



## TEST DESIGN AND FRAMEWORK

### TEST DESIGN

#### Middle Grades Mathematics

The **Middle Grades Mathematics** assessment consists of **one test**. The test contains a section with selected-response questions and a section with constructed-response assignments. Each section counts for a percentage of your total test score. The areas of content assessed, the approximate number of selected-response questions and constructed-response assignments in each content area, and the percentage of your total test score derived from each test section are shown in the table below. Further information regarding the content included in each subarea can be found in the test framework.

■ **Middle Grades Mathematics (Test Code 013)**

Subareas:	Objectives	Approximate Number of Selected-Response Questions	Constructed-Response Assignments
➤ Numbers and Operations	0001–0003	14	
➤ Measurement and Geometry	0004–0006	14	1
➤ Patterns, Algebra, and Functions	0007–0009	14	1
➤ Data Analysis and Probability	0010–0011	9	
➤ Mathematical Processes and Perspectives	0012–0013	9	
<b>TOTAL</b>		<b>60</b>	<b>2</b>
<b>Percentage of Test Score</b>		<b>80%</b>	<b>20%</b>



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### TEST FRAMEWORK

#### Middle Grades Mathematics

##### NUMBERS AND OPERATIONS

**0001 Understand the structure of the base ten numeration system and number theory.**

For example:

- analyzing the structure of the base ten number system (e.g., decimal and whole number place value)
- demonstrating knowledge of the characteristics of whole numbers (e.g., prime/composite, divisibility)
- applying the Fundamental Theorem of Arithmetic to determine the prime factorization of numbers
- using principles of number theory (e.g., greatest common factor, least common multiple) to solve problems in applied contexts

**0002 Understand different representations of real numbers.**

For example:

- identifying and analyzing a variety of models for representing numbers (e.g., fraction strips, diagrams, number lines)
- demonstrating knowledge of equivalency among different representations of numbers (e.g., common and decimal fractions, percents, roots, scientific notation)
- distinguishing between rational and irrational numbers
- comparing, ordering, and rounding different representations of numbers
- selecting and using different representations of numbers to solve problems in applied contexts

**0003 Understand operations on real numbers.**

For example:

- identifying, analyzing, and applying number properties and number operations (e.g., commutative and associative properties, inverses, order of operations)
- using properties of number operations to justify computational procedures
- applying the laws of exponents to simplify expressions
- solving problems using real numbers in applied contexts
- demonstrating a conceptual understanding of number operations

**MEASUREMENT AND GEOMETRY**

**0004 Understand the principles and applications of measurement.**

For example:

- using appropriate units of measurement (e.g., length, area, volume, angles, weight, temperature, time, rates of change) to solve a variety of problems
- converting measurements within the customary and metric systems
- demonstrating knowledge of strategies for estimating measurements and determining if answers are reasonable
- deriving and applying formulas for perimeter, area, surface area, and volume for two- and three-dimensional shapes and figures
- using nets and cross sections to analyze three-dimensional figures
- applying the concepts of similarity, scale factors, and proportional reasoning to solve measurement problems

**0005 Understand the principles and applications of Euclidean geometry.**

For example:

- analyzing and applying properties of points, lines (e.g., parallel, perpendicular), planes, angles (e.g., complementary, corresponding), lengths, and distances (e.g., Pythagorean theorem)
- identifying, analyzing, and justifying basic geometric constructions with compass and straightedge
- analyzing and applying the properties of similarity and congruence
- analyzing and applying the properties of triangles, quadrilaterals, and other polygons to solve problems in applied contexts

**0006 Understand coordinate and transformational geometry.**

For example:

- representing basic geometric figures in the coordinate plane
- applying concepts and properties of slope, midpoint, parallelism, perpendicularity, distance, and congruence to solve problems in the coordinate plane and in applied contexts
- identifying and applying concepts of symmetry and transformations (e.g., translations, rotations, reflections) to figures in the coordinate plane
- using dilations and proportionality to analyze similar figures in the coordinate plane
- identifying and describing three-dimensional figures formed by transformations of plane figures through space

**PATTERNS, ALGEBRA, AND FUNCTIONS**

**0007 Understand patterns, relations, and functions.**

For example:

