



GEOMETRY

OVERVIEW

The Geometry course balances theory and application. Students learn the process of writing formal proofs through inductive and deductive reasoning. The course integrates concepts of space and plane geometry and reinforces algebra skills. It emphasizes logical thinking and the application of special relationships to plane and solid figures. It also explores parallel lines and planes, congruent triangles, quadrilaterals, inequalities, similar polygons, right triangles, circles, constructions, areas of plane figures, areas and volumes of solids and coordinate geometry.

G.1 Language of Geometry

G.1.A Points, Lines and Planes

G.1.A.1 The student will use the undefined terms *point*, *line*, and *plane*.

G.1.A.2 The student will draw representations of points, lines, and planes.

G.1.A.3 The student will use the terms *collinear*, *coplanar*, and *intersection*.

G.1.B Segments, Rays and Distance

G.1.B.1 The student will use symbols of lines, segments, rays, and distances.

G.1.B.2 The student will find distances.

G.1.B.3 The student will state and use the Ruler Postulate and the Segment Addition Postulate.

G.1.C Angles

G.1.C.1 The student will name angles and find their measures.

G.1.C.2 The student will state and use the Angle Addition Postulate.

G.1.C.3 The student will recognize what can be concluded from a diagram.

G.1.D Triangles

The student will demonstrate the following knowledge and skills:

G.1.D.1 Given the lengths of three segments, the student will determine whether a triangle could be formed.

G.1.D.2 Given the lengths of two sides of a triangle, the student will determine the range in which the length of the third side must lie.

G.1.D.3 The student will order the sides of a triangle by their lengths when given information about the measures of the angles.

G.1.D.4 The student will order the angles of a triangle by their measures when given information about the lengths of the sides.

G.1.E Postulates and Theorems Relating Points, Lines, and Planes

G.1.E.1 The student will use postulates and theorems relating points, lines, and planes.

G.1.F Review of Algebraic Properties

G.1.F.1 The student will use properties from Algebra.

G.2 Deductive Reasoning

G.2.A If-Then Statements

G.2.A.1 The student will recognize the hypothesis and the conclusion of an *if-then* statement.

G.2.A.2 The student will identify and determine the validity of the converse of an *if-then* statement.



- _____ G.2.A.3 The student will identify and determine the validity of the inverse of an *if-then* statements.
- _____ G.2.A.4 The student will identify and determine the validity of the contrapositive of an *if-then* statements.
- _____ G.2.A.5 The student will understand the relationship between logically equivalent statements.
- _____ G.2.A.6 The student will draw correct conclusions for given statements.
- _____ G.2.A.7 The student will write indirect proofs in paragraph form.
- _____ G.2.A.8 The student will understand the meaning of “if and only if” and recognize the connection between a biconditional statement and a true conditional statement with a true converse, including statements representing geometric relationships.
- _____ G.2.B The student will translate propositional statements and compound statements into symbolic form, including:
 - a. negations ($\sim p$, read “not p”)
 - b. conjunctions ($p \wedge q$, read “p and q”)
 - c. disjunctions ($p \vee q$, read “p or q”)
 - d. conditionals ($p \rightarrow q$, read “if p then q”)
 - e. biconditionals ($p \leftrightarrow q$, read “p if and only if q”), including statements representing geometric relationships.
- _____ G.2.C Properties from Algebra
- _____ G.2.C.1 The student will use properties from Algebra and properties of congruence in proofs.
- _____ G.2.D Proving Theorems
- _____ G.2.D.1 The student will use the Midpoint Theorem and the Angle Bisector Theorem.
- _____ G.2.D.2 The student will know the kinds of reasons that can be used in proofs.
- _____ G.2.E Special Pairs of Angles
- _____ G.2.E.1 The student will apply the definitions of complementary and supplementary angles.
- _____ G.2.E.2 The student will state and use the theorem about vertical angles.
- _____ G.2.F Perpendicular Lines
- _____ G.2.F.1 The student will apply the definition and theorems about perpendicular lines.
- _____ G.2.G Planning a Proof
- _____ G.2.G.1 The student will state and apply the theorems about angles supplementary to, or complementary to, congruent angles.
- _____ G.2.G.2 The student will plan proofs and then write them in two-column form.



