



Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Mathematics

Course: Geometry (H232)

Grade(s): 9-11

Course Overview

This course is for the successful Algebra 1 student who wishes to continue his study of college preparatory mathematics. The course is Euclidean geometry and includes congruence, similarity, parallelism, perpendicularity, area, volume, and circles. Coordinates and transformations in both two and three dimensions are integrated throughout the course. There is a main sequence of proved theorems with many "originals" for the student to prove. Students completing this course will take the NJSLA Exams in Geometry and are eligible to take Algebra 2 or Algebra 2 with Trigonometry the following year.

Prerequisite: Algebra 1

New Jersey State Learning Standards

Summit Public Schools curriculum aligns with the [New Jersey Student Learning Standards](#).

Content Area Standards:

- G.C.A.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.A.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- G.C.A.4. Construct a tangent line from a point outside a given circle to the circle.
- G.C.B.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.
- G.CO.A.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.B.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.

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- G.CO.B.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.B.8. Explain how the criteria for a triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- G.CO.C.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.C.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.C.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.
- G.CO.D.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.CO.D.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
- G.GMD.A.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- G.GPE.A.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.B.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.MG.A.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.A.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).
- G.SRT.A.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.
- G.SRT.A.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.A.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

- G.SRT.B.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.B.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- G.SRT.C.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.C.7. Explain and use the relationship between the sine and cosine of complementary angles.
- G.SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- G.SRT.D.11+: Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles.

Interdisciplinary Standards:

- RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.
- RST.9-10.7: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Career Readiness, Life Literacies and Key Skills Standards:

- 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas
- 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option
- 9.4.8.DC.7: Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.1.12.PB.2: Prioritize financial decisions by considering alternatives and possible consequences.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
- 9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

Computer Science and Design Thinking Standards:

- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

Career Readiness Practices

- CRP 1. Act as a responsible and contributing citizen and employee.
- CRP 2. Apply appropriate academic and technical skills.
- CRP 3. Attend to personal health and financial well-being.
- CRP 4. Communicate clearly and effectively and with reason.
- CRP 5. Consider the environmental, social and economic impacts of decisions.
- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP 9. Model integrity, ethical leadership and effective management.
- CRP 10. Plan education and career paths aligned to personal goals.
- CRP 11. Use technology to enhance productivity.
- CRP 12. Work productively in teams while using cultural global competence.

New Jersey Curriculum Mandates:

This curriculum integrates lessons that address the following interdisciplinary New Jersey Curriculum Mandates:

- Diversity and Inclusion (Grades K - 12)
 - C.18A:35-4.36a: Curriculum to include instruction on diversity and inclusion.
 - (3) encourage safe, welcoming, and inclusive environments for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs.

Learning Objectives

Learning objectives are clear, specific statements that define what students should know, understand, and be able to do by the end of a lesson or course.

Students will understand that...

- The terms point, line, and plane are used to define other geometric terms such as angles, segments, and rays.
- The first column in a two-column proof lists consecutive statements that lead to a conclusion. The second column provides justification for each statement.
- The coordinate plane provides a logical transition from algebra to geometry. The distance formula, midpoint formula, and Pythagorean Theorem can be used to solve problems involving figures on a coordinate plane.
- Geometric properties can be used to construct geometric figures.