- analyzing, extending, and describing a variety of patterns (e.g., numerical, pictorial, recursive) using rules and algebraic expressions
- interpreting and comparing verbal and graphical descriptions of real-world relations
- identifying, describing, and analyzing the properties of relations and functions (e.g., domain, range) in a variety of forms (e.g., tabular, graphical, algebraic)
- describing and analyzing direct and inverse proportional relationships graphically and algebraically
- describing and using various representations of nonlinear functions (e.g., quadratic, exponential)

**0008 Understand the properties and techniques of algebraic operations.**

For example:

- simplifying, evaluating, and performing operations (e.g., factoring, grouping) on polynomials and other algebraic expressions
- using number properties (e.g., distributive) to justify algebraic manipulations
- solving algebraic equations, including problems involving absolute values
- translating verbal descriptions into algebraic expressions that model problem situations
- modeling and solving a variety of problems that involve ratio and proportion

**0009 Understand linear functions and their applications.**

For example:

- distinguishing between linear and nonlinear functions
- analyzing the relationship between a linear equation or inequality and its graph
- describing and using various representations (e.g., verbal, tabular, graphical, algebraic) of linear functions
- selecting a linear equation that best fits a set of data
- representing and solving problems involving linear equations and inequalities and systems of linear equations and inequalities algebraically and graphically and interpreting solutions to these problems
- interpreting the meaning of the slope and y-intercept in a given situation

**DATA ANALYSIS AND PROBABILITY**

**0010 Understand the process of collecting, organizing, describing, analyzing, and interpreting data.**

For example:

- demonstrating knowledge of the nature of sampling, the collection of data through surveys and experiments, the importance of sample size, and random sampling
- selecting an appropriate format for organizing and displaying data
- analyzing data in a variety of formats (i.e., tables, frequency distributions, histograms, circle graphs, bar graphs, line plots, scatter plots, stem-and-leaf plots, and box-and-whisker plots)
- determining and analyzing measures of central tendency (i.e., mean and median), mode, and dispersion (e.g., range, variance, standard deviation, interquartile range, outliers)
- interpreting summary statistics to determine trends and draw valid conclusions from data (e.g., census)
- analyzing and drawing conclusions about the relationship between two variables

**0011 Understand the theory and applications of probability.**

For example:

- applying basic concepts of set theory (e.g., subsets, complements, unions)
- applying addition and multiplication counting principles to determine the number of outcomes related to an event
- determining probabilities of simple and compound events (e.g., dependent, independent, mutually exclusive, conditional)
- using different graphical representations (e.g., Venn diagrams, tree diagrams) to calculate and interpret probabilities
- demonstrating knowledge of methods (e.g., rolling dice, using random numbers) for predicting the probability of an event using trials or simulations

**MATHEMATICAL PROCESSES AND PERSPECTIVES**

**0012 Understand how to use a variety of representations to communicate mathematical ideas and concepts and connections among them.**

For example:

- communicating mathematical ideas using a variety of representations (e.g., numeric, tabular, graphical, pictorial, symbolic)
- translating among algebraic, graphical, symbolic, diagrammatic, and other means of presenting mathematical ideas (e.g., set notation, interval notation)
- translating between mathematical language, notation, and symbols and everyday language
- using appropriate mathematical terminology with precision and accuracy
- analyzing and evaluating a mathematical model (e.g., equation, graph, pictorial representation) in terms of its appropriateness and usefulness in a given situation
- recognizing connections among different concepts and areas of mathematics (e.g., algebra, geometry) and using them to solve problems
- identifying and applying mathematics in contexts outside of mathematics

**0013 Understand mathematical reasoning, proof, and problem-solving strategies in mathematics and other contexts.**

For example:

- demonstrating knowledge of the nature of proof in mathematics, including direct and indirect proof, and the use of counterexamples
- applying correct mathematical reasoning to draw valid conclusions and to construct and evaluate arguments and proofs
- identifying inductive and deductive reasoning and using them to develop and investigate the validity of conjectures
- selecting an appropriate problem-solving strategy (e.g., estimation, working backward, drawing a diagram) for investigating or solving a particular problem
- applying mathematical concepts, strategies, and appropriate technologies across the curriculum and in everyday contexts to model and solve problems