

***NCTM NCATE Mathematics Content for Middle Grades
Addendum to the NCTM NCATE Standards 2012***

B. Middle Grades Mathematics Teachers

All middle grades mathematics teachers should be prepared with depth and breadth in the following mathematical domains: Number, Algebra, Geometry, Trigonometry, Statistics, Probability, and Calculus. All teachers certified in middle grades mathematics should know, understand, teach, and be able to communicate their mathematical knowledge with the breadth of understanding reflecting the following competencies for each of these domains.

B.1. Number Systems

To be prepared to develop student mathematical proficiency, all middle grades mathematics teachers should know the following topics related to number systems with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

- B.1.1 Structure, properties, relationships, operations, and representations, including standard and non-standard algorithms, of numbers and number systems including whole, integer, rational, irrational, real, and complex numbers
- B.1.2 Fundamental ideas of number theory (divisors, factors and factorization, primes, composite numbers, greatest common factor, and least common multiple)
- B.1.3 Quantitative reasoning and relationships that include ratio, rate, and proportion and the use of units in problem situations
- B.1.4 Vector and matrix operations, modeling, and applications
- B.1.5 Historical development and perspectives of number, number systems, and quantity including contributions of significant figures and diverse cultures

B.2. Algebra

To be prepared to develop student mathematical proficiency, all middle grades mathematics teachers should know the following topics related to algebra with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

- B.2.1 Algebraic notation, symbols, expressions, equations, inequalities, and proportional relationships, and their use in describing, interpreting, modeling, generalizing, and justifying relationships and operations
- B.2.2 Function classes including polynomial, exponential and logarithmic, absolute value, rational, and trigonometric, including those with discrete domains (e.g., sequences), and how the choices of parameters determine particular cases and model specific situations

- B.2.3 Functional representations (tables, graphs, equations, descriptions, recursive definitions, and finite differences), characteristics (e.g., zeros, intervals of increase or decrease, extrema, average rates of change, domain and range, and end behavior), and notations as a means to describe, reason, interpret, and analyze relationships and to build new functions
- B.2.4 Patterns of change in linear, quadratic, polynomial, and exponential functions and in proportional and inversely proportional relationships and types of real-world relationships these functions can model
- B.2.5 Historical development and perspectives of algebra including contributions of significant figures and diverse cultures

B.3. Geometry and Trigonometry

To be prepared to develop student mathematical proficiency, all middle grades mathematics teachers should know the following topics related to geometry and trigonometry with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

- B.3.1 Core concepts and principles of Euclidean geometry in two and three dimensions and two-dimensional non-Euclidean geometries
- B.3.2 Transformations including dilations, translations, rotations, reflections, glide reflections; compositions of transformations; and the expression of symmetry in terms of transformations
- B.3.3 Congruence, similarity and scaling, and their development and expression in terms of transformations
- B.3.4 Right triangles and trigonometry
- B.3.5 Application of periodic phenomena and trigonometric identities
- B.3.6 Identification, classification into categories, visualization, and representation of two- and three-dimensional objects (triangles, quadrilaterals, regular polygons, prisms, pyramids, cones, cylinders, and spheres)
- B.3.7 Formula rationale and derivation (perimeter, area, surface area, and volume) of two- and three-dimensional objects (triangles, quadrilaterals, regular polygons, rectangular prisms, pyramids, cones, cylinders, and spheres), with attention to units, unit comparison, and the iteration, additivity, and invariance related to measurements
- B.3.8 Geometric constructions, axiomatic reasoning, and proof
- B.3.9 Analytic and coordinate geometry including algebraic proofs (e.g., the Pythagorean Theorem and its converse) and equations of lines and planes

B.3.10 Historical development and perspectives of geometry and trigonometry including contributions of significant figures and diverse cultures

B.4. Statistics and Probability

To be prepared to develop student mathematical proficiency, all middle grades mathematics teachers should know the following topics related to statistics and probability with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

- B.4.1 Statistical variability and its sources and the role of randomness in statistical inference
- B.4.2 Creation and implementation of surveys and investigations using sampling methods and statistical designs, statistical inference (estimation of population parameters and hypotheses testing), justification of conclusions, and generalization of results
- B.4.3 Univariate and bivariate data distributions for categorical data and for discrete and continuous random variables, including representations, construction and interpretation of graphical displays (e.g., box plots, histograms, cumulative frequency plots, scatter plots), summary measures, and comparisons of distributions
- B.4.4 Empirical and theoretical probability (discrete, continuous, and conditional) for both simple and compound events
- B.4.5 Random (chance) phenomena, simulations, and probability distributions and their application as models of real phenomena and to decision making
- B.4.6 Historical development and perspectives of statistics and probability including contributions of significant figures and diverse cultures

B.5. Calculus

To be prepared to develop student mathematical proficiency, all middle grades mathematics teachers should know the following topics related to calculus with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

- B.5.1 Limits, continuity, rates of change, the Fundamental Theorem of Calculus, and the meanings and techniques of differentiation and integration
- B.5.2 Applications of function, geometry, and trigonometry concepts to solve problems involving calculus
- B.5.3 Historical development and perspectives of calculus including contributions of significant figures and diverse cultures