GEOMETRY			
GEOMETRY			
CONGRUENCE			
Experiment with transformations in the plane			**Supporting**
G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Angles are formed and measured. • How to construct angles, circles, and lines. • How to name points, lines, angles and rays.	• Communicating about geometric figures should use definitions with specific characteristics that describe the figures.	• Create and recognize given geometric figures in diagrams based on precise definitions. • Create and recognize non-examples of given geometric figures in diagrams based on precise definitions. • Use notation and symbols for given geometric figures. • Attend to precision in use of vocabulary.

<table>
<tr><td colspan="4">GEOMETRY</td></tr>
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<tr><td colspan="4">CONGRUENCE</td></tr>
<tr><td colspan="3">Experiment with transformations in the plane</td><td>Supporting</td></tr>
<tr><td rowspan="3">G-CO.2
Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know</td><td>A student should understand</td><td>A student should be able to do</td></tr>
<tr><td>• Recognize translations, reflections, rotations, and dilations.
• Recognize a pre-image and image under a given transformation.
• Describe what happens to a pre-image point under a given transformation.</td><td>• Every point on a pre-image has a corresponding point on the image that has gone through the transformation rule.
• Every point on an image has a corresponding point on the pre-image that can be found by undoing the transformation rule.</td><td>• Recognize that both distance and angle are preserved under a translation, reflection, and rotation.
• Recognize that both distance and angle are not preserved under a dilation.
• Attend to precision using function notation to represent a transformation rule.</td></tr>
</table>

GEOMETRY			
GEOMETRY			
CONGRUENCE			
Experiment with transformations in the plane			Supporting
G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Recognize a line of symmetry for a figure. • All figures do not have lines of symmetry. • Recognize a rotation and a reflection. • A trapezoid is defined as a quadrilateral with at least one pair of parallel sides. • Properties of rectangles, parallelograms, trapezoids, and regular polygons.	• What it means for a transformation to carry a figure onto itself. • Whether or not a given rotation or reflection will carry a figure onto itself.	• Recognize that reflecting a figure about a line of symmetry for that figure will carry the figure onto itself. • Recognize that rotating a figure about its center by an angle of rotation that is a multiple of the measure of one of its central angles will carry the figure onto itself. • Recognize that rotating a figure about its center by an angle of 360° or a multiple of 360° is a trivial case of carrying a figure onto itself. • Recognize that there are a finite number of ways to reflect a figure onto itself. • Recognize that there are an infinite number of ways to rotate a figure onto itself.

GEOMETRY

GEOMETRY

CONGRUENCE

Experiment with transformations in the plane			Supporting
G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Use and name points, lines, and rays. • Use and name angles, circles, perpendicular lines, parallel lines, and line segments. • What is needed for a rotation: a pre-image, a center of rotation, and an angle measure that indicates both measure and direction. • What is needed for a reflection: a pre-image and a line of reflection. • What is needed for a translation: a pre-image and a quantity that indicates both length and direction.	• Communicating about geometric figures should use definitions with specific characteristics that describe the figures. • A positive angle measure indicates a counterclockwise rotation; a negative angle measure indicates a clockwise rotation. • A vector indicates both length (magnitude) and direction.	• Recognize and create examples and non-examples of rotations, reflections, and translations based on precise definitions. • Use rotations, reflections, and translations in diagrams based on precise definitions. • Use notation and symbols for rotations, reflections, and translations.

GEOMETRY

GEOMETRY

CONGRUENCE

Experiment with transformations in the plane			Supporting
G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• What is needed for a rotation: a pre-image, a center of rotation, and an angle measure that indicates both measure and direction. • What is needed for a reflection: a pre-image and a line of reflection. • What is needed for a translation: a pre-image and a quantity that indicates both length and direction. • Draw a representation of a rotation, reflection, or translation.	• Whether a sequence of transformations will map a given pre-image to an image. • Communicate precisely when specifying a sequence of transformations that will map a given pre-image to an image.	• Draw the image of a given pre-image and a sequence of transformations. • Given a pre-image and an image, describe a sequence of transformations that will carry a given figure onto another. • Recognize and justify whether the order of the sequence of transformations is important. • Attend to vocabulary precision.

