

Saint Patrick High School

Curriculum Guide

Department:	Mathematics	Grade and Level:	Sophomore Honors
Class:	Geometry	Term (Semester or Year):	Year

Required Text:	Geometry for Enjoyment and Challenge
Additional Resources (i.e. texts, materials, apps, etc.):	<u>iPad Apps</u> Nearpod Showbie GoodReader Educreations Geogebra <u>Other</u> TI-84 Graphing Calculator Notebook and Looseleaf Paper Pencil iPad

Course Description

This course will enable the honors student to learn and understand the various topics and relationships within the world of geometry, and relate them to the world outside the classroom. Students will encounter geometric situations that will require the use of algebraic principles learned in their Freshman year. Students will become familiar with and apply various geometric axioms and theorems, as well as properties of geometric figures. Students will also learn the foundations of trigonometry, which will be further expounded upon in their Junior year. Logical thinking will be practiced in formulating basic mathematical skills in problem solving and applying geometric concepts. There will be an emphasis on ACT Exam Preparation.

Unit Themes

Theme 1: Algebra Review and the Pythagorean Theorem
Theme 2: Geometric Reasoning
Theme 3: Basic Concepts and Proofs
Theme 4: Congruent Triangles and Advanced Proofs
Theme 5: Parallel Lines and Related Figures
Theme 6: Lines and Planes in Space
Theme 7: Polygons
Theme 8: Similar Polygons
Theme 9: Trigonometry
Theme 10: Circles
Theme 11: Area
Theme 12: Surface Area and Volume
Theme 13: Additional Topics in Geometry

Agreed Upon Assessments

Forms of assessments may include but are not limited to....

- Mid Chapter Quizzes
- Unit Exams
- Lectures/Discussions
- Group Projects
- Presentations
- Homework Assignments
- Homework Quizzes

Research and Writing Expectations

- Students are required to write detailed solutions to the exercises that they solve
- Analysis questions are also presented, where students are required to explain why a given statement or solution is true or false

Unit 1 Algebra Review and the Pythagorean Theorem

Essential Questions:

- How can the Pythagorean Theorem be used to find the sides of a right triangle?
- How can we find the distance between two points in the Coordinate Plane?
- How are right triangles related to one another?

Learning Targets:

Students will be able to...:

- Simplify radical expressions
- Solve quadratic equations
- Use the Pythagorean Theorem and its converse
- Use the distance formula to compute lengths of segments in the coordinate plane
- Recognize Pythagorean Triples
- Apply the Principle of the Reduced Triangle
- Identify the ratio of side lengths in a 30-60-90 triangle
- Identify the ratio of side lengths in a 45-45-90 triangle

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.SRT.C.8*
Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- *CCSS.Math.Content.HSF.IF.C.8.a*
Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Common Assessments:

- Assignments
- Quizzes
- MCQ 1
- Unit Test 1

Unit 2 Geometric Reasoning

Essential Questions:

- What are the basic building blocks of geometry and how are they related?
- How can geometric objects be measured?
- How do we know that geometric principles are true?

Learning Targets:

Students will be able to...:

- Recognize points, lines, segments, rays, angles, and triangles
- Measure angles and segments
- Classify angles and name the parts of a degree
- Recognize congruent angles and segments
- Recognize collinear and noncollinear points
- Recognize when a point is between two other points
- Apply the triangle-inequality principle
- Correctly interpret geometric diagrams
- Write simple-two column proofs
- Identify bisectors and trisectors of segments and angles
- Write paragraph proofs
- Recognize that geometry is based on a deductive structure
- Identify undefined terms, postulates, and definitions
- Understand the characteristics and application of theorems
- Recognize conditional statements and their related statements
- Use the chain rule to draw conclusions
- Solve probability problems

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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
- *CCSS.Math.Content.HSG.CO.C.9*
Prove theorems about lines and angles

Common Assessments:

- Assignments
- Quizzes
- MCQ 2
- Unit Test 2

Unit 3 Basic Concepts and Proofs

Essential Questions:

- How do we know that geometric principles are true?
- How can angles be related to one another?
- How can lines be related to one another?

