DISTRICT OF COLUMBIA PUBLIC SCHOOLS

SY14-15 Geometry Math Scope and Sequence

Summary of the Year

Although there are many types of geometry, school mathematics is devoted primarily to plane Euclidean geometry, studied both synthetically (without coordinates) and analytically (with coordinates). Euclidean geometry is characterized most importantly by the Parallel Postulate, that through a point not on a given line there is exactly one parallel line. (Spherical geometry, in contrast, has no parallel lines.) During high school, students begin to formalize their geometry experiences from elementary and middle school, using more precise definitions and developing careful proofs. Later in college some students develop Euclidean and other geometries carefully from a small set of axioms.

Year-at-a-Glance

Instructional Window 1
- Unit 1.1: Lines and Angles
- Unit 1.2: Transformations

Instructional Window 2
- Unit 2.1: Congruent Triangles
- Unit 2.2: Quadrilaterals and Polygons

Instructional Window 3
- Unit 3.1: Transformations and Similarity
- Unit 3.2: Trigonometry in Right Triangles
- Unit 3.3: Lines and Angles in Circles

Instructional Window 4
- Unit 4.1: Lines and Angles in Circles
- Unit 4.2: Linear and Area Measurement
- Unit 4.3: Three-Dimensional Figures and Volume

Instructional Window 5
- Unit 5.1: Project-Based Unit

Fluency and/or Culminating Standards

- **G-SRT.5** Fluency with the triangle congruence and similarity criteria will help students throughout their investigations of triangles, quadrilaterals, circles, parallelism, and trigonometric ratios. These criteria are necessary tools in many geometric modeling tasks.
- **G-GPE.4, 5, 7** Fluency with the use of coordinates to establish geometric results, calculate length and angle, and use geometric representations as a modeling tool are some of the most valuable tools in mathematics and related fields.
- **G-CO.12** Fluency with the use of construction tools, physical and computational, helps students draft a model of a geometric phenomenon and can lead to conjectures and proofs.

Geometry Overview

CONGRUENCE
- □ Experiment with transformations in the plane
- ■ Understand congruence in terms of rigid motions
- ■ Prove geometric theorems
- □ Make geometric constructions

SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY
- ■ Understand similarity in terms of similarity transformations
- ■ Prove theorems involving similarity
- ■ Define trigonometric ratios and solve problems involving right triangles

CIRCLES
- ○ Understand and apply theorems about circles
- ○ Find arc lengths and areas of sectors of circles

EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS
- ○ Translate between the geometric description and the equation for a conic section
- ■ Use the coordinates to prove simple geometric theorems algebraically

GEOMETRIC MEASUREMENT AND DIMENSION
- ○ Explain volume formulas and use them to solve problems
- ○ Visualize relationships between two-dimensional and three-dimensional objects

MODELING WITH GEOMETRY
- ■ Apply geometric concepts in modeling situations

KEY: ■ Major Clusters | □ Supporting Clusters | ○ Additional Clusters

MATHEMATICAL PRACTICES:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

First Instructional Window	Instructional Units	Common Core State Standards for Mathematical Content
August 25 – October 9 **Suggested Unit Assessment Window: September 29 – October 7**	**1.1 Lines and Angles**	**Experiment with transformations in the plane (Major Cluster Standards)** **G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, and distance along a line. **Prove geometric theorems (Major Cluster Standards)** **G.CO.9** Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints. **Make geometric constructions (Major Cluster Standards)** **G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line. (No dilations.) **Use coordinates to prove simple geometric theorems algebraically (Major Cluster Standards)** **G.GPE.4** Use coordinates to prove simple geometric theorems algebraically.
	1.2 Transformations	**Experiment with transformations in the plane** **G.CO.2** Represent transformations (no dilations) 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. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). **G.CO.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. **G.CO.5** Given a geometric figure and a rotation, reflection, or translation (no dilations), 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. **Understand congruence in terms of rigid motions (Major Cluster Standards)** **G.CO.6** Use geometric descriptions of 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.