GEOMETRY			
GEOMETRY			
CONGRUENCE			
Understand congruence in terms of rigid motions			Major
G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Rotations, reflections, and translations are rigid motions. • What is needed for a rotation: a pre-image, a center of rotation, and an angle measure that indicates both measure and direction. • What is needed for a reflection: a pre-image and a line of reflection. • What is needed for a translation: a pre-image and a quantity that indicates both length and direction.	• Two figures are congruent to each other if there is a sequence of rigid motions that carries one figure onto the other figure. • Two figures are not congruent to each other if there is not a sequence of rigid motions that carries one figure onto the other figure. • Communicate precisely when specifying a sequence of transformations that will map a given pre-image to an image.	• Recognize whether two figures are congruent to each other. • Recognize the sequence of rigid motions that will map one figure onto another figure.

GEOMETRY			
GEOMETRY			
CONGRUENCE			
Understand congruence in terms of rigid motions			**Major**
G-CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Rotations, reflections, and translations are rigid motions. • What is needed for a rotation: a pre-image, a center of rotation, and an angle measure that indicates both measure and direction. • What is needed for a reflection: a pre-image and a line of reflection. • What is needed for a translation: a pre-image and a quantity that indicates both length and direction.	• Two figures are congruent to each other if there is a sequence of rigid motions that carries one figure onto the other figure. • When two figures are congruent, corresponding pairs of sides and corresponding pairs of angles will be congruent. • When corresponding pairs of sides and corresponding pairs of angles of two figures are congruent, the figures are congruent.	• Recognize whether two figures are congruent to each other. • Recognize the sequence of rigid motions that will map one figure onto another figure. • Recognize that corresponding pairs of sides and corresponding pairs of angles will be congruent when there is a rigid motion (or sequence of rigid motions) that maps one figure onto another figure. • Recognize that when corresponding pairs of sides and corresponding pairs of angles are congruent, there is a rigid motion (or sequence of rigid motions) that maps one figure onto another figure.

GEOMETRY			
GEOMETRY			
CONGRUENCE			
Understand congruence in terms of rigid motions			Major
G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • What a congruence statement is, e.g., ΔABC ≅ ΔXYZ. • Recognize corresponding sides and corresponding angles from a congruence statement. • What is needed for a reflection, translation, and rotation. • Rotations, reflections, and translations are rigid motions. • A dilation is not a rigid motion unless the scale factor is 1.	• Construct a viable argument and critique the reasoning of others. • The necessary and sufficient conditions for two triangles to be congruent by ASA, SAS, and SSS. • ASA, SAS, and SSS are methods for proving triangles congruent that can be proven by using a sequence of rigid motions to map one triangle onto the other triangle. • AA is not a method for proving triangles congruent; there is no sequence of rigid motions that would map two triangles with two pairs of corresponding angles congruent onto each other.	• Given two triangles that are congruent by ASA, show a sequence of rigid motions that maps one triangle onto the other triangle. • Given two triangles that are congruent by SAS, show a sequence of rigid motions that maps one triangle onto the other triangle. • Given two triangles that are congruent by SSS, show a sequence of rigid motions that maps one triangle onto the other triangle.