G.3 Parallel Lines and Planes

G.3.A Definitions

- G.3.A.1 The student will distinguish between intersecting lines, parallel lines, and skew lines.
- G.3.A.2 The student will state and apply the theorem about the intersection of two parallel planes by a third plane.
- G.3.A.3 The student will identify the angles formed when two lines are cut by a transversal line including:
 - a. corresponding angles
 - b. alternate interior angles
 - c. alternate exterior angles
 - d. same-side (consecutive) interior angles
 - e. same-side (consecutive) exterior angles

G.3.B Properties of Parallel lines

- G.3.B.1 The student will state and apply a postulate and theorems about parallel lines and about a parallel and perpendicular to a given line through a point outside the line.
- G.3.B.2 The student will prove two or more lines are parallel given angle measurements expressed numerically or algebraically.
- G.3.B.3 The student will solve problems by using the relationships between pairs of angles formed by the intersection of two parallel lines and a transversal.

G.3.C Angles of a Triangle

- G.3.C.1 The student will classify triangles according to sides and to angles.
- G.3.C.2 The student will state and apply the theorem and the corollaries about the sum of the measures of the angles of a triangle.

G.3.D Angles of a Polygon

- G.3.D.1 The student will recognize and name convex and regular polygons.
- G.3.D.2 The student will find the measures of interior angles and exterior angles of convex polygons.

G.3.E Inductive Reasoning

- G.3.E.1 The student will understand and use inductive reasoning.

G.3.F Proofs

- G.3.F.1 The student will plan and write proofs pertaining to parallel lines.

G.4 Triangles

G.4.A Congruent Figures

- G.4.A.1 The student will identify the corresponding parts of congruent figures.

G.4.B Some Ways to Prove Triangles Congruent

- G.4.B.1 The student will prove two triangles congruent by using the SSS, SAS, and ASA postulates.

G.4.C Using Congruent Triangles

- G.4.C.1 The student will deduce information about segments and angles after proving that two triangles are congruent.

G.4.D The Isosceles Triangle Theorems

- G.4.D.1 The student will apply the theorems and corollaries about isosceles triangles.



____ G.4.E Other Methods of Proving Triangles Congruent

____ G.4.E.1 The student will use the AAS Theorem to prove two triangles congruent.

____ G.4.E.2 The student will use the HL Theorem to prove two triangles congruent.

____ G.4.E.3 The student will prove that two overlapping triangles are congruent.

____ G.4.F Medians, Altitudes, and Perpendicular Bisectors

____ G.4.F.1 The student will apply the definitions of the median and the altitude of a triangle and the perpendicular bisector of a segment.

____ G.4.F.2 The student will state and apply the theorem about a point on the perpendicular bisector of a segment, and the converse.

____ G.4.F.3 The student will state and apply the theorem about a point on the bisector of an angle, and the converse.

____ G.4.G Proofs

____ G.4.G.1 The student will plan and write proofs pertaining to congruent triangles.

____ G.5 Quadrilaterals

____ G.5.A Properties of Parallelograms

____ G.5.A.1 The student will apply the definition of a parallelogram and the theorems about properties of a parallelogram.

____ G.5.B Ways to Prove that Quadrilaterals are Parallelograms.

____ G.5.B.1 The student will prove that certain quadrilaterals are parallelograms.

____ G.5.C Theorems Involving Parallel Lines

____ G.5.C.1 The student will apply theorems about parallel lines.

____ G.5.C.2 The student will apply the midpoint theorems for triangles.

____ G.5.D Special Parallelograms

____ G.5.D.1 The student will apply the definitions and identify the special properties of a rectangle, a rhombus, and a square.

