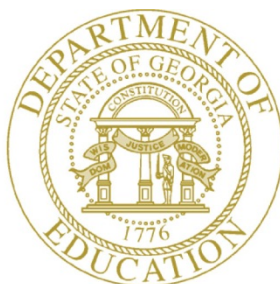# Content Descriptions

Based on the state-mandated content standards

Coordinate Algebra

Dr. John D. Barge, State School Superintendent

"Making Education Work for All Georgians"

Introduction

The State Board of Education is required by Georgia law (A+ Educational Reform Act of 2000, O.C.G.A. §20-2-281) to adopt End-of-Course Tests (EOCT) designed to measure student achievement in core subjects in grades nine through twelve. With educator input and State Board of Education approval, eight content areas were designated in 2001 to be tested. The current state-mandated content standards in mathematics were adopted by the State Board of Education in July 2010, and the Coordinate Algebra EOCT was developed based on these standards.

Program Purpose

The EOCT are designed to improve student achievement by assessing student performance on the standards specific to each course tested. Student performance on each test is provided to schools for diagnostic and remedial use. These results are used to help make instruction more effective and to ensure that all Georgia students have access to rigorous courses that meet high academic expectations. These results are also used for student accountability and to gauge the quality of education in the state. The EOCT are the final exams for the courses specified. For students enrolled in grade nine for the first time before July 1, 2011, the final grade for each course is calculated by weighing the course grade 85% and the EOCT score 15%. For students enrolled in grade nine for the first time on July 1, 2011, or after, the final grade for each course is calculated by weighing the course grade 80% and the EOCT score 20% (State Board Rule 160-4-2-.13). The student must have a final grade of at least 70 to pass the course and earn credit toward graduation.

EOCT Content Descriptions

The EOCT Content Descriptions are provided to acquaint Georgia educators with the content assessed by the EOCT. Only the knowledge, concepts, and skills addressed in the state-mandated content standards are assessed on the EOCT. It is important to note that some content standards are better suited for classroom or individual assessment rather than large-scale summative assessment. While those standards designed for classroom/individual assessment are not included in the Content Descriptions, the knowledge, concepts, and skills outlined are often required for the mastery of the standards that are assessed. Therefore, the EOCT Content Descriptions are in *no way* intended to substitute for the state-mandated content standards; they are provided to help educators better understand how the standards will be assessed. Further, the EOCT Content Descriptions *by no means* suggest *when* concepts and skills should be introduced in the instructional sequence; rather, they are intended only to communicate the concepts and skills that will be assessed on the EOCT, but in no particular order. Georgia law requires educators to teach the material set forth in the state-mandated content standards. The standards are located at www.georgiastandards.org.

Coordinate Algebra Domains
In order to provide reliable measures of student achievement, as well as to give structure to the assessment program, the performance standards were grouped into content domains. Each domain was created by combining standards that share similar content characteristics. Three domains were identified for Coordinate Algebra:

- **Algebra and Functions (includes Number and Quantity)**
  Students will create and interpret algebraic expressions; create, solve, graph, and interpret the solutions to linear equations and inequalities; create, solve, graph, and interpret the solutions to systems of equations; use function notation and interpret the domain and range of a function; model and compare linear and exponential functions using multiple representations; write arithmetic and geometric sequences; build new functions from existing linear and exponential functions.

- **Algebra Connections to Geometry**
  Students will compare and describe transformations on the coordinate plane; use distance and slope to prove simple geometric theorems algebraically; use the distance formula to find perimeters and areas of geometric figures on the coordinate plane.

- **Algebra Connections to Statistics and Probability**
  Students will represent data with plots of the real number line and describe the shape and spread of the data distribution; represent bivariate data on a scatter plot and describe how the variables are related; summarize categorical data for two categories in two-way frequency tables.

Standards for Mathematical Practice

The state-mandated content standards in mathematics require content to be taught in conjunction with the mathematical practices identified in the *Common Core State Standards for Mathematics*. These mathematical practice standards are necessary for students to master each of the mathematics content standards. Problem solving, reasoning, representation, connections, and communication are the critical dimensions of mathematical proficiency that all students need.

The concepts and skills inherent in the practice standards are integrated in items across the content domains.

Standards for Mathematical Practice
1. Students will make sense of problems and persevere in solving them.
2. Students will reason abstractly and quantitatively.
3. Students will construct viable arguments and critique the reasoning of others.
4. Students will model with mathematics.
5. Students will use appropriate tools strategically.
6. Students will attend to precision.
7. Students will look for and make use of structure.
8. Students will look for and express regularity in repeated reasoning.

