Audubon Public School District

Plane and Solid Geometry

Curriculum Guide

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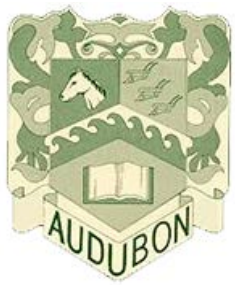

Course Description

Plane and Solid Geometry

This course is designed to develop an understanding of Geometry as a mathematical model of physical space. Emphasis will be placed on the meaning of deductive reasoning and mathematical proof. Major topics include congruency, the use of triangles, parallelism, similarity, polygons, equations of line and circles. Through this course students will prepare to take the State mandated NJSLA Geometry. Students who successfully complete this course will move on to Algebra II.

Overview / Progressions

Overview	Standards for Mathematical Content	Unit Focus	Standards for Mathematical Practice
Unit 1: Geometric Constructions and Congruence	• G.CO.A.1 • G.CO.A.2 • G.CO.A.3 • G.CO.A.4 • G.CO.A.5 • G.CO.B.6 • G.CO.B.7 • G.CO.B.8 • G.CO.C.9 • G.CO.C.10 • G.CO.C.11 • G.CO.D.12 • G.CO.D.13	• Learn the precise definitions of angle, circle, perpendicular line, parallel line and line segment. • Explore transformations in terms of rigid motions, representing transformations in the plane and describing transformations as functions. • Explore and utilize proof to deepen and apply understanding of congruence. • Prove theorems about lines, angles, triangles and parallelograms. • Use definitions of congruence in terms of rigid motions to show that two triangles are congruent.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics.

Unit 2: Similarity and Dilations	● G.CO.A.2 ● G.SRT.A.1 ● G.SRT.A.2 ● G.SRT.A.3 ● G.SRT.B.4 ● G.SRT.B.5 ● G.SRT.C.6 ● G.SRT.C.7 ● G.SRT.C.8	● Explore the properties of dilations given by a center and a scale factor. ● Learn the similarity of triangles as the equality of all corresponding angles and the proportionality of all corresponding sides. ● Prove theorems about triangles. ● Use definitions of similarity transformations to prove similar triangles. ● Learn how trigonometric ratios and the Pythagorean Theorem can be used to solve right triangles in applied problems.	MP.5 Use appropriate tools strategically.. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.
Unit 3: Geometric Properties and Equations	● G.CO.A.1 ● G.GPE.A.1 ● G.GPE.B.4 ● G.GPE.B.5 ● G.GPE.B.6 ● G.GPE.B.7	● Apply the concepts of congruence and similarity to prove simple theorems algebraically using coordinates. ● Prove slope criteria for parallel and perpendicular lines.	

		● Use coordinates to compute perimeters of polygons and areas of triangles and rectangles. ● Learn the precise definition of a circle and use algebra techniques to find the center and radius of a circle.	
Unit 4: Circles and Geometric Measurement	● G.C.A.1 ● G.C.A.2 ● G.C.A.3 ● G.C.B.5 ● G.GMD.A.1 ● G.GMD.A.3 ● G.GMD.B.4 ● G.MG.A.1 ● G.MG.A.2 ● G.MG.A.3	● Explore the relationships among inscribed angles, radii, and chords. ● Learn the relationships between central, inscribed, and circumscribed angles. ● Explore measurement in two and three dimensions, and apply their geometric understanding in modeling situations. ● Construct inscribed and circumscribed circles of a triangle. ● Expand on the understanding of geometric measurement for various formulas and using volume formulas to solve problems.	

Subject: Math	Grade: 9-12	Unit: 1	1st Marking Period
Content Standards	**Suggested Standards for Mathematical Practice**	**Geometric Constructions and Congruence**	
• **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.	MP.1 Make sense of problems and persevere in solving them. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): No new concept(s) introduced. Students are able to: • define line segment based on some or all of the undefined notions of point, line, distance along a line, and distance around a circular arc. • define angle based on some or all of the undefined notions of point, line, distance along a line, and distance around a circular arc • define parallel lines based on some or all of the undefined notions of point, line, distance along a line, and distance around a circular arc • define perpendicular lines based on some or all of the undefined notions of point, line, distance along a line, and distance around a circular arc Learning Goal 1: Explain the definitions of the key foundational geometric terms.	
• **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	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively.	Concept(s): • Construction tools can be used to model geometric relationships. Students are able to: • compass, straightedge, string, reflective devices, and dynamic geometric software are examples of tools that may be used to make	

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.	MP.3 Construct viable arguments & critique the reasoning of others. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure.	formal geometric constructions • make formal geometric constructions with a variety of tools and methods (i.e. paper folding) • use a variety of geometric tools and methods to copy a segment • use a variety of geometric tools and methods to copy an angle • use a variety of geometric tools and methods to bisect a segment • use a variety of geometric tools and methods to bisect an angle • use a variety of geometric tools and methods to construct perpendicular lines, including perpendicular bisectors • use a variety of geometric tools and methods to construct a line parallel to a given line through a point not on the line • construct an equilateral triangle inscribed in a circle§ • construct a regular hexagon inscribed in a circle • construct a square inscribed in a circle Learning Goal 2: Draw and explain the steps used to make geometric constructions.
● **G.CO.A.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	MP.1 Make sense of problems and persevere in solving them. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): • Transformations represent a change to a two-dimensional geometric figure. Students are able to: • represent transformations in the plane using 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

