ACADEMIC COURSE OUTLINE

Department	Mathematics	**Course Title**	Geometry	**Course Length**	1 year
Grade Level(s)	8	**Short Name**	Geo	**Course Code**	2893

COURSE OVERVIEW:

The fundamental purpose of the Geometry course is to formalize and extend students' geometric experiences from the middle grades. This course includes standards from the Geometry conceptual category. Some standards are repeated in multiple higher mathematics courses; therefore instructional notes, which appear in brackets, indicate what is appropriate for study in this particular course.

In this Geometry course, students explore more complex geometric situations and deepen their explanations of geometric relationships, presenting and hearing formal mathematical arguments. Important differences exist between this course and the historical approach taken in geometry classes. For example, transformations are emphasized in this course.

For the Geometry course, instructional time should focus on five critical areas: (1) establish criteria for congruence of triangles based on rigid motions; (2) establish criteria for similarity of triangles based on dilations and proportional reasoning; (3) informally develop explanations of circumference, area, and volume formulas; (4) apply the Pythagorean Theorem to the coordinate plan; and (5) prove basic geometric theorems.

COURSE CONTENT AND TIME ALLOTMENT:

Content sequencing, activities and time allocations may be adjusted by the content team to suit student needs.

Unit 1: Understand the Foundations of Geometry

Duration: 8 weeks (August/September/October)

Description:

In Unit 1, students learn to precisely define essential geometric terms. Using this vocabulary, students find length, area, and angle measures synthetically, on the coordinate plane, and algebraically. While students should be constructing logical arguments throughout their careers in mathematics, Unit 1 focuses on introducing the students to the process of formal reasoning known as "writing a proof." Making connections with algebra from previous courses, students solve equations giving justifications for each step. Students are given a choice of proof formats (two-column, flowchart, and paragraph) and begin using inductive and deductive reasoning.

Materials: Pearson - Chapters 1 - 3

Standards Addressed: CCSS G-CO.1, G-CO.9, G-CO.12, G-GPE.4, G-GPE.5, G-GPE.6, G.GPE.7, G.MG.3

Unit 2: Prove Theorems about Triangles

Duration: 5 weeks (October/November)

Description:

In this unit, students establish triangle congruence criteria, based on analyses of rigid motions and formal

constructions. They build upon this familiar foundation of triangle congruence to continue to develop formal proof techniques. Students make conjectures and construct viable arguments—using a variety of formats—to prove theorems and solve problems about triangles. Using their deductive skills, students explore special segments of triangles and the properties of these segments. Indirect proof is introduced and used to prove several triangle inequality theorems.

Materials: Pearson - Chapters 4 -5

Standards Addressed: CCSS G-CO.10, G-CO.13

Unit 3: Prove Theorems about Quadrilaterals

Duration: 4 weeks (November/December)

Description:
IDrawing on their knowledge of triangle congruence from Unit 2, students now investigate the properties of special quadrilaterals. The triangle congruence criteria are used to prove properties of parallelograms. The family of quadrilaterals grows to include rectangles, rhombuses, kites and trapezoids. Students construct figures by manipulating appropriate geometric tools (compass, ruler, protractor, dynamic software, etc.) and justifying why their written instructions produce the desired figure. Properties of quadrilaterals are proven using a variety of techniques: transformational, synthetic, analytic, and paragraph.

Materials: Pearson - Chapter 6

Standards Addressed: CCSS G-CO.11

Unit 4: Understand and Experiment with Congruence in Terms of Rigid Motions and Similarity in Terms of Dilations

Duration: 2 weeks (January)

Description:
Students apply their earlier experience with dilations and proportional reasoning to build a formal understanding of similarity. They identify criteria for similarity of triangles, make sense of and persevere in solving similarity problems, and apply similarity to right triangles to prove the Pythagorean Theorem and explain the trigonometric ratios. Students apply trigonometric ratios to find missing measures of general triangles. Students model and make sense out of indirect measurement and real-world problems that involve ratios or rates.

Materials: Pearson - Chapter 9

Standards Addressed: CCSS G-SRT.1, G-SRT.1a, G-SRT.1b, G-SRT.2, G-SRT.3, G-SRT.4, G-SRT.5, G-CO.2

Unit 5: Understand Similarity in Terms of Transformations and Prove Similarity Theorems

Duration: 2 weeks (January)

Description:
??? Break apart the one in Unit 4??