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<tr><td colspan="3">Prove geometric theorems</td><td>Major</td></tr>
<tr><td rowspan="2">G-CO.9
Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know
• Attend to precision.
• Use and name points, lines, and rays.
• Use and name angles, circles, perpendicular lines, parallel lines, and line segments.
• Name angles created when parallel lines are cut by a transversal.
• Facts about relationships of angles created when parallel lines are cut by a transversal.
• Angle Addition Postulate
• Use angle pairs such as vertical angles, angles that form a linear pair, supplementary and complementary angles.</td><td>A student should understand
• Construct a viable argument and critique the reasoning of others.
• Vertical angles (the opposite angles formed when two lines intersect) are congruent.
• When two parallel lines are cut by a transversal, the alternate interior angles, corresponding angles, and alternate exterior angles are congruent.
• Auxiliary lines can assist in recognizing the structure for the perpendicular bisector of a given segment (look for and make use of structure).
• Some variation of Euclid's Fifth Postulate is needed in order to prove theorems about the angles created when parallel lines are cut by a transversal.</td><td>A student should be able to do
• Recognize a valid argument for proving theorems about lines and angles.
• Recognize an invalid argument for proving theorems about lines and angles.
• Create a valid argument for proving theorems about lines and angles.</td></tr>
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CONGRUENCE

Prove geometric theorems	Major

<table>
<tr><td rowspan="3"><u>G-CO.10</u>
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.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know</td><td>A student should understand</td><td>A student should be able to do</td></tr>
<tr><td>• Attend to precision.
• Use and name points, lines, and rays, angles, circles, perpendicular lines, parallel lines, and line segments.
• Angle Addition Postulate
• Use angle pairs such as vertical angles, angles that form a linear pair, alternate interior angles, supplementary and complementary angles.
• Use and name special segments in triangles such as medians, angle bisectors, midsegments, and altitudes.</td><td>• Construct a viable argument and critique the reasoning of others.
• The sum of the measures of the interior angles of a triangle is 180°.
• Auxiliary lines can assist in recognizing the structure for proving the triangle sum theorem (look for and make use of structure).
• The midsegment of a triangle is parallel to the third side of the triangle and half the length of the third side of the triangle.
• The medians of a triangle are concurrent at the centroid of the triangle; the centroid is the balancing point of the triangle.</td><td>• Recognize a valid argument for proving theorems about triangles.
• Recognize an invalid argument for proving theorems about triangles.
• Create a valid argument for proving theorems about triangles.</td></tr>
</table>

GEOMETRY			
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CONGRUENCE			
Prove geometric theorems			Major
G-CO.11 Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A parallelogram is a trapezoid with both pairs of opposite sides parallel. • Properties of parallelograms. • Use properties of parallelograms. • All rectangles, rhombi, and squares are parallelograms. • Methods for proving triangles congruent. • Corresponding parts of congruent triangles are congruent.	• Communicating precisely about definitions makes it clear what are the sufficient characteristics to describe a geometric figure and not just its necessary characteristics. • Necessary and sufficient characteristics of special quadrilaterals. • Auxiliary lines such as a diagonal can assist in recognizing the structure for proving theorems about parallelograms (look for and make use of structure).	• Recognize a valid argument for proving theorems about parallelograms. • Recognize an invalid argument for proving theorems about parallelograms. • Create a valid argument for proving theorems about parallelograms. • Attend to precision.

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<tr><td colspan="3">Make geometric constructions</td><td>Supporting</td></tr>
<tr><td rowspan="2">G-CO.12
Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know
Use a compass and a straightedge. Use dynamic geometry software.
Use and name points, lines, and rays, angles, circles, perpendicular lines, parallel lines, and line segments.</td><td>A student should understand
The difference between constructing and drawing.
Recognize advantages to making constructions using dynamic geometry software.
Why given steps of a geometric construction lead to the desired result.</td><td>A student should be able to do
Use appropriate tools strategically.
Name pairs of angles, triangles, segments, arcs, and other figures that are congruent as a result of a geometric construction.
Give valid reasons for why certain pairs of angles, triangles, segments, arcs, and other figures are congruent as a result of a geometric construction.
Attend to precision.</td></tr>
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GEOMETRY			
GEOMETRY			
CONGRUENCE			
Make geometric constructions			**Supporting**
G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Use a compass and a straightedge. Use dynamic geometry software. • Use and name points, lines, and rays, angles, circles, perpendicular lines, parallel lines, and line segments.	• The difference between constructing and drawing. • Recognize advantages to making constructions using dynamic geometry software. • Why given steps of a geometric construction lead to the desired result. • Recognize properties of an equilateral triangle, square, and regular hexagon inscribed in a circle.	• Use appropriate tools strategically. • Name pairs of angles, triangles, segments, arcs, and other figures that are congruent as a result of a geometric construction. • Give valid reasons for why certain pairs of angles, triangles, segments, arcs, and other figures are congruent as a result of a geometric construction.