do not (e.g., translation versus horizontal stretch).		that do not Learning Goal 3: Explain the properties of reflections, translations and rotations and dilations.
● **G.CO.A.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. ● **G.CO.A.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. ● **G.CO.A.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.	MP.1 Make sense of problems and persevere in solving them. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): No new concepts(s) introduced. Students are able to: • describe rotations that carry a given rectangle, parallelogram, trapezoid, or regular polygon onto itself • develop the definition of rotations in terms of angles, circles, perpendicular lines, parallel lines, and/or line segments • given a figure and a rotation, draw the transformed figure using graph paper, tracing paper, or geometry software • describe reflections that carry a given rectangle, parallelogram, trapezoid, or regular polygon onto itself • develop the definition of reflections in terms of angles, circles, perpendicular lines, parallel lines, and/or line segments • given a figure and a reflection, draw the transformed figure using graph paper, tracing paper, or geometry software • develop the definition of translations in terms of angles, circles, perpendicular lines, parallel lines, and/or line segments • develop the definition of translation in terms of angles, circles, perpendicular lines, parallel lines, and/or line segments • specify a sequence of transformations that will carry a given figure onto another

		Learning Goal 4: Explain how each transformation can change for different two-dimensional figures. Draw an image figure, given a transformation rule.
• **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.	MP.1 Make sense of problems and persevere in solving them. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): • Transformations can be used to identify congruent figures. Students are able to: • use geometric descriptions of rigid motions to transform figures • predict the effect of a given rigid motion on a given figure using geometric descriptions of rigid motions • use the definition of congruence in terms of rigid motions to decide if two given figures are congruent Learning Goal 5: Explain the rigid motions that would transform one figure onto another to prove their congruence.
• **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	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.6 Attend to precision. MP.7 Look for and make use of	Concept(s): • Angles relationships can be used to prove different properties. Students are able to: • prove theorems about lines and angles • prove vertical angles are congruent • prove that when a transversal crosses parallel lines, alternate interior angles are congruent • prove that when a transversal crosses parallel lines, corresponding angles are congruent • prove measures of the interior angles of a triangle sum to 180

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.	structure. MP.8 Look for and express regularity in repeated reasoning.	degrees Learning Goal 6: Explain how angles relationships can be used to prove more complex relationships with lines, transversals and triangles. Show how these properties can be used to solve for angle measures.
● **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 triangle congruence (ASA, SAS, and SSS) follow from the definition of	MP.1 Make sense of problems and persevere in solving them. MP.3 Construct viable arguments & critique the reasoning of others. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): • Proving congruent triangles using the relationship of their sides and angles. Students are able to: • show that two triangles are congruent using the definition of congruence in terms of rigid motions if and only if corresponding pairs of sides and corresponding pairs of angles are congruent • explain how ASA, SAS, and SSS follow from the definition of congruence in terms of rigid motions. Learning Goal 7: Explain how the relationship between the corresponding

congruence in terms of rigid motions.		sides and angles of triangles can prove congruence. If not given all of the corresponding pairs of sides and angles, how can triangles still be proven congruent.
• **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	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): • Expand on prior knowledge of lines segments, midpoints and triangles. Students are able to: • prove points on a perpendicular bisector of a line segment is exactly those that are equidistant from the segment endpoints • prove theorems about triangles • prove base angles of an isosceles triangle are congruent • prove that the segment joining midpoints of two sides of a triangle is parallel to the third side of a triangle and half the length • prove the medians of a triangle meet at a point • prove theorems about parallelograms • prove opposite sides in a parallelogram are congruent • prove opposite angles in a parallelogram are congruent • prove the diagonals of a parallelogram bisect each other • prove rectangles are parallelograms with congruent diagonals

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.		Learning Goal 8: Explain the properties of a perpendicular bisector and how they can be used to prove properties of triangles. Learning Goal 9: Explain the properties of a parallelogram and apply them to solve problems.

Formative Assessments	Summative Assessments
● Quick Writing ● Whiteboard work ● Mathematical Discourse Questions ● Exit tickets ● Checks for Understanding	● Test ● Midterm ● Paper ● Common Assessment ● Post Unit Assessment

● Quizzes ● Small group activities ● Standard Mastery on I Ready ● ● Growth Monitoring on I Ready ● ● Diagnostic Assessments on I Ready ● ● Pre-Assessment ● ● Teacher's observation	● Benchmark ● Standardized Testing
Suggested Primary Resources	**Suggested Supplemental Resources**
● Text ● PARCC Released Items (https://nj.mypearsonsupport.com/practice-tests/math/) ● Desmos Online Scientific Calculator (https://www.desmos.com/scientific)	● Desmos Classroom Activities ● Quizlet, Quizizz, Kahoot, etc. ● Edpuzzle ● IXL Math ● Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
● Open ended math problems using language from ELA o NJSLSA.R5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text relate to each other and the whole. ▪ Deconstructing word problems. o NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. ▪ Prose constructed response. ● The math of physical science	
Essential Questions	**Enduring Understanding**
● How are the building blocks of Geometry found in nature and used in engineering daily?	● Geometry is a mathematical system built on accepted facts, basic terms, and definitions.

