

SECONDARY GRADES MATHEMATICS CURRICULUM GEOMETRY

OVERVIEW

The Mathematics Department believes its students must learn the importance of mathematics, the integration of different branches of mathematics, the application of math to real-life problems, and the connections between mathematics and other disciplines.

This course allows students to relate and apply geometric concepts to algebra, statistics, data analysis, probability, and discrete mathematics. Realistic and relevant applications are an integral part of this course. Students should also see a connection between mathematics and other topics.

The Waterville Public School system uses Maine's Learning Results as a framework in organizing all areas of the curriculum. All learning results can be found in bold print with parenthetical references indicating the content standard and performance indicator.

PERFORMANCE INDICATORS

A. NUMBERS AND NUMBER SENSE

Students will understand and demonstrate a sense of what numbers mean and how they are used.

Students will be able to:

- 1. Describe the structure of the real number system and identify its appropriate applications and limitations. (A,1)**

B. COMPUTATION

Students will understand and demonstrate computation skills. Students will be able to:

- 1. Use various techniques to approximate solutions, determine the reasonableness of answers, and justify the results. (B,1)**

C. DATA ANALYSIS AND STATISTICS

Students will understand and apply concepts of data analysis. Students will be able to:

- 1. Determine and evaluate the effect of variables on the results of data collection. (C,1)**
- 2. Predict and draw conclusions from charts, tables, and graphs that summarize data from practical situations. (C,2)**

D. PROBABILITY

Students will understand and apply concepts of probability. Students will be able to:

- 1. Find the probability of compound events and make predictions by applying probability theory. (D,1)**
 - Find the probability of an event.
 - Use area to solve problems involving geometric probability.

E. GEOMETRY

Students will understand and apply concepts from geometry. Students will be able to:

- 1. Draw coordinate representations of geometric figures and their transformations. (E,1)**
 - Solve problems by drawing a diagram.
 - Create tessellations with specific attributes.

- c. Name, recognize, and draw reflection images, lines of symmetry, and points of symmetry.
 - d. Name and draw translation images of figures with respect to parallel lines.
 - e. Name and draw rotation images of figures with respect to intersecting lines.
 - f. Use scale factors to determine if a dilation is an enlargement, a reduction, or a congruence transformation.
- 2. Use inductive and deductive reasoning to explore and determine the properties of and relationships among geometric figures. (E,2)**
- a. Make conjectures based on inductive reasoning.
 - b. Use the Law of Detachment and the Law of Syllogism in deductive reasoning.
 - c. Solve problems by looking for a pattern.
 - d. Use properties of equality in algebraic and geometric proofs.
 - e. Complete proofs involving segment theorems.
 - f. Complete proofs involving angle theorems.
 - g. Use the properties of parallel lines to determine angle measures.
 - h. Prove two lines are parallel based on given angle relationships.
 - i. Apply the angle sum theorem.
 - j. Apply the exterior angle theorem.
 - k. Name and label corresponding parts of congruent triangles.
 - l. Use SSS, SAS, and ASA postulates to test for triangle congruency.
 - m. Use the AAS theorem to test triangle congruency.
 - n. Solve problems by eliminating possibilities.
 - o. Use properties of isosceles and equilateral triangles.
 - p. Identify and use medians, altitudes, angle bisectors, and perpendicular bisectors in a triangle.
 - q. Recognize and use tests for congruence of right triangles.
 - r. Use indirect reasoning and indirect proof to reach a conclusion.
 - s. Recognize and apply properties of inequalities to the measures of segments and angles.
 - t. Solve problems by working backwards.
 - u. Recognize and apply relationships between sides and angles in a triangle.
 - v. Apply the Triangle Inequality theorem.
 - w. Apply the SAS Inequality and the SSS Inequality.
 - x. Recognize and apply the properties of a parallelogram.
 - y. Recognize and apply the conditions that ensure a quadrilateral is a parallelogram.
 - z. Identify and use sub-goals in writing proofs.
 - aa. Recognize and apply the properties of rectangles.
 - bb. Recognize and apply the properties of squares and rhombi.
 - cc. Recognize and apply the properties of trapezoids.
 - dd. Solve problems involving similar figures.
 - ee. Use similar triangles to solve problems.
 - ff. Use proportional parts of triangles to solve problems.
 - gg. Divide a segment into congruent parts.
 - hh. Recognize and use the proportional relationships of corresponding perimeters, altitudes, angle bisectors, and medians of similar triangles.
 - ii. Solve problems involving the circumference of a circle.
 - jj. Find measures of arcs and central angles.
 - kk. Solve problems by making circle graphs.
 - ll. Apply properties of inscribed figures.
 - mm. Find the measures of angles formed by intersecting secants and tangents in a relation to intercepted arcs.
 - nn. Use properties of chords, secants, and tangents to solve segment measure problems.
 - oo. Find the sum of the measures of interior and exterior angles of convex polygons and measures of interior and exterior angles of regular polygons.
 - pp. Solve problems involving angle measures of polygons.
 - qq. Solve problems by using guess-and-check.
 - rr. Use top, front, side, and corner views of three-dimensional solids to make models.
 - ss. Describe and draw cross sections and other slices of three-dimensional figures.
 - tt. Make two-dimensional nets for three-dimensional solids.

