

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 Mathematics 2

This is the second course in a sequence of courses designed to provide students with a rigorous program of study in mathematics. It includes complex numbers; quadratic, piecewise, and exponential functions; right triangles, and right triangular trigonometry; properties of circles; and statistical inference. (*Prerequisite: Successful completion of Mathematics 1 or Core Mathematics 2.*)

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.

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NUMBER AND OPERATIONS

Students will use the complex number system.

MM2N1. Students will represent and operate with complex numbers.

- a. Write square roots of negative numbers in imaginary form.
- b. Write complex numbers in the form $a + bi$.
- c. Add, subtract, multiply, and divide complex numbers.
- d. Simplify expressions involving complex numbers.

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Students will investigate piecewise, exponential, and quadratic functions, using numerical, analytical, and graphical approaches, focusing on the use of these functions in problem-solving situations. Students will solve equations and inequalities and explore inverses of functions.

MM2A1. Students will investigate step and piecewise functions, including greatest integer and absolute value functions.

- a. Write absolute value functions as piecewise functions.
- b. Investigate and explain characteristics of a variety of piecewise functions including domain, range, vertex, axis of symmetry, zeros, intercepts, extrema, points of discontinuity, intervals over which the function is constant, intervals of increase and decrease, and rates of change.
- c. Solve absolute value equations and inequalities analytically, graphically, and by using appropriate technology.

MM2A2. Students will explore exponential functions.

- a. Extend properties of exponents to include all integer exponents.
- b. Investigate and explain characteristics of exponential functions, including domain and range, asymptotes, zeros, intercepts, intervals of increase and decrease, rates of change, and end behavior.
- c. Graph functions as transformations of $f(x) = a^x$.
- d. Solve simple exponential equations and inequalities analytically, graphically, and by using appropriate technology.
- e. Understand and use basic exponential functions as models of real phenomena.

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- f. Understand and recognize geometric sequences as exponential functions with domains that are whole numbers.
- g. Interpret the constant ratio in a geometric sequence as the base of the associated exponential function.

MM2A3. Students will analyze quadratic functions in the forms $f(x) = ax^2 + bx + c$ and $f(x) = a(x - h)^2 + k$.

- a. Convert between standard and vertex form.
- b. Graph quadratic functions as transformations of the function $f(x) = x^2$.
- c. Investigate and explain characteristics of quadratic functions, including domain, range, vertex, axis of symmetry, zeros, intercepts, extrema, intervals of increase and decrease, and rates of change.
- d. Explore arithmetic series and various ways of computing their sums.
- e. Explore sequences of partial sums of arithmetic series as examples of quadratic functions.

MM2A4. Students will solve quadratic equations and inequalities in one variable.

- a. Solve equations graphically using appropriate technology.
- b. Find real and complex solutions of equations by factoring, taking square roots, and applying the quadratic formula.
- c. Analyze the nature of roots using technology and using the discriminant.
- d. Solve quadratic inequalities both graphically and algebraically, and describe the solutions using linear inequalities.

MM2A5. Students will explore inverses of functions.

- a. Discuss the characteristics of functions and their inverses, including one-to-oneness, domain, and range.
- b. Determine inverses of linear, quadratic, and power functions and functions of the form $f(x) = \frac{a}{x}$, including the use of restricted domains.
- c. Explore the graphs of functions and their inverses.
- d. Use composition to verify that functions are inverses of each other.

GEOMETRY

Students will explore right triangles and right-triangle trigonometry. They will understand and apply properties of circles and spheres, and use them in determining related measures.

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MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G2. Students will define and apply sine, cosine, and tangent ratios to right triangles.

- a. Discover the relationship of the trigonometric ratios for similar triangles.
- b. Explain the relationship between the trigonometric ratios of complementary angles.
- c. Solve application problems using the trigonometric ratios.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

DATA ANALYSIS AND PROBABILITY

Students will demonstrate understanding of data analysis by posing questions to be answered by collecting data. Students will organize, represent, investigate, interpret, and make inferences from data. They will use regression to analyze data and to make inferences.

MM2D1. Using sample data, students will make informal inferences about population means and standard deviations.

- a. Pose a question and collect sample data from at least two different populations.
- b. Understand and calculate the means and standard deviations of sets of data.
- c. Use means and standard deviations to compare data sets.

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- d. Compare the means and standard deviations of random samples with the corresponding population parameters, including those population parameters for normal distributions. Observe that the different sample means vary from one sample to the next. Observe that the distribution of the sample means has less variability than the population distribution.

MM2D2. Students will determine an algebraic model to quantify the association between two quantitative variables.

- a. Gather and plot data that can be modeled with linear and quadratic functions.
- b. Examine the issues of curve fitting by finding good linear fits to data using simple methods such as the median-median line and “eyeballing.”
- c. Understand and apply the processes of linear and quadratic regression for curve fitting using appropriate technology.
- d. Investigate issues that arise when using data to explore the relationship between two variables, including confusion between correlation and causation.

Terms/Symbols:

piecewise function, exponential function, step function, extrema, point of discontinuity, asymptote, geometric sequence, standard form, vertex form, quadratic formula, discriminant, root, inverse of a function, one-to-one function, composition of functions, f^{-1} , sine, cosine, tangent, trigonometric ratio, complementary angles, trigonometry, chord, tangent, secant, central angle, inscribed angle, arc, sector, inference, population mean, standard deviation, curve fitting, linear regression, median-median line, algebraic model, quadratic regression

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.

MM2P1. 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.

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MM2P2. 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.

MM2P3. 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.

MM2P4. 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.

MM2P5. 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*.

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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.