● Why is it that a four-legged chair sometimes wobbles, but a three-legged stool never wobbles? ● What formulas could be used to find the midpoint, partitioned point or length of any segment in the coordinate plane? ● How can you use number operations to find and compare the measures of angles? ● Special angle pairs can help you identify geometric relationships. ● How can you use these angle pairs to find angle measures? ● How can you use deductive reasoning to prove a statement is true? ● How can you change a figure's position without changing its size and shape? ● How can you represent a transformation in the coordinate plane? ● How can you use properties of parallel lines to find angle measures? ● How do you know that the sides of a parking space are parallel? ● How does the distance between parallel lines relate to hanging new shelves? ● How do you identify corresponding parts of congruent triangles? ● How do you show that two triangles are congruent? ● How are congruent triangles used in construction?	● Number operations can be used to find and compare the length of segments. ● The Ruler and Segment Addition Postulates can be used in reasoning about lengths. ● Formulas can be used to find the midpoint and length of any segment in the coordinate plane. ● Perimeter, circumference, and area are different ways of measuring the size of geometric figures. ● Special geometric tools can be used to make a figure that is congruent to an original figure without measuring. ● Construction with a straightedge and compass is more accurate than sketching and drawing. ● Special angle pairs and their relationships are used to find angle measures. ● Logical reasoning from one step to another is essential in building a proof. ● Reasons in a proof include given information, definitions, properties, postulates, and previously proven theorems. ● The location and orientation of a geometric figure can be changed while preserving distance and angle measures. ● The distance between any two points, angle measures, and orientation of a geometric figure remain the same when the figure is translated in one direction. ● When you reflect a figure across a line, each point of the figure goes to another point the same distance from the line, but on the other side. ● Distances, angle measures, and orientation of a geometric figure stay the same when a figure is rotated about a center of rotation. ● If two figures can be mapped to each other by a sequence of rigid motions, then the figures are congruent. ● Not all lines and not all planes intersect.

	● When a line intersects two or more lines, the angles formed at the intersection points create special angle pairs. ● The special angle pairs formed by parallel lines and a transversal are either congruent or supplementary. ● Comparing the corresponding parts of two figures can show whether the figures are congruent. ● Two triangles can be proven to be congruent without having to show that all corresponding parts are congruent. ● Two ways triangles can be proven to be congruent are by using three pairs of corresponding sides or by using two pairs of corresponding sides and one pair of corresponding angles. ● Another way triangles can be proven to be congruent is by using one pair of corresponding sides and two pairs of corresponding angles. ● If two triangles are congruent, then every pair of their corresponding part is also congruent.

Differentiation		
504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection ●	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals

IEP	• Utilize “skeleton notes” where some required information is already filled in for the student • Provide access to a variety of tools for responses • Provide opportunities to build familiarity and to practice with multiple media tools • Graphic organizers	• Leveled text and activities that adapt as students build skills • Provide multiple means of action and expression • Consider learning styles and interests • Provide differentiated mentors
ELLs	• Pre-teach new vocabulary and meaning of symbols • Embed glossaries or definitions • Provide translations • Connect new vocabulary to background knowledge	• Provide flash cards • Incorporate as many learning senses as possible • Portray structure, relationships, and associations through concept webs • Graphic organizers
At-risk	• Purposeful seating • Counselor involvement • Parent involvement	• Contracts • Alternate assessments • Hands-on learning
21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		

● Chromebooks ● Internet research ● Online programs	● Virtual collaboration and projects ● Presentations using presentation hardware and software

Subject: Geometry	Grade: 9-12	Unit: 2	2nd Marking Period
Content Standards	**Suggested Standards for Mathematical Practice**	**Critical Knowledge & Skills**	
• **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.CO.A.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	MP.1 Make sense of problems and persevere in solving them. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): • Dilations can be used to identify similar figures. Students are able to: • verify experimentally, given a center and scale factor, that the dilation of a line segment is longer or shorter in the ratio given by the scale factor • verify experimentally, given a center and scale factor, that a dilation leaves a line passing through the center of the dilation unchanged • verify experimentally, given a center and scale factor, that a dilation takes a line not passing through the center of the dilation to a parallel line • represent dilations in the plane using transparencies and geometry software • compare transformations, including dilations, that preserve distance and angle to those that do not Learning Goal 1: Explain how a geometric figure can be transformed into a similar figure that is smaller or larger given a scale factor that is less than or greater than one.	

distance and angle to those that do not (e.g., translation versus horizontal stretch).		
• **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** Given two figures, use the definition of similarity	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): • Proving similar triangles using the relationship of their sides and angles. Students are able to: • use the definition of similarity in terms of similarity transformations to decide if two figures are similar • use similarity transformations to explain the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides • use the properties of similarity transformations to establish the conditions for triangle similarity through the AA criterion • prove that a line parallel to one side of a triangle divides the other two sides of the triangle proportionally • prove that a line that divides two sides of a triangle proportionally is parallel to the third side • prove, using triangle similarity, the Pythagorean Theorem • use the definition of similarity in terms of similarity transformations to decide if two given figures 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

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.		Learning Goal 2: Explain how the relationship between the corresponding sides and angles of triangles can prove similarity. If not given all of the corresponding pairs of sides and angles, how can triangles still be proven similar.
● **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.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): ● Trigonometry and the Pythagorean Theorem can be used to solve for parts of a triangle. Students are able to: ● similarity in right triangles leads to proportional relationships which produce the trigonometric ratios for the acute angles in the right triangle ● side ratios in right triangles are properties of the angles in the triangle as a result of properties of triangle similarity ● define trigonometric ratios for acute angles ● explain and use the relationship between the sine and cosine of complementary angles ● use trigonometric ratios to solve right triangles in applied problems ● use Pythagorean Theorem to solve right triangles in applied problems

		Learning Goal 3: Recognize the ratios of the sides of a triangle and use them in a contextual situation to solve problems using trigonometry or the Pythagorean Theorem.