____ G.5.D.2 The student will determine when a parallelogram is a rectangle, a rhombus or a square.

____ G.5.E Trapezoids

____ G.5.E.1 The student will apply the definitions and identify the properties of a trapezoid and an isosceles trapezoid.

____ G.5.F Proofs

____ G.5.F.1 The student will plan and write proofs pertaining to quadrilaterals.

- a. The student will prove and justify theorems and properties of quadrilaterals using deductive reasoning.

____ G.6 Inequalities in Geometry

____ G.6.A Inequalities

____ G.6.A.1 The student will apply properties of inequalities to positive numbers, lengths of segments, and measures of angles.

____ G.6.A.2 The student will state and use the Exterior Angle Inequality Theorem.

____ G.6.B Inequalities in One Triangle



____ G.6.B.1 The student will state and apply the inequality theorems and corollaries for one triangle.

____ G.7 Similar Polygons

____ G.7.A Ratio and Proportion

____ G.7.A.1 The student will express a ratio in simplest form.

____ G.7.B Properties of Proportions

____ G.7.B.1 The student will solve for an unknown term in a given proportion.

____ G.7.B.2 The student will express a given proportion in an equivalent form.

____ G.7.C Similar Polygons

____ G.7.C.1 The student will state and apply the properties of similar polygons.

____ G.7.D A Postulate for Similar Triangles

____ G.7.D.1 The student will use the AA Similarity Postulate to prove triangles similar.

____ G.7.D.2 The student will use similar triangles to deduce information about segments or angles.

____ G.7.E Theorems for Similar Triangles

____ G.7.E.1 The student will use the SAS Similarity Theorem and the SSS Similarity Theorem to prove triangles are similar.

