

Summer 2015

Units: 10 high school credits **UC Requirement Category:** c **General Description:**

GEOMETRY Grades 9-12

Geometry is a two-semester course exploring and applying geometric concepts to develop a mathematical system. It is an investigation of the properties and relationships of points, lines and planes and of two and three-dimensional figures and their applications in area, volume and proportion. Logical reasoning will be emphasized through the development of proofs and problem solving. It also includes an introduction to analytic geometry.

Course goals will be to understand geometry as a system with the use of logical reasoning to explain and solve problems. Understanding the relationship between geometry and algebra and how geometry assists algebra in developing solutions to problems is an expected outcome. Continuing to generate a positive attitude towards mathematics and improving upon computational methods and abilities is an expected result.

Geometry Course Syllabus

Course Outcomes

1. Students are able to express geometric ideas and concepts orally and in writing.
2. Students are able to understand geometric components.
3. Students are able to understand relationships between geometric components.
4. Students are able to relate algebra to geometric problems.
5. Students are able to apply geometric concepts to develop solutions to real world situations.
6. Students are able to use basic constructions and measurement tools.
7. Students are able to use logic to create solutions.
8. Students are able to develop reasonable diagrams and appropriate visuals to enhance learning and problem solving.

Unit 1: Points, Lines, Planes, and Angles

Subject Matter

1. Points, lines, planes
2. Segments, rays, and distance
3. Angles
4. Postulates and theorems relating to points, lines and planes

Outcomes

1. Students will be able to use and draw representations of the undefined terms “point, line and plane.”
2. Students will be able to define the terms collinear, coplanar, and intersection.
3. Students will be able to use the symbols for lines, segments, rays, and distance.
4. Students will be able to find distances using the Ruler Postulate.
5. Students will be able to name angles and find their measurements using the Protractor

Postulate.

6. Students will be able to state and use the Segment and Angle Addition Postulates.
7. Students will be able to use postulates and theorems relating points, lines, and planes.

Unit 2: Deductive Reasoning

Subject Matter

1. Deductive reasoning
2. If-then statements; converses
3. Properties from algebra
4. Proving theorems
5. Angles and perpendicular line
6. Complementary, supplementary, and vertical angles
7. Perpendicular lines
8. Planning proofs

Outcomes

1. Students will be able to recognize the hypothesis and conclusion of an if-then statement and state the converse.
2. Students will be able to use a counterexample to disprove an if-then statement.
3. Students will be able to use properties from algebra and properties of congruence in proofs.
4. Students will be able to use the Midpoint and Angle Bisector Theorems.
5. Students will be able to demonstrate the definitions of complementary, supplementary, and vertical angles.
6. Students will be able to use the definition and theorems about perpendicular lines.
7. Students will be able to use the theorems about angles supplementary to, or complementary to.

8. Students will be able to use congruent angles.
9. Students will be able to plan proofs and write them in two-column form.

Unit 3: Parallel Lines and Planes

Subject Matter

1. When lines and planes are parallel
 1. Definitions of parallel lines
 2. Properties of parallel lines
2. Applying parallel lines to polygons
 1. Angles of triangles
 2. Angles of polygons
 3. Inductive reasoning

Outcomes

1. Students will be able to distinguish between intersecting, parallel, and skew lines.
2. Students will be able to state and apply the theorem about the intersection of two parallel planes by a third plane.
3. Students will be able to identify the angles formed when two lines are cut by a transversal.
4. Students will be able to state and apply a postulate and theorems about parallel lines.
5. Students will be able to state and apply the theorems about a parallel and perpendicular to a given line through an exterior point.
6. Students will be able to classify triangles according to sides and angles.
7. Students will be able to state and apply the theorem and corollaries about the sum of the measure of the angles of triangle.
8. Students will be able to state and apply the theorem about the measure of an exterior angle of a triangle.
9. Students will be able to find the measures of interior and exterior angles of convex polygons.
10. Students will be able to understand and use inductive reasoning.