Formative Assessments	Summative Assessments
● Quick Writing ● Whiteboard work ● Mathematical Discourse Questions ● Exit tickets ● Checks for Understanding ● Quizzes ● Small group activities ● Standard Mastery on I Ready ● ● Growth Monitoring on I Ready ● ● Diagnostic Assessments on I Ready ● ● Pre-Assessment ● ● Teacher's observation	● Test ● Midterm ● Paper ● Common Assessment ● Post Unit Assessment ● Benchmark ● Standardized Testing
Suggested Primary Resources	**Suggested Supplemental Resources**
● Text ● PARCC Released Items (https://nj.mypearsonsupport.com/practice-tests/math/) ● Desmos Online Scientific Calculator (https://www.desmos.com/scientific)	● Desmos Classroom Activities ● Quizlet, Quizizz, Kahoot, etc. ● Edpuzzle ● IXL Math ● Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
● Open ended math problems using language from ELA	

- NJSLSA.R5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text relate to each other and the whole.
  - Deconstructing word problems.
- NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
  - Prose constructed response.

- The math of physical science

Essential Questions	Enduring Understanding
● How can you change a figure's size without changing its shape? ● Where are transformations found in nature, amusement rides, video games or in a marching band show? ● How do you use proportions to find side lengths in similar polygons? ● How do you show two triangles are similar? ● How can you use transformations to show that figures are similar? ● How do you identify corresponding parts of similar triangles? ● How can you use similar triangles to find the lengths that cannot be easily measured? ● What are the properties of certain right triangles that would allow you to determine their side lengths without Pythagorean Theorem? ● How do you find a side length or angle measure of a right triangle? ● How can surveyors determine angle measures? ● How do airline pilots use angles of elevation and depression?	● A scale factor can be used to make a larger or smaller copy of a figure that is also similar to the original figure. ● If there is an isometry that maps a figure to another, then you can map one onto the other by using a composition of reflections. ● A ratio can be written to compare two quantities. ● An equation can be written stating that two ratios are equal. ● Dilations can be used to prove figures similar. ● Ratios are proportions that can be used to decide whether two polygons are similar and to find unknown side lengths of similar figures. ● All lengths in a scale drawing are proportional to their corresponding actual lengths. ● Triangles can be shown to be similar based on the relationship of two or three pairs of corresponding parts. ● Similar triangles can be used to find unknown measurements. ● When a line is parallel to a side of a triangle and intersect the other two sides, then this line divides those two sides proportionally. ● When two or more parallel lines intersect other lines, proportional segments are formed. ● The bisector of an angle of a triangle divides the opposite side into two segments with lengths proportional to the sides of the triangle that form the angle.

	● Certain right triangles have properties that allow their side lengths to be determined without using Pythagorean Theorem. ● If certain combinations of side lengths and angle measures of a right triangle are known, ratios can be used to find other side lengths and angle measures. ● The angles of elevation and depression are the acute angles of right triangles formed by horizontal distance and a vertical height.

Differentiation		
504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection ●	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
IEP	● Utilize “skeleton notes” where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools ● Graphic organizers	● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors

ELLs	• Pre-teach new vocabulary and meaning of symbols • Embed glossaries or definitions • Provide translations • Connect new vocabulary to background knowledge	• Provide flash cards • Incorporate as many learning senses as possible • Portray structure, relationships, and associations through concept webs • Graphic organizers
At-risk	• Purposeful seating • Counselor involvement • Parent involvement	• Contracts • Alternate assessments • Hands-on learning
21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		
• Chromebooks • Internet research • Online programs		• Virtual collaboration and projects • Presentations using presentation hardware and software

Subject: Geometry	Grade: 9-12	Unit: 3	3rd Marking Period

Content Standards	Suggested Standards for Mathematical Practice	Critical Knowledge & Skills
● **G.GPE.B.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.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.GPE.B.6** Find the point on a directed line segment between	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): ● Points on the coordinate plane can be used to prove geometric relationships. Students are able to: ● prove simple geometric theorems algebraically using coordinates ● prove the slope criteria for parallel lines ● use the slope criteria for parallel lines to solve geometric problems ● prove the slope criteria for perpendicular lines ● use the slope criteria for perpendicular lines to solve geometric problems ● find the point that is between two given points on a directed line segment that partitions the segment in a given ratio ● compute perimeter of polygons using coordinates ● compute areas of rectangles using coordinates ● compute area of triangles using coordinates Learning Goal 1: Explain how using coordinate geometry formulas like midpoint, distance, slope and equations of a line can identify geometric relationships.

two given points that partitions the segment in a given ratio. ● **G.GPE.B.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.		
● **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.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.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): • Equations can be used to represent the center and the radius of a circle. Students are able to: • define a circle based on some or all of the undefined notions of point, line, distance along a line, and distance around a circular arc • derive the equation of a circle given the center and radius using Pythagorean Theorem • complete the square to find the center and radius of a circle given by an equation Learning Goal 2: Explain how the general form for the equation of a circle represents the center and radius of the circle. Use the technique of completing the square to identify the center and radius of a circle.

