Lisa Lishak	Russell County	Judy Welch	Elmore County
Kristy Mann	Tallassee City	Teresa Williams	Alexander City
Michele Matin	Opelika City	Sandi Woods	Alexander City
Jerrie Mattox	Alexander City	Anna Wright	Auburn City
Robin McCoy	Russell County		

The following faculty members and graduate students from Auburn University and Tuskegee University also participated in the process:

Joy Black	Leslie Sitton
Dr. Gary Martin	Dr. Marilyn Strutchens
Dr. Mohammed Qazi	Dr. Steve Stuckwisch
Dr. Chris Rodger	Kathy Westbrook
Dr. Betty Senger	Dr. Phil Zenor