GEOMETRY			
GEOMETRY			
SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY			
Understand similarity in terms of similarity transformations			**Major**
G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Use and name points, lines, and rays, angles, parallel lines, and line segments. • A line does not have length. • What is needed for a dilation. • Draw a dilation.	• Dilating a line that goes through the center of the dilation will produce the same line; the pre-image and image are equal. • Dilating a line that does not go through the center of the dilation will produce a line that is parallel to the given line. • The distance from the center of the dilation to the image is dependent on both the scale factor of the dilation and how far away the pre-image is from the center of dilation.	• Use appropriate tools strategically. • Place points on the given line to dilate. The line that contains the images of the points on given line will be the image of the given line.

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GEOMETRY

SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY

Understand similarity in terms of similarity transformations			Major
G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor: b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Use and name points, lines, and rays, angles, parallel lines, and line segments. • What is needed for a dilation. • Draw a dilation.	• A segment that is dilated by a scale factor k where |k>1| will have an image that is longer than the pre-image. • A segment that is dilated by a scale factor k where |0<k<1| will have an image that is shorter than the pre-image. • When dilating a segment by a scale factor of k, the ratio of the length of the image to the length of the pre-image will equal |k|.	• Use appropriate tools strategically. • Dilate the endpoints of the given segment about the center of dilation using the scale factor. The segment with endpoints that are the images of the endpoints of the given segment will be the image of the given segment. • Verify the third measurement when given any two of the following: scale factor, length of given segment, length of dilated segment.

GEOMETRY

GEOMETRY

SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY

Understand similarity in terms of similarity transformations			Major
G-SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	**Desired Student Performance**		
	A student should know • Attend to precision. • What a similarity statement is, e.g., ΔABC~ΔXYZ. • Recognize corresponding sides and corresponding angles from a similarity statement. • What is needed for a dilation, reflection, translation, and rotation. • Rotations, reflections, and translations are rigid motions. • A dilation is not a rigid motion unless the scale factor is 1.	**A student should understand** • Construct a viable argument and critique the reasoning of others. • Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. • In similar figures, corresponding angles are congruent. • In similar figures corresponding pairs of sides are proportional.	**A student should be able to do** • Given two figures, determine whether the figures are similar. • Given two similar figures, determine the sequence of rotations, reflections, translations, and dilations from which one figure can be obtained by the other figure.

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GEOMETRY

SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY

Understand similarity in terms of similarity transformations			Major
G-SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • What a similarity statement is, e.g., ΔABC~ΔXYZ. • Recognize corresponding sides and corresponding angles from a similarity statement. • What is needed for a dilation, reflection, translation, and rotation. • Rotations, reflections, and translations are rigid motions. • A dilation is not a rigid motion unless the scale factor is 1.	• Construct a viable argument and critique the reasoning of others. • Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. • The necessary and sufficient conditions for two triangles to be similar by AA. • AA is a method for proving triangles similar that can be proven by using a sequence of transformations to obtain one triangle from the other triangle.	• Given two triangles that are similar by AA, show a sequence of transformations by which one triangle can be obtained from the other triangle.