Learning Targets:

Students will be able to...:

- Recognize the need for clarity and concision in proofs
- Understand the concept of perpendicularity
- Recognize complementary and supplementary angles
- Follow a five-step procedure to draw logical conclusions
- Prove angles congruent using theorems
- Apply the addition, subtraction, multiplication and division properties of segments and angles
- Apply the transitive properties of angles and segments
- Apply the Substitution Property
- Recognize opposite rays
- Recognize vertical angles
- Recognize planes
- Recognize transversals
- Identify the pairs of angles formed by a transversal
- Recognize parallel lines

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.CO.C.9*
Prove theorems about lines and angles

- *CCSS.Math.Content.HSG.GPE.B.5*
Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems
- *CCSS.Math.Content.7.G.B.5*
Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Common Assessments:

- Assignments
- Quizzes
- MCQ 3
- Unit Test 3

Unit 4 Congruent Triangles and Advanced Proofs

Essential Questions:

- What does it mean for figures to be congruent?
- How can we prove two triangles are congruent?
- How do we know geometric principles are true?

Learning Targets:

Students will be able to...:

- Understand the concept of congruent figures
- Accurately identify the corresponding parts of figures
- Identify included angles and included sides
- Apply the SSS, SAS, and ASA postulates
- Apply the CPCTC principle
- Recognize some basic properties of circles
- Apply the formulas for the area and circumference of a circle.
- Identify medians and altitudes of triangles
- Understand why auxiliary lines are used in some proofs
- Write proofs in steps beyond CPCTC
- Use overlapping triangles in proofs
- Name the various types of triangles and their parts
- Apply theorems relating the angle measures and side lengths of triangles
- Use the HL postulate to prove right triangle congruent
- Use detours in proofs
- Apply the midpoint formula
- Organize the information in, and draw diagrams for problems presented in words

- Apply one way of proving that two angles are right angles
- Recognize the relationship between equidistance and perpendicular bisection
- Understand the concept of slope
- Relate the slope of a line to its orientation in the coordinate plane
- Recognize relationships between the slopes of parallel and perpendicular lines

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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
- *CCSS.Math.Content.HSG.CO.B.8*
Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- *CCSS.Math.Content.HSG.CO.C.10*
Prove theorems about triangles.

Common Assessments:

- Assignments
- Quizzes
- MCQ 4
- Unit Test 4

Unit 5 Parallel Lines and Related Figures

Essential Questions:

- What are the consequences of lines being parallel?
- How can we show that lines are parallel?
- What are the properties of quadrilaterals?

Learning Targets:

Students will be able to...:

- Write indirect proofs
- Apply the Exterior Angle Inequality Theorem
- Use various methods to prove lines parallel
- Apply the Parallel Postulate
- Identify the pairs of angles formed by a transversal cutting parallel lines

- Apply theorems about parallel lines
- Solve crook problems
- Recognize polygons
- Understand how polygons are named
- Recognize convex polygons
- Recognize diagonals of polygons
- Identify special types of quadrilaterals
- Identify some properties of parallelograms, rectangles, kites, rhombuses, squares, and isosceles trapezoids
- Prove that a quadrilateral is a parallelogram
- Prove that a quadrilateral is a rectangle, kite, rhombus, square or isosceles trapezoid

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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.

- *CCSS.Math.Content.HSG.CO.C.9*

Prove theorems about lines and angles.

- *CCSS.Math.Content.HSG.CO.C.11*

Prove theorems about parallelograms.

Common Assessments:

- Assignments
- Quizzes
- MCQ 5
- Unit Test 5

Unit 6	Lines and Planes in Space
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Essential Questions:

- Where do 2 dimensional geometric objects live?
- How do geometric objects relate to the planes in which they lie?

Learning Targets:

Students will be able to...:

- Understand basic concepts relating to planes
- Identify four methods of determining a plane
- Apply two postulates concerning lines and planes

- Recognize when a line is perpendicular to a plane
- Apply the basic theorem concerning the perpendicularity of a line and a plane
- Recognize lines parallel to planes, parallel planes, and skew lines
- Use properties relating parallel lines and planes

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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.