Formative Assessments	Summative Assessments

<table>
<tr><td>

- Quick Writing
- Whiteboard work
- Mathematical Discourse Questions
- Exit tickets
- Checks for Understanding
- Quizzes
- Small group activities
- Standard Mastery on I Ready
- ● Growth Monitoring on I Ready
- ● Diagnostic Assessments on I Ready
- ● Pre-Assessment
- ● Teacher's observation

</td><td>

- Test
- Midterm
- Paper
- Common Assessment
- Post Unit Assessment
- Benchmark
- Standardized Testing

</td></tr>
<tr><th>Suggested Primary Resources</th><th>Suggested Supplemental Resources</th></tr>
<tr><td>

- Text
- PARCC Released Items (https://nj.mypearsonsupport.com/practice-tests/math/)
- Desmos Online Scientific Calculator (https://www.desmos.com/scientific)

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- Desmos Classroom Activities
- Quizlet, Quizizz, Kahoot, etc.
- Edpuzzle
- IXL Math
- Kuta Software LLC, TeachersPayTeachers, Khan Academy

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<tr><th colspan="2">Cross-Curricular Connections & 21st Century Skills</th></tr>
<tr><td colspan="2">

- Open ended math problems using language from ELA
  - NJSLSA.R5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text relate to each other and the whole.
    - Deconstructing word problems.
  - NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
    - Prose constructed response.
- The math of physical science

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<tr><th>Essential Questions</th><th>Enduring Understanding</th></tr>
</table>

• How can algebra properties help you solve problems and justify your reasoning? • How can you prove special properties regarding the sides, angles and diagonals of a parallelogram are true? • How are parallelograms used in architecture? • How are rectangles used in sports? • How can you use a coordinate plane to prove theorems about quadrilaterals?	• Algebraic properties of equality are used in geometry. • Parallelograms have special properties regarding their sides, angles, and diagonals. • You can decide whether a quadrilateral is a parallelogram if its sides, angles, and diagonals have certain properties. • Rhombi, rectangles, and squares have basic properties about their sides and angles that help identify them. • The diagonals of these parallelograms also have certain properties. • You can determine whether a parallelogram is a rhombus or a rectangle based on the properties of its diagonals. • The angles, sides, and diagonals of a trapezoid have certain properties. • You can classify figures in the coordinate plane using the formulas for slope, distance, and midpoint.

Differentiation		
504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	• Utilize collaborative media tools • Provide differentiated feedback • Opportunities for reflection •	• Encourage student voice and input • Model close reading • Distinguish long term and short term goals

IEP	• Utilize “skeleton notes” where some required information is already filled in for the student • Provide access to a variety of tools for responses • Provide opportunities to build familiarity and to practice with multiple media tools • Graphic organizers	• Leveled text and activities that adapt as students build skills • Provide multiple means of action and expression • Consider learning styles and interests • Provide differentiated mentors
ELLs	• Pre-teach new vocabulary and meaning of symbols • Embed glossaries or definitions • Provide translations • Connect new vocabulary to background knowledge	• Provide flash cards • Incorporate as many learning senses as possible • Portray structure, relationships, and associations through concept webs • Graphic organizers
At-risk	• Purposeful seating • Counselor involvement • Parent involvement	• Contracts • Alternate assessments • Hands-on learning
21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		

● Chromebooks ● Internet research ● Online programs	● Virtual collaboration and projects ● Presentations using presentation hardware and software

Subject: Geometry	**Grade: 9-12**	**Unit: 4**	**4th Marking Period**
Content Standards	**Suggested Standards for Mathematical Practice**	**Critical Knowledge & Skills**	
● **G.C.A.1** Prove that all circles are similar. ● **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.B.5** Derive using similarity the fact that the length of the arc intercepted by an angle is	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): ● Expand on prior knowledge of the parts of circles Students are able to: ● prove that all circles are similar ● identify and describe relationships among inscribed angles, radii, and chords ● identify and describe relationships among inscribed angles, central angles, and circumscribed angles ● the radius of a circle is perpendicular to the tangent where the radius intersects the circle ● inscribed angles on a diameter are right angles ● use similarity to derive the fact that the length of the arc intercepted by an angle is proportional to the radius of a circle	

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.C.A.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.		● define the radian measure of an angle as the constant of proportionality between the length of the arc intercepted by an angle and the radius of a circle ● derive the formula for the area of a sector ● construct the inscribed and circumscribed circles of a triangle ● prove properties of angles for a quadrilateral inscribed in a circle Learning Goal 1: Identify and describe the relationships among radii, chords, inscribed angles, arcs and central angles.
● **G.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. Use dissection arguments, Cavalieri's principle, and informal limit arguments. ● **G.GMD.A.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. ● **G.GMD.B.4** Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated	MP.1 Make sense of problems and persevere in solving them. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): ● Volume of a three-dimensional figure can be found by using its two-dimensional base shape. Students are able to: ● give an informal argument for the formulas for the circumference of a circle and for the area of a circle, using dissection arguments, Cavalieri's principle, and informal limit arguments ● give an informal argument for the formula for the volume of a cylinder, pyramid, and cone using dissection arguments, Cavalieri's principle, and informal limit arguments ● use volume formulas for cylinders, pyramids, cones, and spheres to solve problems ● identify three-dimensional objects generated by rotations of two-dimensional objects ● identify the shapes of two-dimensional cross-sections of three-

by rotations of two-dimensional objects.		dimensional objects Learning Goal 2: Demonstrate how to use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
● **G.MG.A.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.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).	MP.1 Make sense of problems and persevere in solving them. MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): ● Represent the ratio of mass to area and volume. Students are able to: ● describe real-world objects using geometric shapes, their measures, and their properties ● apply concepts of density based on area and volume in modeling situations ● apply geometric methods to solve design problems Learning Goal 3: Apply concepts of density based on area and volume in real life situations.