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<tr><td colspan="4">SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY</td></tr>
<tr><td colspan="3">Prove theorems involving similarity</td><td>Major</td></tr>
<tr><td rowspan="3">G-SRT.4
Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know</td><td>A student should understand</td><td>A student should be able to do</td></tr>
<tr><td>Attend to precision.
Use and name points, lines, and rays, angles, circles, perpendicular lines, parallel lines, and line segments.
Use angle pairs such as vertical angles, angles that form a linear pair, alternate interior angles, supplementary and complementary angles.
Use and name special segments in triangles such as medians, angle bisectors, midsegments, and altitudes.
Use the Pythagorean Theorem.</td><td>Construct a viable argument and critique the reasoning of others.
A line parallel to one side of a triangle divides the other two sides proportionally.
If a line divides two sides of a triangle proportionally, then it is parallel to the third side.
Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations.
In similar figures, corresponding angles are congruent.
In similar figures, corresponding pairs of sides are proportional.</td><td>Auxiliary lines can assist in recognizing the structure for proving theorems about triangles (look for and make use of structure).
Recognize a valid argument for proving theorems about triangles.
Recognize an invalid argument for proving theorems about triangles.
Create a valid argument for proving theorems about triangles.
Recognize and create a valid argument for proving the Pythagorean Theorem using triangle similarity.</td></tr>
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GEOMETRY			
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SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY			
Prove theorems involving similarity			Major
G-SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Recognize corresponding sides and corresponding angles from a congruence statement. • Two figures are congruent to each other if there is a sequence of rigid motions that carries one figure onto the other figure. • Recognize corresponding sides and corresponding angles from a similarity statement. • Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations.	• Construct a viable argument and critique the reasoning of others. • ASA, SAS, and SSS are methods for proving triangles congruent. • The necessary and sufficient conditions for two triangles to be congruent by ASA, SAS, and SSS. • AA is a method for proving triangles similar. • The necessary and sufficient conditions for two triangles to be similar by AA.	• Calculate unknown measurements using known measurements and relationships among congruent and similar triangles. • Given a valid argument for calculating unknown measurements using known measurements and relationships among congruent and similar triangles. • Prove relationships in geometric figures using known measurements and other relationships among congruent and similar triangles.

GEOMETRY

GEOMETRY

SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY

Define trigonometric ratios and solve problems involving right triangles			Major
G-SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• In similar figures, corresponding angles are congruent. • In similar figures corresponding pairs of sides are proportional.	• Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. • AA is a method for proving triangles similar.	• Recognize the effects of changing the sides and angles of a right triangle on the sine, cosine, and tangent ratios. • Connect sine, cosine, and tangent with appropriate ratios for the acute angles in a right triangle. • Connect cotangent, secant, and cosecant with appropriate ratios for the acute angles in a right triangle.

GEOMETRY			
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SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY			
Define trigonometric ratios and solve problems involving right triangles			**Major**
G-SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Use angle pairs such as complementary angles. • Given a right triangle, determine the sine and cosine ratios of the acute angles.	• The relationship between sine and cosine of complementary angles: sin(x°)=cos(90-x°) and sin(90-x°)=cos(x°).	• Create a valid argument for why the sine of one acute angle in a right triangle is equal to the cosine of the other acute angle in the right triangle. • Give an equivalent expression for the sine or cosine of one of the acute angles in a right triangle such as cos(40°). e.g., cos(40°)=sin(50°). • Use the relationship between the sine and cosine of complementary angles to solve problems.

GEOMETRY			
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SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY			
Define trigonometric ratios and solve problems involving right triangles			**Major**
G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Use angle pairs such as complementary angles. • Given a right triangle, determine the trigonometric ratios of the acute angles. • The Pythagorean Theorem.	• Use trigonometric ratios of the acute angles in a right triangle to solve applied problems. • Use inverse trigonometric functions to determine unknown angle measures when given the side lengths of a right triangle in an applied problem.	• Model with mathematics. • Identify what is important in an applied problem. • Draw a diagram to represent the given information in an applied problem. • Use the Pythagorean Theorem to calculate unknown measures when appropriate. • Select an appropriate trigonometric ratio using the acute angles in a right triangle to solve an applied problem. • Solve an equation using a trigonometric ratio to solve an applied problem.