- *CCSS.Math.Content.HSG.CO.C.9*

Prove theorems about lines and angles.

Common Assessments:

- Assignments
- Quizzes
- MCQ 6
- Unit Test 6

Unit 7	Polygons
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Essential Questions:

- What are some consequences of the Pythagorean Theorem?
- How are angles of polygons related?
- How are sides and angles of a triangle related?

Learning Targets:

Students will be able to...:

- Apply theorems about the interior angles, the exterior angles and the midlines of triangles.
- Apply the No-Choice Theorem and the AAS theorem
- Use some important formulas that apply to polygons
- Recognize regular polygons
- Use a formula to find the measure of an exterior angle of an equiangular polygon
- Apply the Triangle Inequality
- Apply the Exterior-Angle-Inequality Theorem
- Use the Pythagorean Theorem test to classify a triangle as acute, right or obtuse
- Recognize the relationships between the side lengths and the angle measures of a triangle
- Use the hinge theorems to determine the relative measures of sides and angles.

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.CO.C.10*
Prove theorems about triangles
- *CCSS.Math.Content.8.G.B.7*
Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
- *CCSS.Math.Content.HSA.CED.A.4*
Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Common Assessments:

- Assignments
- Quizzes
- MCQ 7
- Unit Test 7

Unit 8	Similar Polygons
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Essential Questions:

- What does it mean for polygons to be similar?
- How can we show triangles are similar?
- What are the consequences of drawing the altitude to the hypotenuse of a right triangle?

Learning Targets:

Students will be able to...:

- Recognize and work with ratios
- Recognize and work with proportions
- Apply the product and ratio theorems
- Calculate geometric means
- Identify the characteristics of similar figures
- Use several methods to prove that triangles are similar
- Use the concept of similarity to establish the congruence of angles and the proportionality of segments
- Solve shadow problems
- Apply three theorems frequently used to establish proportionality
- Identify the relationships between the parts of a right triangle when an altitude is drawn to the hypotenuse

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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.
- *CCSS.Math.Content.HSG.SRT.A.3*
Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar
- *CCSS.Math.Content.HSG.SRT.B.4*
Prove theorems about triangles
- *CCSS.Math.Content.HSG.SRT.B.5*
Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures

Common Assessments:

- Assignments
- Quizzes
- MCQ 8
- Unit Test 8

Unit 9 Trigonometry

Essential Questions:

- What are the main tenets of trigonometry?
- What purposes does trigonometry have?

Learning Targets:

Students will be able to...:

- Understand three basic trigonometric relationships
- Use trigonometric ratios to solve right triangles

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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.

- *CCSS.Math.Content.HSG.SRT.C.7*
Explain and use the relationship between the sine and cosine of complementary angles.
- *CCSS.Math.Content.HSG.SRT.C.8*
Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems

Common Assessments:

- Assignments
- Quizzes
- MCQ 9
- Unit Test 9

Unit 10	Circles
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Essential Questions:

- How are segments and angles within a circle related?
- How can a circle be described in the coordinate plane?

Learning Targets:

Students will be able to...:

- Identify the characteristic of circles, chords and diameters
- Recognize special relationships between radii and chords
- Apply the relationship between congruent chords of a circle
- Identify different types of arcs, determine the measure of an arc, and recognize congruent arcs
- Relate congruent arcs, chords and central angles
- Identify secant and tangent lines and segments
- Distinguish between two types of tangent circles
- Recognize common internal and common external tangents
- Determine the measures of central, inscribed, tangent-chord, chord-chord, secant-secant, secant-tangent, and tangent-tangent angles
- Recognize congruent inscribed and tangent-chord angles
- Determine the measure of an angle inscribed in a semicircle
- Apply the relationship between the measures of a tangent-tangent angle and its minor arc
- Recognize inscribed and circumscribed polygons
- Apply the relationship between opposite angles of an inscribed quadrilateral
- Identify the characteristics of an inscribed parallelogram
- Apply the power theorems
- Determine the circle circumference and arc length
- Write equations that correspond to circles

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.C.A.1*
Prove that all circles are similar.
- *CCSS.Math.Content.HSG.C.A.2*
Identify and describe relationships among inscribed angles, radii, and chords.
- *CCSS.Math.Content.HSG.C.A.3*
Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- *CCSS.Math.Content.HSG.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

Common Assessments:

- Assignments
- Quizzes
- MCQ 10
- Unit Test 10

Unit 11	Area
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Essential Questions:

- How can we find the area of two dimensional figures?
- How are the areas of similar figures related?

