**Geometry**

**Learning Objectives**

Updated: 12/8/16

Semester 1

Ch. 1

* Students will know the precise definitions of angle, perpendicular line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
* Students will make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic software, etc.) Students will copy a segment, copy an angle, bisect a segment, bisect an angle, construct perpendicular lines, including the perpendicular bisector of a line segment, and construct a line parallel to a given line through a point not on the line.
* Students will use coordinates to compute perimeters of polygons and areas of triangles and rectangles (distance formula).

Ch. 2

* Students will prove vertical angles are congruent.

Ch. 3

* Students will know the precise definition of a parallel line.
* Students will prove alternate interior angles are congruent and corresponding angles are congruent.
* Students will prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.
* Students will make formal geometric constructions with a variety of tools and methods (dynamic software)
* Students will find the point on a directed line segment between two given points that partitions the segment in a given ratio.

Ch. 4

* Students will construct an equilateral triangle and a regular hexagon inscribed in a circle.
* Students will prove that the measures of interior angles of a triangle sum to 180 degrees.
* Students will prove that base angles of isosceles triangles are congruent.
* Students will use geometric descriptions or rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
* Students will use the definition of congruence in terms of rigid motions to show that two triangles are congruent iff corresponding pairs of angles are congruent.
* Students will explain how the criteria for triangle congruence (ASA, SAS, SSS) follow from the definition of congruence in terms of rigid motions.

Ch. 5

* Students will prove that points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints.
* Students will prove the medians of a triangle meet at a point.

Ch. 6

* Students will prove that in a parallelogram opposite sides are congruent.
* Students will prove that in a parallelogram opposite angles are congruent.
* Students will prove that in a parallelogram diagonals bisect each other.
* Students will prove that rectangles are parallelograms with congruent diagonals.
* Students will construct a square inscribed in a circle.
* Students will use geometric shapes, their measures, and their properties to describe objects.
* Students will use coordinates to prove or disprove that a figure defined by four given points in a coordinate plane is a rectangle.

Ch. 7

* Students will us the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
* Students will prove a line parallel of one side of a triangle divides the other two proportionally.
* Students will prove the Pythagorean Theorem using triangle similarity.
* Students will use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
* Students will prove the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length.

Ch. 8

* Students will understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trig ratios for acute triangles.
* Students will explain and use the relationship between the sine and cosine of complementary angles.
* Students will use trig ratios and the Pythagorean Theorem to solve right triangles in applied problems.
* Students will derive the formula A = ½ ab sin (C) for the area of a triangle by drawing and auxiliary line from the vertex perpendicular to the opposite side.
* Students will prove the law of sines and cosines and use them to solve problems.
* Students will understand and apply the law of sines and law of cosines to find unknown measurements in right and non-right triangles.
* Students will construct an equilateral triangle and square.
* Students will prove the Pythagorean Theorem.

Semester 2

Ch. 9

* Students will represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Students will compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
* Students will given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
* Students will develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
* Students will given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
* Students will verify experimentally the properties of dilations given by a center and a scale factor:
  + A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
  + The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
* Students will given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

Ch. 10

* Students will know precise definitions of a circle.
* Students will prove that all circles are similar.
* Students will identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
* Students will construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
* Students will construct a tangent line from a point outside a given circle to the circle.
* Students will derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
* Students will derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Ch. 11

* Students will use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
* Students will use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
* Students will give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
* Students will derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Ch. 12

* Students will Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
* Students will apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
* Students will apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Ch. 13

* Students will give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
* Students will give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
* Students will use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
* Students will use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
* Students will apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
* Students will apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
* Students will prove that all circles are similar.