

## Geometry GT Essential Curriculum

### UNIT I: Fundamental Concepts and Patterns in Geometry

**Goal.** The student will demonstrate the ability to use fundamental concepts of geometry including definitions, basic constructions, tools of geometry, and coordinate geometry.

Objectives - The student will be able to:

- a. Explore and recognize geometric patterns.
- b. Identify and apply basic definitions of geometry.
- c. Identify and apply segment relationships including segment addition, midpoint of a segment, and the concept of betweenness.
- d. Graph points and lines in the coordinate plane.
- e. Calculate the distance between two points in the coordinate plane.
- f. Find the midpoint of a given segment in the coordinate plane.
- g. Identify and apply angle relationships including complementary, supplementary, vertical, and adjacent angles.
- h. Construct a segment bisector and the bisector of a given angle.
- i. Find the perimeter and area of common plane figures.
- j. Represent a point in space as an ordered triple.
- k. Use the distance and midpoint formulas for segments in three-dimensional space.
- l. Explore relationships given a set of points in space such as collinear, coplanar, and relative placement inside or outside a figure.

### UNIT II: Geometric Reasoning and Proof

**Goal.** The student will demonstrate the ability to apply geometric properties and relationships through inductive and deductive reasoning.

Objectives - The student will be able to:

- a. Use inductive reasoning to arrive at a valid conclusion.
- b. Analyze and rewrite conditional and biconditional statements.
- c. Find a counterexample to disprove a conjecture.
- d. Write the inverse, converse, and contrapositive of a conditional statement.
- e. Use point, line, and plane postulates to solve problems and prove theorems about segments and angles.
- f. Use deductive reasoning to prove a conjecture.
- g. Use the properties of equality in a geometric situation.
- h. Present valid arguments in the form of narrative, flow chart, or two-column proof.
- i. Construct a segment congruent to a given segment.
- j. Draw conclusions from a Venn diagram.
- k. Identify errors in mathematical and logical reasoning.
- l. Use indirect proof to justify algebraic and geometric conjectures.

### UNIT III: Parallel and Perpendicular Lines

**Goal.** The student will demonstrate the ability to apply the properties of parallel and perpendicular lines.

Objectives - The student will be able to:

- a. Identify parallel and perpendicular lines and planes.
- b. Draw parallel lines, intersecting lines, and perpendicular bisectors.
- c. Determine the measures of angles formed by parallel lines, perpendicular lines, and transversals.
- d. Prove statements and theorems using parallel and perpendicular lines.
- e. Determine the slope of a line parallel or perpendicular to a given line.
- f. Construct a line perpendicular to a line at a given point on the line, a line perpendicular from a given point to a line, an angle congruent to a given angle, and the parallel to a given line through a given point not on that line.

### UNIT IV: Triangle Relationships and Triangle Congruence

**Goal.** The student will demonstrate the ability to apply the definitions and theorems of triangles.

Objectives - The student will be able to:

- a. Classify triangles by their sides and by their angles.
- b. Apply the Triangle-Angle Sum Theorem, the Isosceles Triangle Theorem and its converse, and the Exterior Angle Theorem.
- c. Name corresponding parts of congruent polygons.
- d. Prove triangles congruent using SAS, SSS, ASA, AAS, and HL theorems.
- e. Construct a triangle congruent to a given triangle.
- f. Use congruent triangles to prove statements and theorems.
- g. Use the Perpendicular Bisector Theorem and its converse.
- h. Use the Angle Bisector Theorem and its converse.
- i. Identify and construct the median, the altitude, and the perpendicular bisector of the sides of a triangle.
- j. Identify the midsegments of a triangle and use the properties of the midsegment of a triangle.
- k. Compare the side and angle measurements in one triangle.
- l. Use the Triangle Inequality Theorem.
- m. Construct, in the context of a real-world application, the centroid, circumcenter, and incenter of a triangle.

### UNIT V: Exploring Quadrilaterals

**Goal.** The student will demonstrate the ability to explore and verify properties of quadrilaterals.

Objectives - The student will be able to:

- a. Identify regular and nonregular polygons.
- b. Describe the characteristics of a quadrilateral.
- c. Apply the properties of parallelograms.