Learning Targets:

Students will be able to...:

- Understand the concept of area
- Find the area of rectangles and squares
- Use the basic properties of area
- Find the areas of parallelograms, triangles, trapezoids, kites, equilateral triangles, regular polygons, circles, sectors, and segments
- Use the measure of a trapezoid's median to find its area
- Find ratios of areas by calculating and comparing the areas
- Find ratios of areas by applying properties of similar figures
- Find the areas of figures by using Hero's Formula and Brahmagupta's Formula

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.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.
- *CCSS.Math.Content.7.G.B.4*
Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
- *CCSS.Math.Content.7.G.B.6*
Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Common Assessments:

- Assignments
- Quizzes
- MCQ 11
- Unit Test 11

Unit 12 Surface Area and Volume

Essential Questions:

- How do the principles of two dimensional figures apply to three dimensional space?
- What methods can be used to find the volume of a three dimensional object?
- What methods can be used to find the surface area of a three dimensional object?

Learning Targets:

Students will be able to...:

- Find the surface areas of prisms
- Find the surface areas of pyramids
- Find the surface areas of circular solids
- Find the volumes of right rectangular prisms
- Find the volumes of other prisms
- Find the volumes of cylinders
- Use the area of a prism's or a cylinder's cross section to find the solid's volume
- Find the volumes of pyramids
- Find the volume of cones
- Solve problems involving cross sections of pyramids and cones

- Find the volumes of spheres
- Apply the Pythagorean Theorem to solid figures

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.GMD.A.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.
- *CCSS.Math.Content.HSG.GMD.A.3*
Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*
- *CCSS.Math.Content.HSG.GMD.B.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

Common Assessments:

- Assignments
- Quizzes
- MCQ 12
- Unit Test 12

Unit 13	Additional Topics in Geometry
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Essential Questions:

- What methods can be used to solve locus problems?
- How are the points of concurrency of a triangle related?
- What are advanced geometric formulas used for?

Learning Targets:

Students will be able to...:

- Graph in three dimensions
- Apply the properties of reflections
- Apply the principles of coordinate geometry in a variety of situations
- Use the four step locus procedure to solve locus problems
- Apply the compound locus procedure
- Identify the circumcenter, incenter, orthocenter and centroid of a triangle
- Use a formula to determine the distance from a point to a line in the coordinate plane
- Use a formula to find the area of a triangle when only the coordinates of its vertices are known
- Use a formula to find the diameter of a triangle's circumscribed circle

- Recognize a relationship among the parts of a triangle with a segment drawn from a vertex to the opposite side.
- Recognize a relationship involving the sides and the diagonals of a cyclic quadrilateral
- Use the concept of mass points to solve problems
- Use formulas to calculate the radii of a triangle's inscribed circle and a triangle circumscribed circle
- Find or prove additional formulas

Academic Standards Addressed (CCSS):

- *CCSS.Math.Content.HSG.MG.A.1*
Use geometric shapes, their measures, and their properties to describe objects
- *CCSS.Math.Content.HSG.MG.A.2*
Apply concepts of density based on area and volume in modeling situations
- *CCSS.Math.Content.HSG.MG.A.3*
Apply geometric methods to solve design problems
- *CCSS.Math.Content.HSG.GPE.B.6*
Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
- *CCSS.Math.Content.HSG.GPE.B.7*
Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
- *CCSS.Math.Content.HSG.GPE.A.2*
Derive the equation of a parabola given a focus and directrix.
- *CCSS.Math.Content.HSG.GPE.A.3*
(+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant

Common Assessments:

- Assignments
- Quizzes
- MCQ 13
- Unit Test 13