- uu. Prove theorems using coordinate proofs.
 - vv. Find the magnitude and direction of a vector.
 - ww. Determine if two vectors are equal.
 - xx. Perform operations with vectors.
 - yy. Locate a point in space.
 - zz. Locate, draw, and describe a locus in a plane or in space.
- 3. Apply trigonometry to problem situations involving triangles and periodic phenomena. (E,3)**
- a. Use the properties of 45° , -45° , -90° , and 30° , -60° , -90° triangles.
 - b. Find the trigonometric ratios using right triangles.
 - c. Solve problems using trigonometric ratios.
 - d. Use trigonometry to solve problems involving angles of elevation or depression.
 - e. Use the Law of Sines to solve triangles.
 - f. Use the Law of Cosines to solve triangles.

F. MEASUREMENT

Students will understand and demonstrate measurement skills. Students will be able to:

- 1. Use measurement tools and units appropriately and recognize limitations in the precision of the measurement tools. (F,1)**
- 2. Derive and use formulas for area, surface area, and volume of many types of figures. (F,2)**
 - a. Solve problems by using formulas.
 - b. Find maximum area of a rectangle for a given perimeter.
 - c. Find the distance between two points on a number line and between two points in a coordinate plane.
 - d. Use the Pythagorean theorem to find the length of the hypotenuse.
 - e. Find areas of parallelograms, triangles, trapezoids, regular polygons, and circles.
 - f. Find surface areas.
 - g. Find the lateral area and surface area of a right prism, a right cylinder, a regular pyramid, and a right circular cone.
 - h. Find the volume of a right prism, a right cylinder, a pyramid, and a right circular cone.
 - i. Find the surface area and the volume of a sphere.

G. PATTERNS, RELATIONS, FUNCTIONS

Students will understand that mathematics is the science of patterns, relationships, and functions.

H. ALGEBRA CONCEPTS

Students will understand and apply algebraic concepts. Students will be able to:

- 1. Use tables, graphs, and spreadsheets to interpret expressions, equations, and inequalities. (H,1)**
 - a. Solve problems by making a table.
- 2. Investigate concepts of variation by using equations, graphs, and data collection. (H,2)**
 - a. Find the slopes of lines.
 - b. Use slope to identify parallel and perpendicular lines.
 - c. Graph linear equations using the intercept method and the slope-intercept method.
 - d. Write an equation of a line given information about its graph.
 - e. Relate statistics and equations of lines to geometric concepts.
 - f. Use the distance and midpoint formulas for points in space.
 - g. Find the midpoint of a segment.
- 3. Formulate and solve equations and inequalities. (H,3)**
 - a. Recognize and use ratios and proportions.
 - b. Apply the properties of proportions.
 - c. Solve problems by solving a simpler problem.
 - d. Find the geometric mean between two numbers.
 - e. Solve problems involving relationships between parts of a triangle and the altitude to its hypotenuse.
 - f. Use the Pythagorean theorem and its converse.
 - g. Write and use the equation of a circle in the coordinate plane.

h. Solve problems by using equations.