- d. Justify that a quadrilateral is a parallelogram.
- e. Use the properties of special quadrilaterals.
- f. Investigate the family hierarchy of quadrilaterals.
- g. Calculate the area of triangles and quadrilaterals.
- h. Justify that a quadrilateral is a rectangle, rhombus, or square.

## **UNIT VI: Transformations and Similarity**

**Goal.** The student will demonstrate the ability to analyze the effects of transformations and identify and use similar polygons.

Objectives - The student will be able to:

- a. Perform geometric transformations including reflections, rotations, translations and dilations.
- b. Describe how transformations affect the properties of geometric figures.
- c. Use transformations to recognize and create designs.
- d. Name corresponding parts of similar polygons.
- e. Apply proportions to similar figures in real-world problems.
- f. Prove triangles similar using AA, SSS, SAS Similarity Theorems.
- g. Write and plot ordered pairs from matrix notation and find transformation images, including rotations, reflections, dilations and translations, using matrices.
- h. Identify the distance and direction of a given vector and find resultant vectors.
- i. Describe translations using vectors and find translation images using vector sums.

## **UNIT VII: Investigating Right Triangles**

**Goal.** The student will demonstrate the ability to solve problems using properties of right triangles, including trigonometric ratios.

Objectives - The student will be able to:

- a. State and apply the theorem involving the altitude on the hypotenuse as the geometric mean, and find the geometric mean between two numbers.
- b. Define and apply the Pythagorean Theorem and its converse.
- c. Use the Pythagorean Theorem to develop and solve problems involving right triangles and special right triangles (30-60-90 and 45-45-90).
- d. Define sine, cosine, and tangent ratios in right triangles.
- e. Use appropriate keystrokes on a graphing calculator to find trigonometric ratios and measures of angles.
- f. Find the missing parts of a right triangle using trigonometric and inverse trigonometric ratios.
- g. Apply right triangle trigonometry to real-world situations.
- h. Apply the Law of Sines and the Law of Cosines to solve problems involving oblique triangles, disregarding problems that use the ambiguous case for Law of Sines.

## **UNIT VIII: Polygons**

**Goal.** The student will demonstrate the ability to find one- and two- dimensional measures relating to polygons.

Objectives - The student will be able to:

- a. Find the measures of interior and exterior angles of polygons.
- b. Determine the perimeter and area of regular polygons.
- c. Find the area of similar figures.
- d. Compare perimeter and area of congruent and similar polygons.

## **UNIT IX: Surface Area and Volume**

**Goal.** The student will demonstrate the ability to find two- and three- dimensional measures relating to geometric solids.

Objectives - The student will be able to:

- a. Calculate the volume and surface areas of solid figures including composite figures.
- b. Compare linear dimensions, surface area, and volume of similar figures using ratios.
- c. Apply formulas for surface area and volume to real-world situations.
- d. Explore nets of three-dimensional figures.
- e. Analyze the properties and relationships of geometric solids with bases other than rectangles, triangles, or circles.
- f. Analyze the properties and relationships of truncated three-dimensional solids.

## **UNIT X: Circles**

**Goal.** The student will demonstrate the ability to find one- and two- dimensional measurements relating to circles.

Objectives - The student will be able to:

- a. Calculate the measure of angles and line segments created by radii, chords, secants, and tangents.
- b. Apply relationships among central angles, inscribed angles, and arcs of circles.
- c. Solve problems involving inscribed and circumscribed polygons.
- d. Construct a tangent to a circle at a given point when the given point is on that circle and when the point is not on that circle.
- e. Calculate circumference, arc length, and area of a circle and a sector.
- f. Explore the relationship between radian measure and the corresponding degree measure from 0 to  $2\pi$ .

## **UNIT XI: Non-Euclidean Geometry**

**Goal.** The student will demonstrate the ability to contrast geometric properties in Euclidean geometry and non-Euclidean geometry.

Objectives - The student will be able to:

- a. Investigate why the parallel postulate is invalid in spherical geometry.
- b. Investigate other geometric properties in spherical geometry, using spheres as physical models.
- c. Investigate why the parallel postulate is invalid in hyperbolic geometry.
- d. Investigate other geometric properties in hyperbolic geometry, using Non-Euclid computer software.