GEOMETRY			
GEOMETRY			
CIRCLES			
Understand and apply theorems about circles			Additional
G-C.1 Prove that all circles are similar.	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• What is needed for a dilation, reflection, translation, and rotation. • Rotations, reflections, and translations are rigid motions. • A dilation is not a rigid motion unless the scale factor is 1. • Use basic circle vocabulary such as concentric circles and congruent circles.	• Construct a viable argument and critique the reasoning of others. • Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations.	• Recognize a valid argument for proving that all circles are similar. • Create a valid argument for proving that all circles are similar. • Calculate the scale factor for the dilation of one circle onto another circle given the lengths of their radii, diameters, circumferences, or some other pair of corresponding linear measures.

GEOMETRY			
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CIRCLES			
Understand and apply theorems about circles			Additional
G-C.2 Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Use basic circle vocabulary such as radius, diameter, chord, secant, and tangent. • A central angle has a vertex at the center of the circle and has two sides that are radii of the circle. • An inscribed angle has a vertex on the circle and has two sides that are chords of the circle. • A circumscribed angle has a vertex outside the circle and has two sides that are tangents of the circle.	• A central angle is equal to the measure of its intercepted arc. • An inscribed angle is one-half the measure of its intercepted arc. • A circumscribed angle forms a quadrilateral with the two radii drawn to the points of tangency. • An angle inscribed in a semicircle is a right angle. • The radius of a circle is perpendicular to a tangent line at the point of tangency.	• Calculate missing angle and/or arc measures for central angles, inscribed angles, and circumscribed angles. • Look for and make use of structure such as using the right triangle formed by a radius drawn to a tangent line at the point of tangency to calculate missing side lengths.

GEOMETRY

GEOMETRY

CIRCLES

Understand and apply theorems about circles			Additional
G-C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Use a compass and a straightedge. Use dynamic geometry software. • Use basic circle vocabulary such as radius, diameter, chord, secant, and tangent. • When a circle is inscribed in a polygon, every side of the polygon will be tangent to the circle. • When a circle is circumscribed about a polygon, every side of the polygon will be a chord of the circle.	• The difference between constructing and drawing. • Recognize advantages to making constructions using dynamic geometry software. • Why given steps of a geometric construction lead to the desired result. • Opposite angles of a cyclic quadrilateral are supplementary. • Necessary and sufficient conditions for a quadrilateral to be inscribed in a circle.	• Use appropriate tools strategically. • Name pairs of angles, triangles, segments, arcs, and other figures that are congruent as a result of a geometric construction. • Give valid reasons for why certain pairs of angles, triangles, segments, arcs, and other figures are congruent as a result of a geometric construction. • Recognize a valid argument for proving properties of cyclic quadrilaterals. • Create a valid argument for proving properties of cyclic quadrilaterals. • Calculate missing angle measures for a cyclic quadrilateral.

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<tr><td colspan="4">CIRCLES</td></tr>
<tr><td colspan="3">Find arc lengths and areas of sectors of circles</td><td>Additional</td></tr>
<tr><td rowspan="2">G-C.5
Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know
• All circles are similar.
• Basic geometry vocabulary such as radius, central angle, intercepted arc, and sector.</td><td>A student should understand
• The length of the arc intercepted by an angle is proportional to the radius, and the radian measure of the angle is the constant of proportionality.</td><td>A student should be able to do
• Recognize a valid argument for calculating the arc length of a sector.
• Create a valid argument for calculating the arc length of a sector.
• Recognize a valid argument for calculating the area of a sector.
• Create a valid argument for calculating the area of a sector.
• Calculate arc length and area of a sector.
• Given any two of the following measurements for a sector, calculate the third: arc length or area, angle measure, radius.</td></tr>
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GEOMETRY			
GEOMETRY			
EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS			
Translate between the geometric description and the equation for a conic section			**Additional**
G-GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• The Pythagorean Theorem. • Basic geometry vocabulary such as radius, diameter, circle. • Calculate the distance between two points. • Determine the midpoint of a segment when given the coordinates of its endpoints. • Expand the square of a binomial. • Factor perfect square trinomials.	• The equation of a circle in the coordinate plane follows from the Pythagorean Theorem. • Every point (x,y) on a circle with center at the origin and radius r will satisfy the equation $x^2+y^2=r^2$.	• Reason abstractly and quantitatively. • Create a valid argument for how the equation of a circle is derived from the Pythagorean Theorem. • Write the equation of a circle given its center and radius. • Complete the square to find the center and radius of a circle given its equation.