		Prove geometric theorems (Major Cluster Standards) **G.CO.9** Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
Second Instructional Window	**Instructional Units**	**Common Core State Standards for Mathematical Content**
October 14 – December 12 **Suggested Unit Assessment Window: November 19 – December 2**	**2.1 Congruent Triangles**	**Experiment with transformations in the place** **G.CO.5** Given a geometric figure and a rotation, reflection, or translation (no dilations), 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. **Understand congruence in terms of rigid motions (Major Cluster Standards)** **G.CO.6** Use geometric descriptions of 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. **G.CO.7** Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. **G.CO.8** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. **Prove geometric theorems (Major Cluster Standards)** **G.CO.10** Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point **Prove theorems involving similarity (Major Cluster Standards)** **G.SRT.5** Use congruence for triangles to solve problems and to prove relationships in geometric figures. **Use coordinates to prove simple geometric theorems algebraically (Major Cluster Standards)** **G.GPE.4** Use coordinates to prove simple geometric theorems algebraically. (Include triangles and quadrilaterals to extend the lines and angles concepts.)

	2.2 Quadrilaterals and Polygons	**Experiment with transformations in the place** **G.CO.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. **Prove geometric theorems (Major Cluster Standards)** **G.CO.11** Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. **Prove theorems involving similarity (Major Cluster Standards)** **G.SRT.5** Use congruence for triangles to solve problems and to prove relationships in geometric figures**.**
Third Instructional Window	**Instructional Units**	**Common Core State Standards for Mathematical Content**
December 15 – February 12 **Suggested Unit Assessment Window: February 2 – February 10**	**3.1 Transformations and Similarity**	**Experiment with transformations in the plane** **G.CO.2** 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. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). **Understand similarity in terms of similarity transformations (Major Cluster Standards)** **G.SRT.1** Verify experimentally the properties of dilations given by a center and a scale factor. **A.** 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. **B.** The dilation of a line segment is longer or shorter in the ratio given by the scale factor. **Understand similarity in terms of similarity transformations (Major Cluster Standards)** **G.SRT.2** 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. **G.SRT.3** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. **Prove theorems involving similarity (Major Cluster Standards)** **G.SRT.4** Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. **G.SRT.5** Use congruence for triangles to solve problems and to prove relationships in geometric figures.

		Apply geometric concepts in modeling situations (Major Cluster Standards) **G.MG.3** 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).
	3.2 Trigonometry in Right Triangles	**Define trigonometric ratios and solve problems involving right triangles (Major Cluster Standards)** **G.SRT.6** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. **G.SRT.7** Explain and use the relationship between the sine and cosine of complementary angles **G.SRT.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
	3.3 Lines and Angles in Circles	**Understand and apply theorems about circles (Major Cluster Standards)** **G.C.1** Prove that all circles are similar. **G.C.2** 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.
Fourth Instructional Window	**Instructional Units**	**Standards**
February 17 - April 10 **Suggested Unit Assessment Window (Optional) March 30 – April 28**	**4.1 Lines and Angles in Circles**	**Model geometric constructions (Major Cluster Standards)** **G.CO.13.** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. **Understand and apply theorems about circles (Major Cluster Standards)** **G.C.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. **Use coordinates to prove simple geometric theorems algebraically (Major Cluster Standards)** **G.GPE.4** Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).
	4.2 Linear and Area Measurement	**Experiment with transformations in the plane** **G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a and distance around a circular arc. **Find arc lengths and areas of sectors of circles (Major Cluster Standards)**

		G.C.5 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. **Use coordinates to prove simple geometric theorems algebraically (Major Cluster Standards)** **G.GPE.5.** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). **G.GPE.6.** Find the point on a directed line segment between two given points that partitions the segment in a given ratio. **G.GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. **Explain volume formulas and use them to solve problems (Major Cluster Standards)** **G.GMD.1** 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. **Apply geometric concepts in modeling situations (Major Cluster Standards)** ★**G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). ★**G.MG.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
	4.3 Three-Dimensional Figures and Volume	**Explain volume formulas and use them to solve problems (Major Cluster Standards)** **G.GMD.1** 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. **G.GMD.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. **Apply geometric concepts in modeling situations (Major Cluster Standards)** ★**G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). ★**G.MG.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

Fifth Instructional Window	Instructional Units	Common Core State Standards for Mathematical Content
April 20 – June 17 **Suggested Unit Assessment Window: May 4 – June 12**	**5.1 Project-Based Unit**	**Apply geometric concepts in modeling situations (Major Cluster Standards)** ★**G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). ★**G.MG.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). ★**G.MG.3** 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).

★ Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by the star symbol (★)