- Most statements can be written conditionally, i.e. “if p, then q”. The negation, converse, inverse, and contrapositive are formed using varied forms and orders of p and q. Once a statement is written conditionally, it can be structured in a two-column proof.
- Angles are classified by their measure: acute for angles measuring less than 90 degrees, obtuse for angles measuring more than 90 degrees, right if an angle measures exactly 90 degrees, and straight for angles that measure exactly 180 degrees. A pair of angles whose measures add to 90 degrees are called complementary; supplementary if the measures add to 180 degrees. Two congruent angles are angles with the same measure. Perpendicular lines form four right angles. Vertical angles are formed by two intersecting lines; vertical angles have a common vertex yet do not share sides. Vertical angles are congruent.
- Parallel lines have equal slopes. Slopes of perpendicular lines are opposite reciprocals.
- Two lines are parallel if any of the following are true:
 - Alternate interior angles are congruent.
 - Alternate exterior angles are congruent.
 - Corresponding angles are congruent.
 - Consecutive interior angles are supplementary.
 - Consecutive exterior angles are supplementary.
 - If two lines in the same plane are perpendicular to the same line, then the lines are parallel.
- Congruent figures are figures that have exactly the same size and shape. All pairs of corresponding parts are congruent.
- There are three postulates (ASA, SAS, and SSS) and one theorem (AAS) that can be used to prove triangles congruent.
- The CPCTC principle states corresponding parts of congruent triangles are congruent.
- Medians, altitudes, angle bisectors and perpendicular bisectors are special segments in a triangle that each have their own application.
- Indirect reasoning and indirect proof can be used to reach a conclusion.
- To find measures of segments and angles, you must recognize and apply properties of inequalities.
- You can use inequalities in triangles to solve a variety of problems.
- The Triangle Inequality Theorem tells us that the sum of the lengths of any two sides of a triangle is greater than the length of the third side.
- A parallelogram is a quadrilateral with both pairs of opposite sides parallel.
- Opposite sides and angles of a parallelogram are congruent. Consecutive angles of a parallelogram are supplementary. The diagonals of a parallelogram bisect each other.
- The special quadrilaterals are parallelograms, rectangles, squares, rhombi, kites, trapezoids, and isosceles trapezoids. They are defined by the properties of their sides, angles, and sometimes diagonals.
- Similar figures are figures that have the same shape but not necessarily the same size.
- Similar polygons are polygons in which the ratios of the measures of corresponding sides are equal and corresponding angles are congruent. For triangles, it is common to use the following theorems: AA~, SSS~, and SAS~.
- The following theorems can be used if two triangles are similar:
 - The ratio of the perimeters of two similar polygons equals the ratio of any pair of corresponding sides.
 - If a line is parallel to one side of a triangle and intersects the other two sides, it divides those two sides proportionally.

- Special segments that are proportional include the altitudes, angle bisectors, and medians. An angle bisector in a triangle separates the opposite side into segments that have the same ratio as the other two sides.
- In a right triangle, the sum of the squares of the leg is equal to the square of the hypotenuse. This equation can be used to solve for missing side lengths of a right triangle.
- If the acute angles of a right triangle measure 30° and 60° , the sides have ratio $1 : \sqrt{3} : 2$. If the acute angles of a right triangle measure 45° , thus forming an isosceles triangle, the sides have ratio $1 : 1 : \sqrt{2}$.
- Missing side lengths can be found using proportions with these ratios.
- The sine ratio is defined as the measure of the side opposite the reference angle to the measure of the hypotenuse.
- The cosine ratio is defined as the measure of the side adjacent to the reference angle to the measure of the hypotenuse.
- The tangent ratio is defined as the measure of the opposite side to the measure of the adjacent side.
- To solve problems, students can use proportions and inverse trigonometric functions.
- Every circle has a center.
- By joining the center and any point on the circle, a radius is drawn. By joining any two points on a circle, a chord is drawn.
- The longest chord (the diameter) can be constructed by passing through the center of the circle.
- Chords, diameters, and radii create arcs, central angles, and inscribed angles.
- Radii and diameters are also useful in computing and discussing area, circumference, arc length and other related measures.
- After constructing special segments to and in circles, many theorems can be defined, discussed, and proven.
- If a convex polygon has n sides and S is the sum of the measures of its interior angles, then $S = 180(n - 2)$. The sum of the measures of the exterior angles, one at each vertex, is 360.
- Formulas for area include:
 - Triangle: $A = \frac{1}{2}bh$
 - Rectangles and Parallelograms: $A = bh$
 - Squares: $A = s^2$
 - Trapezoid: $A = \frac{1}{2}(b_1 + b_2)h$
 - Regular Polygon: $A = \frac{1}{2}aP$
- Geometric properties can be used to construct geometric figures.
- The surface area of a three-dimensional figure is the sum of the areas of each surface that forms the exterior of the figure.
- The volume of a prism or cylinder is the product of the area of the base of the figure and the height of the figure. The volume of a pyramid or cone is one-third this same product.
- Reflections can be used to solve problems involving mirrors, pool and golf
- How do we draw translations?
- Translations are used to describe linear movement in the real-world as well as on a coordinate plane.
- Rotations are an important part of motion, which affects every aspect of your life.

Units of Study

Units of study are organized collections of lessons and learning experiences focused on a specific topic and set of skills within a course. Each unit is guided by a set of essential questions.

