

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 3

This is the third course in a sequence of courses designed to provide students with a rigorous program of study in mathematics. It includes exponential and logarithmic functions, matrices, polynomial functions of higher degree, conic sections, and normal distributions. (*Prerequisite: Successful completion of 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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ALGEBRA

Students will investigate exponential, logarithmic and polynomial functions of degree higher than 2. Students will understand matrices and use them to solve problems.

MM3A1. Students will analyze graphs of polynomial functions of higher degree.

- a. Graph simple polynomial functions as translations of the function $f(x) = ax^n$.
- b. Understand the effects of the following on the graph of a polynomial function: degree, lead coefficient, and multiplicity of real zeros.
- c. Determine whether a polynomial function has symmetry and whether it is even, odd, or neither.
- d. Investigate and explain characteristics of polynomial functions, including domain and range, intercepts, zeros, relative and absolute extrema, intervals of increase and decrease, and end behavior.

MM3A2. Students will explore logarithmic functions as inverses of exponential functions.

- a. Define and understand the properties of n^{th} roots.
- b. Extend properties of exponents to include rational exponents.
- c. Define logarithmic functions as inverses of exponential functions.
- d. Understand and use properties of logarithms by extending laws of exponents.
- e. Investigate and explain characteristics of exponential and logarithmic functions including domain and range, asymptotes, zeros, intercepts, intervals of increase and decrease, and rate of change.
- f. Graph functions as transformations of $f(x) = a^x$, $f(x) = \log_a x$, $f(x) = e^x$, $f(x) = \ln x$.
- g. Explore real phenomena related to exponential and logarithmic functions including half-life and doubling time.

MM3A3. Students will solve a variety of equations and inequalities.

- a. Find real and complex roots of higher degree polynomial equations using the factor theorem, remainder theorem, rational root theorem, and fundamental theorem of algebra, incorporating complex and radical conjugates.
- b. Solve polynomial, exponential, and logarithmic equations analytically, graphically, and using appropriate technology.
- c. Solve polynomial, exponential, and logarithmic inequalities analytically, graphically, and using appropriate technology. Represent solution sets of inequalities using interval notation.
- d. Solve a variety of types of equations by appropriate means choosing among mental calculation, pencil and paper, or appropriate technology.

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MM3A4. Students will perform basic operations with matrices.

- a. Add, subtract, multiply, and invert matrices, when possible, choosing appropriate methods, including technology.
- b. Find the inverses of two-by-two matrices using pencil and paper, and find inverses of larger matrices using technology.
- c. Examine the properties of matrices, contrasting them with properties of real numbers.

MM3A5. Students will use matrices to formulate and solve problems.

- a. Represent a system of linear equations as a matrix equation.
- b. Solve matrix equations using inverse matrices.
- c. Represent and solve realistic problems using systems of linear equations.

MM3A6. Students will solve linear programming problems in two variables.

- a. Solve systems of inequalities in two variables, showing the solutions graphically.
- b. Represent and solve realistic problems using linear programming.

MM3A7. Students will understand and apply matrix representations of vertex-edge graphs.

- a. Use graphs to represent realistic situations.
- b. Use matrices to represent graphs, and solve problems that can be represented by graphs.

GEOMETRY

Students will understand and use the analytic geometry of conic sections and of planes and spheres in space.

MM3G1. Students will investigate the relationships between lines and circles.

- a. Find equations of circles.
- b. Graph a circle given an equation in general form.
- c. Find the equation of a tangent line to a circle at a given point.
- d. Solve a system of equations involving a circle and a line.
- e. Solve a system of equations involving two circles.

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MM3G2. Students will recognize, analyze, and graph the equations of the conic sections (parabolas, circles, ellipses, and hyperbolas).

- a. Convert equations of conics by completing the square.
- b. Graph conic sections, identifying fundamental characteristics.
- c. Write equations of conic sections given appropriate information.

MM3G3. Students will investigate planes and spheres.

- a. Plot the point (x, y, z) and understand it as a vertex of a rectangular prism.
- b. Apply the distance formula in 3-space.
- c. Recognize and understand equations of planes and spheres.

DATA ANALYSIS AND PROBABILITY

Students will use a normal distribution to calculate probabilities. They will organize, represent, investigate, interpret, and make inferences using data from both observational studies and experiments.

MM3D1. Students will create probability histograms of discrete random variables, using both experimental and theoretical probabilities.

MM3D2. Students will solve problems involving probabilities by interpreting a normal distribution as a probability histogram for a continuous random variable (z-scores are used for a general normal distribution).

- a. Determine intervals about the mean that include a given percent of data.
- b. Determine the probability that a given value falls within a specified interval.
- c. Estimate how many items in a population fall within a specified interval.

MM3D3. Students will understand the differences between experimental and observational studies by posing questions and collecting, analyzing, and interpreting data.

Terms/Symbols: logarithmic function, matrix, degree of a polynomial, multiplicity of roots, n^{th} root, n , asymptote, half-life, radical conjugate, inverse matrix, vertex-edge graph, conic sections, parabola, ellipse, hyperbola, 3-space, discrete random variable, normal distribution, discrete random variable, continuous random variable, z-score

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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.

MM3P1. 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.

MM3P2. 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.

MM3P3. 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.

MM3P4. 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.

MM3P5. 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.

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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.

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- 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.