Unit 4: Congruent Triangles

Subject Matter

1. Corresponding parts in a congruence
 1. Congruent figures
 2. Ways to prove triangles congruent
 3. Using congruent triangles
2. Theorems based on congruent triangles
 - a. Isosceles triangle theorems
 - b. Other methods of proving triangles congruent
3. More proofs in geometry

a. Using more than one pair of congruent triangles b. Medians, altitudes, and perpendicular bisectors

Outcomes

1. Students will be able to identify corresponding parts of congruent figures.
2. Students will be able to prove two triangles congruent by using the SSS, SAS, or the ASA Postulates.
3. Students will be able to deduce information about segments and angles after proving that two triangles are congruent.
4. Students will be able to apply the theorem and corollaries about isosceles triangles.
5. Students will be able to use the AAS and HL theorems to prove two triangles congruent.
6. Students will be able to prove that two overlapping triangles are congruent.
7. Students will be able to prove two triangles congruent by first proving two other triangles congruent.
8. Students will be able to apply the definitions of the median and the altitude of a triangle and the perpendicular bisector of a segment.
9. Students will be able to state and apply the perpendicular bisector theorem and its converse.

Unit 5: Quadrilaterals

Subject Matter

1. Parallelograms
2. Properties of parallelograms
3. Ways to prove that quadrilaterals are parallelograms
4. Theorems involving parallel lines
5. Special quadrilaterals
6. Special parallelograms
7. Trapezoids

Outcomes

1. Students will be able to apply the definition of a parallelogram and the theorems about properties of a parallelogram.
2. Students will be able to prove that certain quadrilaterals are parallelograms.
3. Students will be able to apply theorems about parallel lines.
4. Students will be able to apply the midpoint theorems for triangles.
5. Students will be able to apply the definitions and identify the special properties of a rectangle, a rhombus, and a square.
6. Students will be able to determine when a parallelogram is a rectangle, rhombus, or square.

7. Students will be able to apply the definitions and identify the properties of a trapezoid and an isosceles trapezoid.

Unit 6: Inequalities in Geometry

Subject Matter

1. Inequalities and indirect proof a. Inequalities c. Indirect proof
2. Inequalities in triangles
 - a. Inequalities for one triangle
 - b. Inequalities for two triangles

Outcomes

1. Students will be able to apply properties to positive numbers, lengths of segments, and measures of angles.
2. Students will be able to state and use the exterior angle inequality theorem.
3. Students will be able to state the contrapositive and inverse of an if-then statement.
4. Students will be able to draw correct conclusions from given statements.
5. Students will be able to write indirect proofs.
6. Students will be able to state and apply the inequality theorems and corollaries for one triangle.
7. Students will be able to state and apply the inequality theorems for two triangles.

Unit 7: Similar Polygons

Subject Matter

1. Ratio, proportion, and similarity
2. Ratio and proportion
3. Properties of proportions
4. Similar polygons
5. Working with similar polygons
6. Postulate for similar triangles
7. Theorems for similar triangles
8. Proportional lengths

Outcomes

1. Students will be able to express a ratio in simplest form.
2. Students will be able to solve for an unknown term in a given proportion.
3. Students will be able to express a given proportion in an equivalent form.
4. Students will be able to state and apply the properties of similar polygons.

5. Students will be able to use the AA Similarity Postulate to prove triangles similar.
6. Students will be able to use similar triangles to deduce information about segments or angles.
7. Students will be able to use the SAS Similarity Theorem and the SSS Similarity Theorem to prove triangles similar.
8. Students will be able to apply the Triangle Proportionality Theorem and its corollary.
9. Students will be able to state and apply the Triangle Angle-Bisector Theorem.

Unit 8: Right Triangles Subject Matter

1. Right triangles
2. Similarity in right triangles
3. Pythagorean theorem
4. Converse Pythagorean theorem
5. Special right triangles
6. Introduction to trigonometry
7. Tangent ratio
8. Sine and cosine ratios
9. Applications of right triangle trigonometry

Outcomes

1. Students will be able to determine the geometric mean.
2. Students will be able to state and apply the geometric mean relationships that exist when the altitude is drawn to the hypotenuse of a right triangle.
3. Students will be able to state and apply the Pythagorean theorem.
4. Students will be able to state and apply the converse of the Pythagorean theorem.
5. Students will be able to determine the lengths of two sides of a 45-45-90 or a 30-60-90 triangle when the third side is known.
6. Students will be able to define tangent, sine, cosine ratio for a right triangle.
7. Students will be able to solve right triangle problems by using the sine, cosine, and tangent ratios.