Materials: Pearson - Chapter 7

Standards Addressed: CCSS G-CO.3, G-CO.4, G-CO.5, G-CO.6, G-CO.7, G-CO.8

Unit 6: Apply Trigonometry to General Triangles

Duration: 3 weeks (February)

Description:
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Materials: Pearson - Chapter 8

Standards Addressed: CCSS G-SRT.6, G-SRT.7, G-SRT.8, G.SRT.8.1, G-SRT.9, G-SRT.10, G-SRT.11

Unit 7: Explain Area and Volume Formulas and Use Them to Solve Problems

Duration: 6 weeks (February/March/April)

Description:
In this unit students prove and apply basic circle theorems such as: a tangent line is perpendicular to a radius theorem, the inscribed angle theorem, and theorems about chords, secants, and tangents dealing with segment lengths and angle measures. They study relationships among segments on chords, secants, and tangents as an application of similarity. In the Cartesian coordinate system, students explain the correspondence between the definition of a circle and the equation of a circle written in terms of the distance formula, its radius, and coordinates of its center. Given an equation of a circle, they draw the graph in the coordinate plane, and apply techniques for solving quadratic equations. Students' experience with two-dimensional objects is extended to include informal and formal explanations of circumference, area and volume formulas. Additionally, students use their knowledge of two-dimensional shapes to consider the shapes of cross-sections and the result of rotating a two-dimensional object about a line. They reason abstractly and quantitatively to develop, justify and apply volume formulas.

Materials: Pearson - Chapter 10 - 11

Standards Addressed: CCSS G-GMD.1, G-GMD.3, G-GMD.4, G-GMD.5, G-GMD.6, G-MG.1, G-MG.2

Unit 8: Understand and Apply Theorems about Circles

Duration: 3 weeks (April)

Description:
??? Break apart unit 7?

Materials: Pearson - Chapter 12

Standards Addressed: CCSS G-C.1, G-C.2, G-C.3, G-C.4, G-C.5, G-GPE.1, G-GPE.2

Unit 9: Understand Independence and Conditional Probability and Use Them to Interpret Data and Compute Probabilities of Compound Events

Duration: 3 weeks (May)

Description:
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Materials: Pearson - Chapter 13

Standards Addressed: CCSS S-CP.1, S-CP.2, S-CP.3, S-CP.4, S-CP.5, S-CP.6, S-CP. 7, S-CP.8, S-CP.9, S-MD.6, S-MD.7

GRADE WEIGHTING

Assessments - 80% (Includes: Test, Quizzes)
Assignments - 20% (Includes: Homework, Classwork, Notes, Tasks)

LATE WORK POLICY

Students can complete two assignments for full credit using a homework pass.

STANDARDS

EMC #1

Understand the Foundations of Geometry

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 line, and distance around a circular arc.

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.

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.

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).
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.
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).

EMC #2
Prove Theorems about Triangles
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.
G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

EMC #3
Prove Theorems about Quadrilaterals
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.

EMC #4
Understand Similarity in Terms of Transformations and Prove Similarity Theorems
G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:
G-SRT.1a 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.
G-SRT.1b The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
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 Angle-Angle (AA) criterion for two triangles to be similar.
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 and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
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).

EMC #5
Understand and Experiment with Congruence in Terms of Rigid Motions and Similarity in Terms of Dilations
G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
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, 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.
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.

EMC #6
Apply Trigonometry to General Triangles
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.
G-SRT.8.1 Derive and use the trigonometric ratios for special right triangles (30°, 60°, 90° and 45°, 45°, 90°). Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. (CA)
G-SRT.9 (+) Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
G-SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.
G-SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

EMC #7
Explain Area and Volume Formulas and Use Them to Solve Problem
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.
G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
G-GMD.5 Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k, k^2, and k^3, respectively; determine length, area and volume measures using scale factors. (CA)
G-GMD.6 Verify experimentally that in a triangle, angles opposite longer sides are larger, sides opposite larger angles are longer, and the sum of any two side lengths is greater than the remaining side length; apply these relationships to solve real-world and mathematical problems. (CA)
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).

EMC #8
Understand and Apply Theorems about Circles
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.

G-C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
G-C.4 (+) Construct a tangent line from a point outside a given circle to the circle.
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. Convert between degrees and radians. (CA)
G-GPE.1 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.
G-GPE.2 Derive the equation of a parabola given a focus and directrix.

EMC #9
Understand Independence and Conditional Probability and Use Them to Interpret Data and Compute Probabilities of Compound Event
S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
S-CP.2 Understand that two events *A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*
S-CP.3 Understand the conditional probability of A given B as *P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.*
S-CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.
S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
S-CP.6 Find the conditional probability of *A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.*
S-CP.7 RApply the Addition Rule, *P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.*
S-CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, *P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.*

S-CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.
S-MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
S-MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).