Unit 1: Discovering Points, Lines, Planes, and Angles (~10 Days)

- What are the defining characteristics of basic geometric figures?
- How are two-column proofs used in justifying properties or theorems?
- What algebraic formulas can be used to solve problems about geometric figures?
- How can we best represent and verify geometric/algebraic relationships?

Unit 2: Connecting Reasoning and Proof (~10 Days)

- How is logic used to prove or explain mathematical statements?
- How can angles or pairs of angles be defined?

Unit 3: Using Parallel and Perpendicular Lines (~13 Days)

- Explain the slope criteria for parallel and perpendicular lines.
- How can two lines be proved parallel?

Unit 4: Identifying Congruent Triangles (~15 Days)

- What are congruent figures?
- How can two triangles be proved congruent?
- If two triangles are congruent, how can additional congruency statements be developed?

Unit 5: Properties of Triangles (~8 Days)

- What are the special segments of a triangle and how can we use them?
- How can we use indirect reasoning to reach a conclusion?
- What are the relationships between sides and angles of triangles?

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Unit 6: Exploring Quadrilaterals (~10 Days)

- What is the definition of a parallelogram?
- What are the properties of a parallelogram?
- What are the special quadrilaterals and how are they defined?

Unit 7: Connecting Proportion and Similarity (~2 Days)

- What are similar figures?
- How can two polygons be proved similar?
- If two triangles are similar, how can additional statements (similarity, congruency, and equality) be developed?
- What special segments of similar triangles are proportional to the corresponding sides?

Unit 8: Applying Right Triangles and Trigonometry (~14 Days)

- How is the Pythagorean Theorem used? How do we apply it and its converse?
- How do we find the geometric mean between two numbers?

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- How are special right triangles used to solve problems?
- How can basic right triangle trigonometry be used to solve problems?
- How do we solve problems involving relationships between parts of a triangle and the altitude to its hypotenuse?
- How do we use the properties of 45° - 45° - 90° and 30° - 60° - 90° triangles?

Unit 9: Analyzing Circles (~15 Days)

- How are parts of a circle related to one another?
- What relationships are found in circles when tangents, secants, tangent segments, and secant segments, and chords are drawn to and in a circle?
- How do we find the degree and linear measures of arcs?
- How do we find the measures of angles in circles?
- How do we solve problems by making circle graphs?
- How do we use properties of chords, tangents, and secants to solve problems?
- How do we write equations of circles?

Unit 10: Exploring Polygons and Area (~13 Days)

- How do you identify and name polygons?
- How do you find the measures of angles in polygons?
- How can the area be computed?
- How can we construct a regular polygon inscribed in a circle?
- How do you solve problems using geometric probability?

Unit 11: Investigating Surface Area and Volume (~10 Days)

- How can we describe and draw cross sections and other slices of three-dimensional figures?
- How do we make two-dimensional nets for three-dimensional solids?
- How do we find lateral areas, surface areas, and volumes of solids?
- How do we identify and state properties of congruent or similar solids?

Unit 12: Exploring Transformations (~7 Days)

- How do we draw reflections?
- How do we draw translations?
- How do we draw rotations centered around the origin?
- How do we draw rotations not centered around the origin?
- How do we draw dilations centered around the origin?
- How do we draw dilations not centered around the origin?

FINAL EXAM

Instructional Resources and Materials

Instructional resources are the information sources teachers utilize to guide their teaching and assessing. Instructional materials are the texts students read or review. The instructional resources and materials may vary in order to meet the learning needs of students.

- Guided Note Outlines
- [Google Classroom](#)

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- [DeltaMath](#)
- [Desmos](#)
- [Khan Academy](#)
- [NJ Standardized Test Prep Resources](#)
- [Kuta Software](#)

Assessment Strategies

Assessment measures a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes and for evaluative purposes. Teachers may choose one or more of the following ideas to assess learners. They may also modify these ideas to make the assessment more responsive to students' interests and needs.

Formative: Practice Problem Sets, Homework Exercises, Exit Tickets, Graded Check-Ins

Summative: Quizzes & Unit Tests

Benchmark: Midterm and Final Exams

Alternative: Projects

Suggested Strategies for Modification & Differentiation

[Modifications Chart](#)

Multilingual Learners

Please note this curriculum can be modified for Multilingual Learners for the Sheltered Math 7 course