Formative Assessments	Summative Assessments

● Quick Writing ● Whiteboard work ● Mathematical Discourse Questions ● Exit tickets ● Checks for Understanding ● Quizzes ● Small group activities ● Standard Mastery on I Ready ● ● Growth Monitoring on I Ready ● ● Diagnostic Assessments on I Ready ● ● Pre-Assessment ● ● Teacher's observation	● Test ● Midterm ● Paper ● Common Assessment ● Post Unit Assessment ● Benchmark ● Standardized Testing
Suggested Primary Resources	**Suggested Supplemental Reso urces**
● Text ● PARCC Released Items (https://nj.mypearsonsupport.com/practice-tests/math/) ● Desmos Online Scientific Calculator (https://www.desmos.com/scientific)	● Desmos Classroom Activities ● Quizlet, Quizizz, Kahoot, etc. ● Edpuzzle ● IXL Math ● Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
● Open ended math problems using language from ELA o NJSLSA.R5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text relate to each other and the whole. ▪ Deconstructing word problems. o NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. ▪ Prose constructed response. ● The math of physical science	

Essential Questions	Enduring Understanding
● When lines intersect a circle or within a circle, how do you find the measures of resulting angles, arcs, and segments? ● How do you find the equation of circle in the coordinate plane? ● What kinds of angles do the hands on a clock form? ● How are tangents related to track and field events? ● How are lengths of intersecting chords related? ● How do you find the surface area and volume of a solid? ● How do the surface area and volumes of similar solids compare? ● How can you determine the intersection of a solid and a plane? ● How is the cross section of an object related to its volume?	● The length of part of a circle's circumference can be found by relating it to the central angle in the circle. ● A radius of a circle and the tangent that intersects the endpoint of the radius on the circle has a special relationship. ● A circle has a special relationship to a triangle whose sides are tangent to the circle. ● Information about congruent parts of a circle (or congruent circles) can be used to find information about other parts of the circle (or circles). ● Angles formed by intersecting lines have special relationship to the arcs the intersecting lines intercept. ● Specifically, arcs intercepted by chords that form inscribed angles are related to the inscribed angles. ● Angles formed by intersecting lines have a special relationship to the arcs the intersecting lines intercept. ● Arcs formed by lines intersecting either within a circle or outside a circle are related to the angles formed by the lines. ● There are special relationships between intersecting chords, intersecting secants, or a secant and tangent that intersect. ● The information in the equation of a circle allows the circle to be graphed. ● The equation of a circle can be written if its center and radius are known. ● The area of a parallelogram or a triangle can be found when the length of its base and its height are known. ● The area of a trapezoid can be found when the height and the lengths of its bases are known. ● The area of a rhombus or a kite can be found when the lengths of its diagonals are known. ● Ratios can be used to compare the perimeters and areas of similar figures.

	● The area of a circle can be found when the circles radius is known. ● The area of a three-dimensional figure is equal to the sum of the areas of each surface of the figure. ● The surface area of a sphere can be found when its radius is known. ● The volume of a prism and a cylinder can be found when its height and the area of its base are known. ● The volume of a composite space figure is the sum of the volumes of the figures that are combined. ● The volume of a pyramid is related to the volume of a prism with the same base and height. ● The volume of a cone is related to the volume of a cylinder with the same base and height. ● The volume of a sphere can be found when its radius is known. ● A cross section is the intersection of a three-dimensional figure and a plane.

Differentiation		
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Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection ●	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals

IEP	• Utilize “skeleton notes” where some required information is already filled in for the student • Provide access to a variety of tools for responses • Provide opportunities to build familiarity and to practice with multiple media tools • Graphic organizers	• Leveled text and activities that adapt as students build skills • Provide multiple means of action and expression • Consider learning styles and interests • Provide differentiated mentors
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21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		

• Chromebooks • Internet research • Online programs	• Virtual collaboration and projects • Presentations using presentation hardware and software

Appendix A

Audubon Public Schools
Engaging Students ~ Fostering Achievement ~ Cultivating 21st Century Global Skills
Written By: Steven Ireland
Reapproved June 2017

Course Title: Geometry Unit Name: Lines and Angles
Grade Level: 9-11

Content Statements	**NJSLS**
This unit covers points, lines and angles, concepts of two- and three-dimensional figures, inductive and deductive reasoning and an in-depth exploration of parallel and perpendicular lines.	G-CO.1,9,12 G-GMD.1-4 G-GPE.5,7 G-MG.1
Overarching Essential Questions What are the basic parts of any construction or description in geometry? How are definitions, postulate and theorems used to write geometric proofs and solve problems? How can you prove a statement true?	**Overarching Enduring Understandings** Studying geometry involves learning the basic parts of geometry. Everything is built from points, lines and planes and follows very strict and organized rules.
Unit Essential Questions What are points, lines and planes, collinear and coplanar points and intersecting lines and is there a real life representation of them? How do you find distance and midpoint of a segment? What are angles and how are they measures and classified? What are angle bisectors, perpendicular lines, and special angle pairs and how are they useful? What kinds of angles are formed when streets intersect?	**Unit Enduring Understandings** It is important to identify and give examples of terms and solve problems involving, perimeter, area, surface area and volume of basic geometric figures. Axioms, theorems and inductive and deductive reasoning can be used to write proofs, and give counter-examples of basic ideas of geometric congruence. Theorems can be used to prove geometric axioms like those involving the properties of parallel lines cut by a transversal.

What are polygons and how can you find their area, perimeter and circumference? What are 3-dimensional figures and how can you find their surface area and volume? What are conjectures and counterexamples and how can you make them? What are truth values, conjunctions and disjunctions and how are they useful? What are truth tables and how do you complete one? How do you read a Venn diagram and how are they related to conjunctions and disjunctions? What are postulates, axioms, and properties of equality and how are they used to write paragraph proofs and 2-column proofs? How can proofs be used to show segment and angle, relationships? What are parallel and skew lines and planes and how can they be identified? When 2 parallel lines are cut by a transversal what special angles are formed how can I use special angle relationships to solve problems involving angle measure? What is slope of a line and how is it related to parallel and perpendicular lines? How can you write equations of lines when given information about their graphs and how can equations be used to solve problems? How can you prove lines parallel based on angle relationships? How can you find the distance between a point and a line or between 2 parallel lines?	