Associated Concepts and Skills
- Building new mathematical knowledge through problem solving
- Solving problems that arise in mathematics and in other contexts
- Applying and adapting a variety of appropriate strategies to solve problems
- Monitoring and reflecting on the process of mathematical problem solving
- Recognizing reasoning and proof as fundamental aspects of mathematics
- Making and investigating mathematical conjectures
- Developing and evaluating mathematical arguments and proofs
- Selecting and using various types of reasoning and methods of proof
- Organizing and consolidating mathematical thinking through communication
- Communicating mathematical thinking coherently and clearly to peers, teachers, and others
- Analyzing and evaluating mathematical thinking and strategies of others
- Using the language of mathematics to express mathematical ideas precisely
- Recognizing and using connections among mathematical ideas
- Understanding how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognizing and applying mathematics in contexts outside of mathematics
- Creating and using representations to organize, record, and communicate mathematical ideas
- Selecting, applying, and translating among mathematical representations to solve problems
- Using representations to model and interpret physical, social, and mathematical phenomena

Coordinate Algebra
Domain: Algebra and Functions (includes Number and Quantity)

Overview of the Domain
- Students will create and interpret algebraic expressions.
- Students will create, solve, graph, and interpret the solutions to linear equations and inequalities.
- Students will create, solve, graph, and interpret the solutions to simple exponential equations.
- Students will create, solve, graph, and interpret the solutions to systems of linear equations.
- Students will use function notation and interpret the domain and range of a function.
- Students will model and compare linear and exponential functions using multiple representations.
- Students will write arithmetic and geometric sequences.
- Students will build new functions from existing linear and exponential functions.

Associated Standards
MCC9-12.N.Q (1, 2, 3)
MCC9-12.A.CED (1, 2, 3, 4)
MCC9-12.A.REI (1, 3, 5, 6, 10, 11, 12)
MCC9-12.A.SSE (1, 1a, 1b)
MCC9-12.F.IF (1, 2, 3, 4, 5, 6, 7, 7a, 7e, 9)
MCC9-12.F.BF (1, 1a, 1b, 2, 3)
MCC9-12.F.LE. (1, 1a, 1b, 1c, 2, 3, 5)

Associated Concepts and Skills
Assessment of this domain will focus on the student's ability to
- interpret expressions that represent a quantity in terms of its context
    – interpret terms in a linear expression
    – interpret factors in a linear expression
    – interpret coefficients in a linear expression
    – interpret terms, factors, and coefficients in exponential expressions with integer exponents
    – interpret complicated expressions by viewing one or more of their parts as a single entity
- create equations and inequalities in one variable
    – create equations that describe relationships represented in different ways (numerically in tables, algebraically, graphically, or by verbal description)
    – create equations and inequalities that describe relationships given in word problems
    – create equations that describe linear functions and simple exponential functions

- – rearrange formulas to highlight a quantity of interest
- – choose and interpret units consistently in formulas
- create equations and inequalities in two or more variables
  - – create linear equations and inequalities to represent a relationship between quantities
- solve linear equations in one variable
  - – use the properties of rational numbers to solve linear equations
  - – solve linear equations with coefficients represented by numbers or letters
  - – represent constraints by equations and interpret the solution as viable or nonviable options in a modeling context
- solve linear inequalities in one variable
  - – use the properties of rational numbers to solve linear inequalities
  - – represent constraints by inequalities and interpret the solution as viable or nonviable options in a modeling context
- solve systems of equations
  - – solve systems of equations in two variables graphically
  - – solve systems of linear equations algebraically
  - – write and use systems of linear equations to solve word problems
- solve multi-variable formulas or literal equations for a specific variable
- graph linear equations in two variables
  - – graph linear equations on coordinate axes with the appropriate labels and scales
  - – choose and interpret the scale and the origin in graphs
  - – show key features of the graph of a linear function, such as intercepts, increasing or decreasing intervals, positive or negative slope
  - – construct linear functions represented in different ways (numerically in tables, algebraically, graphically, or by verbal description)
  - – calculate and interpret the average rate of change (slope)
  - – graph the solution to the equation $f(x) = g(x)$
  - – define appropriate quantities for the purpose of descriptive modeling
- graph linear inequalities in two variables
  - – show key features of the graph of a linear inequality, such as boundary, half-plane
  - – interpret the solutions of linear inequalities as a solution set
- understand the concept of a function
  - – define and interpret the domain of a function
  - – define and interpret the range of a function
  - – use function notation
  - – evaluate functions for inputs of their domains
  - – calculate and interpret the average rate of change of a function
  - – interpret linear functions that arise in applications in terms of the context
  - – recognize sequences as functions
- solve simple exponential equations using the laws of exponents
- graph exponential functions
  - – compare linear and exponential models
  - – define and interpret the domain and range of an exponential function
  - – evaluate exponential functions at integer inputs of their domains

