Middle Grades Mathematics 5–9

Section 25

Middle Grades Mathematics 5–9

1 Knowledge of problem-solving and reasoning skills

- 1. Analyze realistic situations and identify the appropriate mathematical expression or equation.
- 2. Apply strategies to solve nonroutine problems with multiple steps.
- 3. Evaluate the reasonableness of results from the original problem.
- 4. Apply appropriate mathematical concepts and procedures to solve problems in various contexts.
- 5. Evaluate the validity of mathematical arguments (e.g., a justification that the sum of two odd numbers is always even).
- 6. Predict logical conclusions from given statements.
- 7. Identify appropriate instructional strategies to facilitate student understanding of problem solving.
- 8. Distinguish between deductive and inductive reasoning in a given situation.

2 Knowledge of mathematical manipulatives and models and instructional technology

- 1. Identify appropriate mathematical representations (e.g., verbal statements, manipulatives, pictures, graphs, algebraic expressions).
- 2. Interpret concepts with multiple representations (e.g., manipulatives, tables, graphs, symbolic expressions, technology).
- 3. Select appropriate manipulatives and technology for teaching specific mathematical concepts (e.g., graphing calculators, dynamic software, virtual and physical manipulatives).
- 4. Use appropriate manipulatives and technology for teaching diverse groups of students (e.g., varied learning styles and exceptionalities).

3 Knowledge of assessment in mathematics

- 1. Assess student learning through various methods (e.g., informal, formative, summative).
- 2. Analyze student work samples to assess and diagnose student learning needs.
- 3. Analyze student performance using technology (e.g., online resources, audience-response systems, instructor software).

- 4. Interpret student performance data to drive instruction.
- 5. Recognize cognitive complexity in various questioning strategies.
- 6. Evaluate appropriate alternative assessments (e.g., projects, portfolios) that utilize various cognitive complexity levels.

4 Knowledge of connections among mathematical concepts

- 1. Identify prerequisite skills for a given topic (e.g., ratio, slope).
- 2. Predict common misconceptions in mathematics (e.g., area and perimeter, box plot).
- 3. Connect interrelated mathematical concepts (e.g., scale factor and proportional reasoning).
- 4. Analyze mathematical errors (e.g., computational, algebraic, statistical, geometric).
- 5. Identify fundamental concepts that connect middle grades mathematics to high school and postsecondary mathematics (e.g., trigonometry, number theory, calculus).

5 Knowledge of number sense, operations, and proportionality

- 1. Compare the relative size of real numbers expressed in a variety of forms (e.g., fractions, decimals, percents, absolute value).
- 2. Apply mental computation and estimation strategies.
- 3. Apply prime factorization of composite numbers to other operations (e.g., cube roots, polynomials).
- 4. Compute fluently with rational numbers using the greatest common factor (GCF) and least common multiple (LCM).
- 5. Apply ratios and proportions to similar figures and to solve realistic problems.
- 6. Select the appropriate operation(s) to solve realistic problems that involve real numbers.

6 Knowledge of foundations of algebra

- 1. Predict missing terms in numerical, algebraic, and pictorial patterns.
- 2. Analyze relationships between tables, graphs, or equations.
- 3. Simplify rational and irrational expressions.
- 4. Simplify expressions involving radicals and rational exponents using the properties of exponents.

- 5. Solve equations or inequalities with one variable (e.g., number line).
- 6. Identify graphs of inequalities involving one variable on a number line.
- 7. Identify graphs of linear equations or inequalities involving two variables on the coordinate plane.
- 8. Identify and interpret the slope and intercepts using a graph, table, or an equation.
- 9. Determine the equation of a line.
- 10. Find and estimate square roots.
- 11. Apply properties of operations (e.g., commutative, associative, distributive) to generate equivalent expressions.

7 Knowledge of algebraic thinking

- 1. Determine the impact when changing values of given linear and nonlinear functions (e.g., change of y-intercept or coefficients).
- 2. Identify the equation of a line that is perpendicular or parallel to a given line.
- 3. Apply operations to analyze polynomials (e.g., finding zeros, factoring, arithmetic operations).
- 4. Solve systems of linear equations involving two variables using graphing, substitution, or elimination.
- 5. Determine the solution set of a system of linear inequalities involving two variables.
- 6. Use quadratic equations to solve abstract and realistic problems.
- 7. Identify the graph of quadratic functions.
- 8. Solve equations involving radicals, limited to square roots.
- 9. Apply the laws of exponents.

8 Knowledge of data analysis, statistics, and probability

- 1. Determine which measure of center (i.e., central tendency) is the most appropriate in a given situation.
- 2. Find and interpret the range and distribution of data.
- 3. Interpret information and patterns from various graphical representations using univariate (e.g., a line plot) and bivariate data (e.g., scatterplot).

- 4. Identify appropriate graphical representations for a given data set.
- 5. Identify an appropriate sample to draw inferences about a population.
- 6. Make predictions based on experimental or theoretical probabilities.

9 Knowledge of two-dimensional geometry

- 1. Identify precise definitions of symbols for lines, segments, rays, and distances based on point, line, and plane as undefined terms.
- 2. Identify and apply properties of the relationships of angles or pairs of angles.
- 3. Identify and apply properties of polygons to determine the measure(s) of interior angles and/or exterior angles.
- 4. Evaluate proofs and apply the properties of triangles (e.g., isosceles, scalene, equilateral).
- 5. Evaluate proofs and apply triangle inequality theorems (e.g., opposite the largest angle is the longest side, the sum of two sides is greater than the third side).
- 6. Use the SAS, ASA, and SSS postulates to show pairs of triangles congruent, including the case of overlapping triangles.
- 7. Apply theorems and postulates that apply to right triangles to solve mathematical and realistic problems (e.g., Pythagorean theorem, special right triangles).
- 8. Apply trigonometric ratios to solve right triangle problems.
- 9. Apply the specific properties of quadrilaterals (e.g., parallelograms, rectangles, rhombuses, squares, kites, trapezoids).
- 10. Apply the formulas for distance and midpoint on the coordinate plane.
- 11. Classify and apply the types of transformations of geometric figures including similar figures.
- 12. Apply properties and theorems about circles.

10 Knowledge of measurement and spatial sense

- 1. Convert units of measure within and between given measurement systems, including derived units.
- 2. Solve realistic and mathematical problems involving perimeter, circumference, area, surface area, and volume.
- 3. Determine how a change in dimensions (e.g., length, width, height, radius) affects other measurements (e.g., perimeter, area, surface area, volume).

- 4. Identify characteristics of three-dimensional figures (e.g., faces, edges, vertices).
- 5. Identify the net of a three-dimensional figure.
- 6. Identify the two-dimensional view of a three-dimensional object.