Unit 9: Circles

Subject Matter

1. Tangents, arcs, chords
2. Basic terms
3. Tangents
4. Arcs and central angles
5. Arcs and chords
6. Angles and segments
7. Inscribed angles
8. Other angles

9. Circles and lengths of segments

Outcomes

1. Students will be able to define a circle, a sphere, and terms related to them.
 2. Students will be able to recognize inscribed polygons and circumscribed circles.
 3. Students will be able to apply theorems that relate tangent and radii.
 4. Students will be able to recognize circumscribed polygons and inscribed circles.
 5. Students will be able to define and apply properties of arc and central angles.
 6. Students will be able to apply theorems about the chords of a circle.
 7. Students will be able to solve problems involving inscribed angles.
 8. Students will be able to solve problems involving angles formed by chords, secants, and tangents.
9. Students will be able to solve problems involving lengths of chords, secant segments, and tangent segments.

Unit 10: Constructions and Loci

Subject Matter

1. Basic constructions
2. Definitions
3. Perpendicular and parallels
4. Concurrent lines
5. Circles
6. Special segments
7. Locus
8. Definitions
9. Locus problems
10. Locus construction

Outcomes

1. Students will be able to construct a segment congruent to a given segment.
2. Students will be able to construct an angle congruent to a given angle.
3. Students will be able to construct the bisector of a given angle.
4. Students will be able to construct the perpendicular bisector of a given statement.
5. Students will be able to construct the perpendicular to a given line through a given point on the line.
6. Students will be able to construct a perpendicular to a given line through a given point not on the line.
7. Students will be able to construct a line parallel to given line through a given point not on the line.

8. Students will be able to state and apply the properties of the sets of concurrent lines of a triangle: the three angle bisectors, the three altitudes, the three perpendicular bisectors of its sides, and the three medians.
9. Students will be able to construct a tangent to a circle at a given point.
10. Students will be able to construct a tangent to a circle from a given point outside the circle.
11. Students will be able to circumscribe a circle about a given triangle.
12. Students will be able to inscribe a circle inside a given triangle.
13. Students will be able to divide a segment into a number of congruent parts.
14. Students will be able to, given three segments, construct a fourth in given proportion.
15. Students will be able to construct the geometric mean on two given segments.

Unit 11: Areas of Plane Figures

Subject Matter

1. Areas of rectangles
2. Areas of parallelograms, triangles, and rhombuses
3. Areas of trapezoids
4. Areas of regular polygons
5. Circles, similar figures, and geometric probability
6. Circumferences and areas of circles
7. Arc lengths and areas of sectors
8. Ratios of areas
9. Geometric probability

Outcomes

1. Students will be able to use the formula for the area of a rectangle.
2. Students will be able to use the formulas for the areas of parallelograms, triangles, and rhombuses.
3. Students will be able to use the formula for the area of a trapezoid.
4. Students will be able to use the formula for the area of regular polygons.
5. Students will be able to use the formulas for the circumferences and areas of circles.
6. Students will be able to use the formulas for arc length and areas of sectors of a circle.
7. Students will be able to find the ratio of the areas of two triangles.
8. Students will be able to apply the relationship between scale factors, perimeters and areas of similar figures.

Units 12: Areas and Volumes of Solids

Subject Matter

1. Important Solids
2. Prisms
3. Pyramids
4. Cylinders and cones
5. Similar solids
6. Spheres
7. Areas and volume of similar solids

Outcomes

1. Students will be able to identify the parts of prisms.
2. Students will be able to find the lateral areas, total areas, and volumes of right prisms.
3. Students will be able to identify the parts of pyramids.
4. Students will be able to find lateral areas, total areas, and volumes of regular pyramids.
5. Students will be able to find lateral areas, total areas, and volumes of right cylinders, and right cones.
6. Students will be able to find the area and the volume of a sphere.

Unit 13: Coordinate Geometry

Subject Matter

1. Geometry and algebra
2. Distance formula
3. Slope of a line
4. Parallel and perpendicular lines
5. Vectors
6. Midpoint formula
7. Lines and coordinate geometry proofs
8. Graphing linear equations
9. Writing linear equations
10. Organizing coordinate proofs
11. Coordinate geometry proofs

Outcomes

1. Students will be able to state and apply the distance formula.
2. Students will be able to state and apply the general equation of a circle.
3. Students will be able to state and apply the slope formula.
4. Students will be able to demonstrate the basic properties of vectors.
5. Students will be able to state and apply the midpoint formula.
6. Students will be able to identify the slope and y-intercept of a line given its equation.
7. Students will be able to draw the graph of a line given its equation.

8. Students will be able to determine the intersection of two lines.
9. Students will be able to determine the equation of a line given one point and the slope of the line, or given two points on the line.