4. Analyze and explain situations using symbolic representations. (H,4)

I. DISCRETE MATHEMATICS

Students will understand and apply concepts in discrete mathematics. Students will be able to:

1. Use networks to find solutions to problems. (I,2)

- a. Recognize nodes and edges as used in graph theory.
- b. Determine if a network is traceable.
- c. Determine if a network is complete.

J. MATHEMATICAL REASONING

Students will understand and apply concepts of mathematical reasoning. Students will be able to:

1. Analyze situations where more than one logical conclusion can be drawn from data presented. (J,1)

K. MATHEMATICAL COMMUNICATION

Students will reflect upon and clarify their understanding of mathematical ideas and relationships.

Students will be able to:

1. Restate, create, and use definitions in mathematics to express understanding, classify figures, and determine the truth of a proposition or argument. (K,1)

- a. Solve problems by listing possibilities.
- b. Complete proofs involving segment theorems.
- c. Identify angles and classify angles.
- d. Use the angle addition postulate to find the measures of angles.
- e. Identify and use congruent angles and the bisector of an angle.
- f. Identify and use adjacent, vertical, complementary, supplementary, and linear pairs of angles, and perpendicular lines.
- g. Determine what information can and cannot be assumed from a diagram.
- h. Write the converse, inverse, and contrapositive of an if-then statement.
- i. Identify and use basic postulates about points, lines, and planes.
- j. Identify the relationships between two lines or two planes.
- k. Name angles formed by a pair of lines and a transversal.
- l. Recognize angle conditions that produce parallel lines.
- m. Recognize and use distance relationships among points, lines, and planes.
- n. Identify points, lines, and planes in spherical geometry.
- o. Compare and contrast basic properties of plane and spherical geometry.
- p. Identify the parts of triangles and classify triangles by their parts.
- q. Identify similar figures.
- r. Identify similar triangles.
- s. Identify and use parts of circles.
- t. Recognize major arcs, minor arcs, semicircles, and central angles.
- u. Recognize and use relationships among arcs, chords, and diameters.
- v. Recognize and find measures of inscribed angles.
- w. Recognize tangents and use properties of tangents.
- x. Identify and name polygons.
- y. Identify regular and uniform (semi-regular) tessellations.
- z. Recognize and define basic properties of spheres.
- aa. Identify congruent or similar solids.
- bb. State properties of congruent solids.
- cc. Determine the center and radius of a sphere.
- dd. Recognize an isometry or congruence transformation.
- ee. Write a statement in if-then form.

2. Read mathematical presentations of topics within the Learning Results with understanding. (K,2)

ASSESSMENT

The Mathematics Department adheres to the National Council of Teachers of Mathematics Assessment Standards. Assessment should: reflect the mathematics that all students need to know and be able to do, enhance mathematics learning, promote equity, be an open process, promote valid inferences about mathematics learning, and be a coherent process.

To meet these standards, assessment includes a range of short-response exercises and longer-term, open-ended activities. Students can evaluate their own learning through the use of math journals. Students will also be given classroom-based projects and performance tests.

INSTRUCTIONAL PRACTICES

To address the needs of each student, teachers use a variety of instructional practices, flexible groupings, and knowledge of different learning styles. Instructional practices are designed to be meaningful, purposeful, and integrated with other content area subjects wherever possible. Teachers will use instructional practices that allow students to participate actively in learning. Teachers are encouraged to make use of available technology to enhance instruction.

Instructional practices include, but are not limited to:

1. Teacher-directed instruction
2. Mini-lessons
3. Guided practice
4. Modeling
5. Individualized instruction
6. Cooperative learning activities
7. Small group instruction
8. Manipulative-based instruction
9. Exploration of concepts taught
10. Problem solving: communication and appreciation of a variety of strategies
11. Drill and practice
12. Real-life math experiences
13. Technology used to support and enrich instruction

RESOURCES

Textbook: *Geometry*, Glencoe/McGraw Hill, 1997.

Glencoe Classroom Resources Algebra Kit: Study Guide Masters, Practice Masters, Enrichment Masters, Real-World Applications, Graphing Calculator Masters, Assessment and Evaluation Masters, Test and Review Software, etc.

T1-82 graphing calculators