____ G.7.F Proportional Lengths

____ G.7.F.1 The student will apply the Triangle Proportionality Theorem and its corollary.

____ G.7.F.2 The student will state and apply the Triangle Angle-Bisector Theorem.

____ G.7.G Proofs

____ G.7.G.1 The student will plan and write proofs pertaining to similar polygons.

____ G.8 Algebra Unit on Radicals and Radical Equations

____ G.8.A Simplifying Radicals

____ G.8.A.1 The student will simplify radicals.

____ G.8.A.2 The student will simplify sums, differences, and products of radicals.

____ G.8.B Multiplication of Binomials Containing Radicals

____ G.8.B.1 The student will multiply binomials containing square-root radicals.

____ G.8.B.2 The student will rationalize binomial denominators that contain square-root radicals.

____ G.8.C Simple Radical Equations

____ G.8.C.1 The student will solve simple radical equations.

____ G.9 Right Triangles

____ G.9.A Similarity in Right Triangles

____ G.9.A.1 The student will determine the geometric mean between two numbers.

____ G.9.A.2 The student will state and apply the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle.

____ G.9.B The Pythagorean Theorem

____ G.9.B.1 The student will state and apply the Pythagorean Theorem.



- ____ G.9.B.2 The student will solve problems, including those in context, involving right triangles using the Pythagorean Theorem including recognizing Pythagorean Triples.
- ____ G.9.C The Converse of the Pythagorean Theorem
 - ____ G.9.C.1 The student will state and apply the converse of the Pythagorean Theorem and related theorems about obtuse and acute triangles.
- ____ G.9.D Special Right Triangles
 - ____ G.9.D.1 The student will determine the lengths of two sides of a $45^\circ - 45^\circ - 90^\circ$ or a $30^\circ - 60^\circ - 90^\circ$ triangle when the length of the third side is known.
- ____ G.9.E Trigonometry
 - ____ G.9.E.1 The student will define the tangent, sine, and cosine ratios for an acute angle.
 - ____ G.9.E.2 The student will solve right triangle problems by correct selection and use of the tangent, sine, and cosine ratios.
- ____ G.10 Circles
 - ____ G.10.A Basic Terms
 - ____ G.10.A.1 The student will define a circle, sphere, and related terms.
 - ____ G.10.A.2 The student will recognize inscribed polygons and circumscribed circles.
 - ____ G.10.B Tangents
 - ____ G.10.B.1 The student will apply theorems that relate tangents and radii.
 - ____ G.10.B.2 The student will recognize circumscribed polygons and inscribed circles.
 - ____ G.10.C Arcs and Central Angles
 - ____ G.10.C.1 The student will define and apply properties of arcs and central angles.
 - ____ G.10.D Arcs and Chords
 - ____ G.10.D.1 The student will apply theorems about the chords of a circle.
 - ____ G.10.E Inscribed Angles
 - ____ G.10.E.1 The student will solve problems and prove statements involving inscribed angles.
 - ____ G.10.E.2 The student will solve problems and prove statements involving angles formed by chords, secants, and tangents.
 - ____ G.10.F Other Angles
 - ____ G.10.F.1 The student will solve problems and prove statements involving angles formed by chords, secants, and tangents.
 - ____ G.10.G Circles and Lengths of Segments
 - ____ G.10.G.1 The student will solve problems involving lengths of chords, secant segments, and tangent segments.
- ____ G.11 Areas of Plane Figures
 - ____ G.11.A Areas of Rectangles
 - ____ G.11.A.1 The student will understand what is meant by the area of a polygon.
 - ____ G.11.A.2 The student will understand the area postulates.
 - ____ G.11.A.3 The student will know and use the formula for the area of a rectangle.
 - ____ G.11.B Areas of Parallelograms, Triangles, and Rhombuses



- _____ G.11.B.1 The student will know and use the formulas for the areas of parallelograms, triangles, and rhombuses.
- _____ G.11.C Areas of Trapezoids
 - _____ G.11.C.1 The student will know and use the formula for the area of a trapezoid.
- _____ G.11.D Areas of Regular Polygons
 - _____ G.11.D.1 The student will know and use the formula for the areas of regular polygons.
- _____ G.11.E Circumferences and Areas of Circles
 - _____ G.11.E.1 The student will know and use the formulas for the circumferences and areas of circles that are derived from the perimeter and area formulas for regular polygons.
- _____ G.11.F Arc Lengths and Areas of Sectors
 - _____ G.11.F.1 The student will know and use the formulas for arc length and the areas of sectors of a circle.
- _____ G.11.G Ratios of Areas
 - _____ G.11.G.1 The student will find the ratio of the areas of two triangles.
 - _____ G.11.G.2 The student will understand and apply the relationship between scale factors, perimeters, and the areas of similar figures.
- _____ G.12 Areas and Volumes of Solids
 - _____ G.12.A Prisms
 - _____ G.12.A.1 The student will identify the parts of prisms.
 - _____ G.12.A.2 The student will find the lateral areas, total areas, and volumes of right prisms.
 - _____ G.12.B Pyramids
 - _____ G.12.B.1 The student will identify the parts of pyramids.
 - _____ G.12.B.2 The student will find the lateral areas, total areas, and volumes of pyramids.
 - _____ G.12.C Cylinders and Cones
 - _____ G.12.C.1 The student will find the lateral areas, total areas, and volumes of right cylinders and right cones
 - _____ G.12.D Spheres
 - _____ G.12.D.1 The student will find the area and volume of a sphere.
 - _____ G.12.E Areas and Volumes of Similar Solids
 - _____ G.12.E.1 The student will state and apply the properties of similar solids.
 - _____ G.12.E.2 The student will describe how changes in one or more dimensions of a figure affect other derived measures (perimeter, area, total surface area, and volume) of the figure.
 - _____ G.12.E.3 The student will describe how changes in surface area and/or volume of a figure affect the measures of one or more dimensions of the figure.
 - _____ G.12.E.4 The student will solve problems, including those in context, involving changing the dimensions or derived measures of a three-dimensional figure.
 - _____ G.12.E.5 The student will compare ratios between side lengths, perimeters, areas, and volumes of similar figures.
 - _____ G.12.E.6 The student will recognize when two- and three-dimensional figures are similar and solve problems, including those in context, involving attributes of similar geometric figures.