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<tr><td colspan="4">EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS</td></tr>
<tr><td colspan="3">Use coordinates to prove simple geometric theorems algebraically</td><td>Major</td></tr>
<tr><td rowspan="3">G-GPE.4
Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know</td><td>A student should understand</td><td>A student should be able to do</td></tr>
<tr><td>• Calculate the distance between two points.
• Determine the midpoint of a segment when given the coordinates of its endpoints.
• Determine the endpoint of a segment when given its midpoint and other endpoint.
• Calculate the slope of the line that contains two given points.
• Write the equation of a circle given its center and radius.
• Properties of rectangles, parallelograms, trapezoids, and regular polygons.</td><td>• Sufficient conditions for proving that a figure is a special quadrilateral.
• A point that lies on a circle will satisfy the equation of the circle when the x- and y-coordinates are substituted for x and y in the equation.
• A point that lies inside the circle will be less than the square of the radius when the x- and y-coordinates are substituted for x and y in the equation.
• A point that lies outside the circle will be greater than the square of the radius when the x- and y-coordinates are substituted for x and y in the equation.</td><td>• Use slope calculations to determine whether two lines are parallel or perpendicular.
• Use distance calculations to determine whether two segments are congruent.
• Use midpoint calculations to determine whether a segment has been bisected.
• Prove properties of special quadrilaterals in the coordinate plane using distance, midpoint, and slope.
• Prove whether four points in the coordinate plane form a special quadrilateral.
• Prove whether a given point lies on, inside, or outside a circle.</td></tr>
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EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS

Use coordinates to prove simple geometric theorems algebraically			**Major**
G-GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. • In similar figures, corresponding angles are congruent. • In similar figures corresponding pairs of sides are proportional. • Calculate the slope of the line that contains two given points. • Write the equation of a line given its slope and a point on the line. • Rewrite a linear equation in slope-intercept form. • Two slope triangles on the same line are similar to each other.	• Slope triangles on parallel lines are similar to each other. • Parallel lines have slopes that are equal. • A vertical line (slope is undefined) and a horizontal line (slope of 0) are perpendicular. • Oblique perpendicular lines have slopes with a product of –1.	• Look for and make use of structure, such as drawing auxiliary lines to create slope triangles on parallel lines in order to prove that their slopes are equal. • Create a valid argument for why the slopes of parallel lines are equal. • Create a valid argument for why the slopes of perpendicular lines have a product of –1. • Use slope calculations to determine whether two lines are perpendicular. • Write an equation of a line parallel or perpendicular to a given line that passes through a given point.

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EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS

Use coordinates to prove simple geometric theorems algebraically			Major
G-GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Two figures are similar if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. • In similar figures, corresponding angles are congruent. • In similar figures corresponding pairs of sides are proportional. • Calculate the distance between two points. • Use the Pythagorean Theorem. • Solve a proportion with one variable.	• A line parallel to one side of a triangle divides the other two sides proportionally. • If a line divides two sides of a triangle proportionally, then it is parallel to the third side.	• Look for and make use of structure, such as drawing similar slope triangles on a directed line segment to set up a proportion with corresponding side lengths. • Set up a proportion to determine the point on a directed line segment that partitions the segment in a given ratio.