- – show intercepts and end behavior
- – construct exponential functions represented in different ways (numerically in tables, algebraically, graphically, or by verbal description)
- interpret linear and exponential functions that arise in applications in terms of the context
- write arithmetic and geometric sequences recursively or with an explicit formula
- build new functions from existing functions
    - – explain why the graph of every linear function is a transformation of the graph of the basic function $f(x) = x$
    - – explain why the graph of every exponential function is a transformation of the graph of the basic function $f(x) = b^x$
    - – graph vertical translations of a linear or exponential graph based on its parent graph

Coordinate Algebra
Domain: Algebra Connections to Geometry

Overview of the Domain
- Students will compare and describe transformations on the coordinate plane.
- Students will use distance and slope to prove simple geometric theorems algebraically.
- Students will use the distance formula to find perimeters and areas of geometric figures on the coordinate plane.

Associated Standards
MCC9-12.G.CO (1, 2, 3, 4, 5)
MCC9-12.G.GPE (4, 5, 6, 7)

Associated Concepts and Skills
Assessment of this domain will focus on the student's ability to
- use and understand geometric definitions
    - use and understand the definition of angles
    - use and understand the definition of circles
    - use and understand the definition of perpendicular and parallel lines
    - use and understand the definition of line segments as distances along a line or the length of an arc
- develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments
- explore translations
    - use various tools to translate images in the coordinate plane
    - find the coordinates of the vertices of a translated image
    - describe translations as functions that map a figure onto itself or another figure
- explore reflections
    - use various tools to reflect images in the coordinate plane
    - find the coordinates of the vertices of a reflected image
    - describe reflections as functions that map a figure onto itself or another figure
- explore rotations
    - use various tools to rotate images in the coordinate plane
    - find the coordinates of the vertices of a rotated image given the angle of rotation and direction
    - describe rotations as functions that map a figure onto itself or another figure
- compare transformations that preserve size and shape to those that do not
- create sequences of transformations that map a figure onto itself or another figure

- use coordinates to prove simple geometric theorems algebraically
  - prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle
  - prove or disprove that a given point (p, q) lies on a circle centered at the origin and containing another given point
  - prove the slope criteria for parallel and perpendicular lines
- find the equation of a line that is parallel or perpendicular to a given line and that passes through a given point
- develop and use the formulas for the distance between two points and for finding the point that partitions a line segment in a given ratio
- use coordinates to determine the perimeter and area of geometric figures

Coordinate Algebra
Domain: Algebra Connections to Statistics and Probability

Overview of the Domain
- Students will represent data with plots on the real number line and describe the shape and spread of the data distribution.
- Students will represent bivariate data on a scatter plot and describe how the variables are related.
- Students will summarize categorical data for two categories in two-way frequency tables.

Associated Standard
MCC9-12.S.ID (1, 2, 3, 5, 6, 6a, 6b, 6c, 7, 8, 9)

Associated Concepts and Skills
Assessment of this domain will focus on the student's ability to
- create and interpret dot plots
  – plot data values on a real number line using appropriate scales and intervals
  – interpret the shape and spread of the data and identify extreme data points (outliers)
  – compare the center (mean, median) and spread (interquartile range) of two or more different data sets
- create and interpret histograms
  – organize and categorize data values and use appropriate scales and intervals
  – interpret the shape and spread of the data distribution
  – compare the center (mean, median) and spread (interquartile range) of two or more different data sets
- create and interpret box plots
  – create box plots from the given data values using quartiles and range
  – compare the center (median) and spread (interquartile range) of two or more different data sets
  – account for the possible effects of outliers
- construct and interpret two-way frequency tables
  – interpret relative frequencies in the context of the data
  – identify joint, marginal, and conditional relative frequencies
  – recognize possible associations and trends in the data
- create and interpret scatter plots
  – plot bivariate data on a scatter plot
  – describe how two quantitative variables shown on the scatter plot are related
  – fit a function to the data (linear and simple exponential)
  – use functions fitted to data to solve problems in the context of the data
  – use the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data

- analyze the goodness of fit by looking at the residuals
- distinguish between correlation and causation