Unit Rationale	**Unit Overview**
The study of geometry teaches not only geometry but the systematic dissection and construction of a problem. This unit codifies knowledge from previous courses of study into a firm base that will be used to further study geometry.	Identifying and understanding basic geometric terms such as lines, planes and angles and how they can be used to prove theorems.

Resources

Glencoe-McGraw Hill Geometry (ISBN 978-0-07-873826-5)
Scientific Calculator
Geometric Figures and Demonstrations - mathopenref.com
Kuta worksheets - kutasoftware.com
TI Smart software

Suggested Student Activities

Use graph paper to draw net figures of polygons that can be cut and folded to create a 3-dimensional figure. Calculate the Surface Area and Volume of that figure.
Use plastic wrap, buttons and pipe cleaners to construct intersecting planes "recreating" images from the text from 2D to 3D.
Apply a grid to a map (Audubon etc.) to calculate the distance from one local landmark to another. Using Google maps images, locate the homes of students and calculate the distance from each other and from school. Calculate the location of an appropriate meeting place (midpoint) for students to walk.
Use pipe cleaners or tooth picks and dots to construct three dimensional figures. Examine these figures for their features, faces, vertices, surface area, volume, conservation of volume, etc. "Explode" them to create net drawings of the surfaces.

Key Terms

Point – a location
Line – made up of points and has no thickness or width
Plane – flat surface made up of points
Midpoint – the point on the segment that divides the segment into two congruent segments
Ray – part of a line that has one endpoint and extends indefinitely in one direction
Vertex – common endpoint
Complementary angles – two angles with measures that sum to 90 degrees
Supplementary angles- two angles with measures that sum to 180 degrees
Perpendicular – lines that form right angles
Transversal – a line that intersects two or more lines in a plane

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Written By: Steven Ireland
Reapproved June 2017

Course Title: Geometry Unit Name: Polygons
Grade Level: 9-11

Content Statements This unit covers the use of geometric relationships to verify conjectures and solve problems involving triangles.	**NJSLS** G-CO.6-8,10, 11, 13 G-SRT.6 G-GPE.4
Overarching Essential Questions What is a polygon? How can geometric properties of triangles be used?	**Overarching Enduring Understandings** Polygons are the two dimensional building blocks of our world. Anything can be broken down and analyzed in terms of its two dimensional parts.
Unit Essential Questions How can triangles be classified using sides or angles? How can you apply the Angle Sum Theorem and the Exterior Angle Theorem and use them to solve problems? How are congruent triangles and their corresponding parts identified, named, and labeled? What are properties of Isosceles and Equilateral triangles and how are they useful? What are congruence transformations and how are they useful? What are coordinate proofs and how are they written? What are perpendicular bisectors, angle bisectors, medians and altitudes and how are they used to find missing measures and solve problems?	**Unit Enduring Understandings** Analyze geometric relationships in order to make and verify conjectures involving triangles. Apply the concept of congruence to justify properties of figures and solve problems Use a variety of representations to describe geometric relationships and solve problems involving triangles Analyze properties and describe relationships in quadrilaterals. Apply logical reasoning to justify and prove mathematical statements involving quadrilaterals.

What are the properties of inequalities relating to sides and angles of triangles and how can they be applied? What is an indirect proof and how can it be used in algebra and geometry? What are the Triangle Inequality Theorem, SAS and SSS Inequalities and how can they be applied? How can you find the measures of interior or exterior angles of polygons? How can you apply the properties of polygons to determine the shape of a given polygon?	
Unit Rationale This unit codifies the study of polygons from previous courses and adds more rigorous concepts and vocabulary to its study and application.	**Unit Overview** Identifying and understanding polygons, their parts, and relationships and using them to solve meaningful problems.
Resources Glencoe-McGraw Hill Geometry (ISBN 978-0-07-873826-5) Scientific Calculator Geometric Figures and Demonstrations - mathopenref.com Kuta worksheets - kutasoftware.com TI Smart software	
Suggested Student Activities Use straws and pipe cleaners to create quadrilaterals measure the sides and angles and make conjectures about what kind of quadrilateral you have.	
Key Terms Perpendicular bisector – bisects a segment into two congruent segments and forms a right angle with the segment Median – segment whose endpoints are a vertex of a triangle and the midpoint of the side opposite the vertex Altitude – segment from the vertex of a triangle to the line containing the opposite side Concurrent lines – when three or more lines intersect at a common point Circumcenter – point of concurrency of the perpendicular bisectors of a triangle Incenter – point of concurrency of the angle bisectors of a triangle Centroid – point of concurrency for the medians of a triangle	

Orthocenter – point of concurrency of the altitudes of a triangle

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Written By: Steven Ireland
Reapproved June 2017

Course Title: Geometry Unit Name: Similarity
Grade Level: 9-11

Content Statements	**NJSLS**
This unit covers the similarity in figures, right triangles and transformations, apply ratios and proportions to similar figures and scale factors, focus on right triangles and the use of Pythagorean Theorem and trigonometric ratios.	G-SRT.1-5,7-11 G-GPE.6 G-MG.3 G-CO.2-5
Overarching Essential Questions	**Overarching Enduring Understandings**
How are proportions used to verify similarity between objects? How can trigonometry be used to solve right triangles?	There are many applications of algebra in geometry and crossover into other branches of mathematics. Studying triangles helps us to better understand our world.
Unit Essential Questions	**Unit Enduring Understandings**
What is the Pythagorean Theorem and when is it properly applied? How can the converse of the Pythagorean Theorem be used to find right triangles? What is similarity and how is it applied to scale drawings? What are the properties of similar polygons and how can they be used to find missing measurements? How can the rules of special triangles be used to find missing measures? What are the basic trigonometric ratios? What are the inverse trigonometric functions? How are they used to find angles?	The Pythagorean Theorem can be used to find missing sides of right triangles, while the three basic trigonometric functions can find missing sides or angles. There are special right triangles – the 30-60-90 and 45-45-90 that can be easily identified and solved. Changing the dimensions of a figure changes the figure's perimeter, area, and –or volume, and the changes aren't always direct variations.

