Mathematics Georgia Performance Standards
K-12 Mathematics Introduction

The Georgia Mathematics Curriculum focuses on actively engaging the students in the development of mathematical understanding by using manipulatives and a variety of representations, working independently and cooperatively to solve problems, estimating and computing efficiently, and conducting investigations and recording findings. There is a shift towards applying mathematical concepts and skills in the context of authentic problems and for the student to understand concepts rather than merely follow a sequence of procedures. In mathematics classrooms, students will learn to think critically in a mathematical way with an understanding that there are many different ways to a solution and sometimes more than one right answer in applied mathematics. Mathematics is the economy of information. The central idea of all mathematics is to discover how knowing some things well, via reasoning, permit students to know much else—without having to commit the information to memory as a separate fact. It is the connections, the reasoned, logical connections that make mathematics manageable. As a result, implementation of Georgia's Performance Standards places a greater emphasis on problem solving, reasoning, representation, connections, and communication.

Georgia Performance Standards
GPS Pre-Calculus

This is a course in pre-calculus and statistics, designed to prepare students to enter college at the calculus level. It includes rational, trigonometric, and inverse trigonometric functions; basic trigonometric identities and the laws of sines and cosines; sequences and series; vectors; the central limit theorem and confidence intervals.

(*Prerequisite: Successful completion of GPS Advanced Algebra.*)
Instruction and assessment should include the appropriate use of manipulatives and technology. Topics should be represented in multiple ways, such as concrete/pictorial, verbal/written, numeric/data-based, graphical, and symbolic. Concepts should be introduced and used, where appropriate, in the context of realistic phenomena.

ALGEBRA

Students will analyze rational and trigonometric functions. Students will investigate and apply sequences and series and will understand and use vectors.

MM4A1. Students will explore rational functions.

a. Investigate and explain characteristics of rational functions, including domain, range, zeros, points of discontinuity, intervals of increase and decrease, rates of change, local and absolute extrema, symmetry, asymptotes, and end behavior.
b. Find inverses of rational functions, discussing domain and range, symmetry, and function composition.
c. Solve rational equations and inequalities analytically, graphically, and by using appropriate technology.

MM4A2. Students will use the circle to define the trigonometric functions.

a. Define and understand angles measured in degrees and radians, including but not limited to 0°, 30°, 45°, 60°, 90°, their multiples, and equivalences**.**

b. Understand and apply the six trigonometric functions as functions of general angles in standard position.

c. Find values of trigonometric functions using points on the terminal sides of angles in the standard position.

d. Understand and apply the six trigonometric functions as functions of arc length on the unit circle.

e. Find values of trigonometric functions using the unit circle.

MM4A3. Students will investigate and use the graphs of the six trigonometric functions.

a. Understand and apply the six basic trigonometric functions as functions of real numbers.

b. Determine the characteristics of the graphs of the six basic trigonometric functions.

c. Graph transformations of trigonometric functions including changing period, amplitude, phase shift, and vertical shift.

d. Apply graphs of trigonometric functions in realistic contexts involving periodic phenomena.

MM4A4. Students will investigate functions.

a. Compare and contrast properties of functions within and across the following types: linear, quadratic, polynomial, power, rational, exponential, logarithmic, trigonometric, and piecewise.

b. Investigate transformations of functions.

c. Investigate characteristics of functions built through sum, difference, product, quotient, and composition.

MM4A5. Students will establish the identities below and use them to simplify trigonometric expressions and verify equivalence statements.

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

$$\cot\theta = \frac{\cos\theta}{\sin\theta}$$

$$\sec\theta = \frac{1}{\cos\theta}$$

$$\csc\theta = \frac{1}{\sin\theta}$$

$$\sin^2\theta + \cos^2\theta = 1$$

$$\tan^2\theta + 1 = \sec^2\theta$$

$$1 + \cot^2\theta = \csc^2\theta$$

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$$

$$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$$

$$\sin(2\theta) = 2\sin\theta\cos\theta$$

$$\cos(2\theta) = \cos^2\theta - \sin^2\theta$$

MM4A6. Students will solve trigonometric equations both graphically and algebraically.

a. Solve trigonometric equations over a variety of domains, using technology as appropriate.
b. Use the coordinates of a point on the terminal side of an angle to express x as $r\cos\theta$ and y as $r\sin\theta$.
c. Apply the law of sines and the law of cosines.

MM4A7. Students will verify and apply $A = -absinC$ to find the area of a triangle.

MM4A8. Students will investigate and use inverse sine, inverse cosine, and inverse tangent functions.

a. Find values of the above functions using technology as appropriate.
b. Determine characteristics of the above functions and their graphs.

MM4A9. Students will use sequences and series.

a. Use and find recursive and explicit formulas for the terms of sequences.
b. Recognize and use simple arithmetic and geometric sequences.
c. Find and apply the sums of finite and, where appropriate, infinite arithmetic and geometric series.
d. Use summation notation to explore finite series.

MM4A10. Students will understand and use vectors.

a. Represent vectors algebraically and geometrically.
b. Convert between vectors expressed using rectangular coordinates and vectors expressed using magnitude and direction.
c. Add, subtract, and compute scalar multiples of vectors.
d. Use vectors to solve realistic problems.

DATA ANALYSIS AND PROBABILITY

Students will organize, represent, investigate, interpret, and make inferences from data, using the central limit theorem and the standard normal distribution. Students will apply the Central Limit Theorem to calculate confidence intervals for a population mean using data from large samples. Students will use sample data and confidence intervals to draw conclusions about populations.

MM4D1. Using simulation, students will develop the idea of the central limit theorem.

MM4D2. Using student-generated data from random samples of at least 30 members, students will determine the margin of error and confidence interval for a specified level of confidence.

MM4D3. Students will use confidence intervals and margins of error to make inferences from data about a population. Technology is used to evaluate confidence intervals, but students will be aware of the ideas involved.

Process Standards

The following process standards are essential to mastering each of the mathematics content standards. They emphasize critical dimensions of the mathematical proficiency that all students need.

MM4P1. Students will solve problems (using appropriate technology).

a. Build new mathematical knowledge through problem solving.
b. Solve problems that arise in mathematics and in other contexts.
c. Apply and adapt a variety of appropriate strategies to solve problems.
d. Monitor and reflect on the process of mathematical problem solving.

MM4P2. Students will reason and evaluate mathematical arguments.

a. Recognize reasoning and proof as fundamental aspects of mathematics.
b. Make and investigate mathematical conjectures.
c. Develop and evaluate mathematical arguments and proofs.
d. Select and use various types of reasoning and methods of proof.

MM4P3. Students will communicate mathematically.

a. Organize and consolidate their mathematical thinking through communication.
b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
c. Analyze and evaluate the mathematical thinking and strategies of others.
d. Use the language of mathematics to express mathematical ideas precisely.

MM4P4. Students will make connections among mathematical ideas and to other disciplines.

a. Recognize and use connections among mathematical ideas.
b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
c. Recognize and apply mathematics in contexts outside of mathematics.

MM4P5. Students will represent mathematics in multiple ways.

a. Create and use representations to organize, record, and communicate mathematical ideas.
b. Select, apply, and translate among mathematical representations to solve problems.
c. Use representations to model and interpret physical, social, and mathematical phenomena.

Reading Standard Comment After the elementary years, students are seriously engaged in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas *in context.* Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects. Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

MRC. Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas
- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas
- Read both informational and fictional texts in a variety of genres and modes of discourse
- Read technical texts related to various subject areas

b. Discussing books
- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

c. Building vocabulary knowledge
- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

d. Establishing context
- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.