

Geometry

Prerequisite: Algebra 1

The main goal of Geometry is for students to develop the structure of Euclidean geometry logically and apply the resulting theorems and formulas to address meaningful problems. Students will use experimentation and inductive reasoning to construct geometric concepts, discover geometric relationships, and formulate conjectures. Students will employ deductive logic to construct formal logical arguments and proofs. Students will extend their pre-existing experiences with algebra and geometry to trigonometry and coordinate geometry. Students will use dynamic geometry software, compass and straightedge, and other tools to investigate and explore mathematical ideas and relationships and develop multiple strategies for analyzing complex situations. Students will apply mathematical skills and make meaningful connections to life's experiences.

Standard I: Students will use algebraic, spatial, and logical reasoning to solve geometry problems.

Objective 1: Use inductive and deductive reasoning to develop mathematical arguments.

- a. Write conditional statements, converses, and inverses, and determine the truth value of these statements.
- b. Formulate conjectures using inductive reasoning.
- c. Prove a statement false by using a counterexample.

Objective 2: Analyze characteristics and properties of angles.

- a. Use accepted geometric notation for lines, segments, rays, angles, similarity, and congruence.
- b. Identify and determine relationships in adjacent, complementary, supplementary, or vertical angles and linear pairs.
- c. Classify angle pairs formed by two lines and a transversal.
- d. Prove relationships in angle pairs.
- e. Prove lines parallel or perpendicular using slope or angle relationships.

Objective 3: Analyze characteristics and properties of triangles.

- a. Prove congruency and similarity of triangles using postulates and theorems.
- b. Prove the Pythagorean Theorem in multiple ways, find missing sides of right triangles using the Pythagorean Theorem, and determine whether a triangle is a right triangle using the converse of the Pythagorean Theorem.
- c. Prove and apply theorems involving isosceles triangles.
- d. Apply triangle inequality theorems.
- e. Identify medians, altitudes, and angle bisectors of a triangle, and the perpendicular bisectors of the sides of a triangle, and justify the concurrency theorems.

Objective 4: Analyze characteristics and properties of polygons and circles.

- a. Use examples and counterexamples to classify subsets of quadrilaterals.
- b. Prove properties of quadrilaterals using triangle congruence relationships, postulates, and theorems.
- c. Derive, justify, and use formulas for the number of diagonals, lines of symmetry, angle measures, perimeter, and area of regular polygons.
- d. Define radius, diameter, chord, secant, arc, sector, central angle, inscribed angle, and tangent of a circle, and solve problems using their properties.
- e. Show the relationship between intercepted arcs and inscribed or central angles, and find their measures.

Objective 5: Perform basic geometric constructions, describing and justifying the procedures used.

- a. Investigate geometric relationships using constructions.
- b. Copy and bisect angles and segments.
- c. Construct perpendicular and parallel lines.
- d. Justify procedures used to construct geometric figures.
- e. Discover and investigate conjectures about geometric properties using constructions.

Objective 6: Analyze characteristics and properties of three-dimensional figures.

- a. Identify and classify prisms, pyramids, cylinders and cones based on the shape of their base(s).
- b. Identify three-dimensional objects from different perspectives using nets, cross-sections, and two-dimensional views.
- c. Describe the symmetries of three-dimensional figures.
- d. Describe relationships between the faces, edges, and vertices of polyhedra.

Mathematical Language and Symbols Students Should Use

conditional statement, converse, inverse, conjecture, inductive, deductive, counterexample, adjacent, complementary, supplementary, vertical angles, linear pair, transversal, congruent, postulate, theorem, isosceles, median, altitude, angle bisector, secant, arc, sector, central angle, inscribed angle, tangent of a circle, intercepted arc, construct, bisect, net, polyhedra, \overline{AB} , \vec{AB} , \overleftrightarrow{AB} , $//$, \perp , \sphericalangle

Standard II: Students will use the language and operations of algebra to explore geometric relationships with coordinate geometry.

Objective 1: Describe the properties and attributes of lines and line segments using coordinate geometry.

- a. Verify the classifications of geometric figures using coordinate geometry to find lengths and slopes.
- b. Find the distance between two given points and find the coordinates of the midpoint.
- c. Write an equation of a line perpendicular or a line parallel to a line through a given point.

Objective 2: Describe spatial relationships using coordinate geometry.

- a. Graph a circle given the equation in the form $(x - h)^2 + (y - k)^2 = r^2$, and write the equation when given the graph.
- b. Determine whether points in a set are collinear.

Mathematical Language and Symbols Students Should Use
distance formula, equation of a circle, collinear

Standard III: Students will extend concepts of proportion and similarity to trigonometric ratios.

Objective 1: Use triangle relationships to solve problems.

- a. Solve problems using the properties of special right triangles, e.g., 30° , 60° , 90° or 45° , 45° , 90° .
- b. Identify the trigonometric relationships of sine, cosine, and tangent with the appropriate ratio of sides of a right triangle.
- c. Express trigonometric relationships using exact values and approximations.

Objective 2: Use the trigonometric ratios of sine, cosine, and tangent to represent and solve for missing parts of triangles.

- a. Find the angle measure in degrees when given the trigonometric ratio.
- b. Find the trigonometric ratio given the angle measure in degrees, using a calculator.
- c. Find unknown measures of right triangles using sine, cosine, and tangent functions and inverse trigonometric functions.

Mathematical Language and Symbols Students Should Use
special right triangle, sine (sin), cosine (cos), tangent (tan), exact value

Standard IV: Students will use algebraic, spatial, and logical reasoning to solve measurement problems.

Objective 1: Find measurements of plane and solid figures.

- a. Find linear and angle measures in real-world situations using appropriate tools or technology.
- b. Develop surface area and volume formulas for polyhedra, cones, and cylinders.
- c. Determine perimeter, area, surface area, lateral area, and volume for prisms, cylinders, pyramids, cones, and spheres when given the formulas.
- d. Calculate or estimate the area of an irregular region.
- e. Find the length of an arc and the area of a sector when given the angle measure and radius.

Objective 2: Solve real-world problems using visualization and spatial reasoning.

- a. Solve problems using the Pythagorean Theorem and its converse.
- b. Solve problems using the distance formula.
- c. Solve problems involving trigonometric ratios.
- d. Solve problems involving geometric probability.

<p>Mathematical Language and Symbols Students Should Use polyhedra, cone, cylinder, sphere, arc, area of a sector, geometric probability</p>