What's the difference between an angle of elevation and an angle of depression? What are the main types of geometric transformation in a plane? What are lines of symmetry? What is rotational symmetry? What is a tessellation? What are vectors and how are they used to model quantities with both magnitude and direction?	
Unit Rationale This unit gives direct applications for the study of triangles and their special properties. These will have direct applications in this and subsequent courses.	**Unit Overview** Explore proportional relationships between similar triangles, the relationships between the angles and sides of right triangles, and transformations in the coordinate plane are essential to geometry and engineering. They also form the backbone of trigonometry and are building blocks for calculus.
Resources Glencoe-McGraw Hill Geometry (ISBN 978-0-07-873826-5) Scientific Calculator Geometric Figures and Demonstrations - mathopenref.com Kuta worksheets - kutasoftware.com TI Smart software	
Suggested Student Activities Use the angle of elevation on the sun and the length of an object's shadow to find the height of an object. Use a square to cut out a pattern that can be used to form a tessellation.	
Key Terms Ratio – comparison of two quantities Proportion – two ratios that are equal Similar polygons – same shape but different in size Geometric mean – positive square root of the product of two numbers Trigonometric ratio – ratio of the lengths of the sides of a right triangle	

Engaging Students ~ Fostering Achievement ~ Cultivating 21st Century Global Skills
Written By: Steven Ireland
Reapproved June 2017

Course Title: Geometry Unit Name: Area and Volume
Grade Level: 9-11

Content Statements	**NJSLS**
This unit covers the calculation of area, surface area and volume of two- and three- dimensional figures, special properties of circles including inscribed and circumscribed polygons, tangents and secants.	G-C.1-5 G-CO.13 G-PE.1 G-MG.2
Overarching Essential Questions How can area, surface area and volume be found for different objects? How are interior and exterior angles of all polygons related?	**Overarching Enduring Understandings** Area, surface area, and volume have many real life applications. Many polygons and polyhedron have common features based on their common characteristics. Apply concepts density based on area and volume in modeling situation.
Unit Essential Questions How can the circumference of a circle be calculated? What are the arcs and chords of a circle? What is an inscribed polygon and how can its interior angles be calculated? How can the basic area formulas be extended to find the areas of composite figures? What is the relationship between area and probability? How can isometric drawings and cross sections be used to represent 3-dimensional figures? What is the difference between a pyramid and a prism? What is the difference between a face and a base? What are the methods for calculating the surface areas of prisms, cylinders, pyramids, cones, and spheres? What methods can be used to find the volumes of prisms, pyramids, cylinders, cones and spheres?	**Unit Enduring Understandings** The formulas for area, perimeter, and volume for various shapes and solids aren't just numbers on a page. They represent real properties of the shape or solid, and finding area, volume and so on is essential to learning the size, weight, etc of real world objects.

What methods can be used to find the volumes of prisms, pyramids, cylinders, cones and spheres? How can the distance and midpoint formulas be applied in 3-dimensional space?	
Unit Rationale This unit expands upon previous study of calculating volume, surface area, and area and further organizes the connections between the shapes and figures based upon their characteristics and prepares students to use them in their real world applications.	**Unit Overview** The study of area, perimeter, surface area and volume is critical to an understanding of real-world special relationships. It Is also a gateway topic to the study of calculus, and concepts like volume are fundamental to the physical sciences.
Resources Glencoe-McGraw Hill Geometry (ISBN 978-0-07-873826-5) Scientific Calculator Geometric Figures and Demonstrations - mathopenref.com Kuta worksheets - kutasoftware.com TI Smart software	
Suggested Student Activities Use knowledge of inscribed polygons to determine the largest dimensions of a square peg that will fit through a round hole. Use the volume of a rectangular prism to make an educated guess about the amount of jelly beans that can fit inside the prism. Make a 2-Dimensional net figure on card stock that students need to fold into the proper 3-Dimensional polyhedron.	
Key Terms Central angle – center of circle is its vertex and its sides contain two radii of the circle Arc – the central angles separates the circle into two parts Arc length – part of the circumference of a circle based on its central angle Tangent – interests a circle at exactly one point Secant – a line that intersects a circle at exactly two points	

Appendix

Differentiation	
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection ● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
Intervention & Modification	● Utilize “skeleton notes” where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools ● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors ● Graphic organizers

ELLs	● Pre-teach new vocabulary and meaning of symbols ● Embed glossaries or definitions ● Provide translations ● Connect new vocabulary to background knowledge ● Provide flash cards ● Incorporate as many learning senses as possible ● Portray structure, relationships, and associations through concept webs ● Graphic organizers
21st Century Skills	
● Creativity ● Innovation ● Critical Thinking ● Problem Solving ● Communication ● Collaboration	
Integrating Technology	
● Chromebooks ● Internet research ● Online programs ● Virtual collaboration and projects ● Presentations using presentation hardware and software	