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EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS

Use coordinates to prove simple geometric theorems algebraically			**Major**
G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*	**Desired Student Performance**		
	A student should know • Attend to precision. • Calculate the distance between two points. • Use the Pythagorean Theorem. • Calculate the perimeter of a polygon. • Compose or decompose a polygon into triangles and/or rectangles. • Calculate the areas of triangles and rectangles. • Recognize right triangles such as 45-45-90 triangles.	**A student should understand** • Recognize when a polygon is contained in a larger polygon that might be more manageable for calculations, even when subtracting the excess. • The area of a polygon is equal to the sum of the areas of its non-overlapping parts.	**A student should be able to do** • Look for and make use of structure. For example, the number of computations might be reduced by recognizing the symmetry of a given figure. • Calculate the perimeter of a polygon using the distance between two points. • Calculate the area of a polygon by decomposing the polygon into triangles and rectangles.

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<tr><td colspan="4">GEOMETRIC MEASUREMENT AND DIMENSION</td></tr>
<tr><td colspan="3">Explain volume formulas and use them to solve problems</td><td>Additional</td></tr>
<tr><td rowspan="2"><u>G-GMD.1</u>
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.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know
• Formulas for a circle such as circumference and area.
• Formulas for the volume of a cylinder, pyramid, and cone.
• Horizontal cross sections for a cylinder, pyramid, and cone.</td><td>A student should understand
• Area answers the question "how much can it cover".
• Volume answers the question "how much does it hold".
• Pi is defined as the ratio of the Circumference of any circle to its diameter.
• Informal limit arguments, such as how we can slice a cylinder horizontally into an infinite number of circles and calculate the volume of the cylinder by summing the areas of each circular slice.
• A cone is a pyramid with a circular base, and so the volume formula for a cone is like the volume formula for a pyramid.</td><td>A student should be able to do
• Recognize and create a valid argument for the formulas for the area and circumference of a circle.
• Recognize and create a valid argument for the formulas for the volume of a cylinder, pyramid, and cone.
• Use Cavalieri's principle: If two solid figures have the same height and the same cross sections at every height, then their volumes are the same.</td></tr>
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GEOMETRIC MEASUREMENT AND DIMENSION

Explain volume formulas and use them to solve problems			Additional
G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Formulas for the volume of a cylinder, pyramid, and cone. • Use the Pythagorean Theorem to calculate unknown measures. • Select an appropriate trigonometric ratio using the acute angles in a right triangle to calculate unknown measures.	• Volume answers the question "how much does it hold". • Units relate to whether a measurement represents area, volume, or a linear quantity.	• Model with mathematics. • Calculate volume and/or missing linear measurements to solve problems. • Solve a volume formula for an unknown measure to solve an applied problem.

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<tr><td colspan="4">GEOMETRIC MEASUREMENT AND DIMENSION</td></tr>
<tr><td colspan="3">Visualize relationships between two-dimensional and three-dimensional objects</td><td>Additional</td></tr>
<tr><td rowspan="3"><u>G-GMD.4</u>
Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</td><td colspan="3">Desired Student Performance</td></tr>
<tr><td>A student should know</td><td>A student should understand</td><td>A student should be able to do</td></tr>
<tr><td>• Attend to precision.
• Graph lines in the coordinate plane.
• Properties of two-dimensional figures.
• Properties of three-dimensional figures.</td><td>• When a two-dimensional object is rotated but not bounded by the line of rotation, the resulting three-dimensional objects will have a “hole”.</td><td>• Identify the shape of the two-dimensional cross section when a three-dimensional object is sliced in different ways.
• Identify the solid created and its properties when a two-dimensional shape is rotated about a line. For example, when a rectangle sitting on the x-axis and bounded on the left by a vertical line is rotated about the vertical line, the resulting three-dimensional object is a solid whose height equal to the height of the rectangle and whose base radius is equal to the base of the rectangle.</td></tr>
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<tr><td colspan="3" align="center">Apply geometric concepts in modeling situations</td><td align="center">Major</td></tr>
<tr><td rowspan="2">G-MG.1
Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*</td><td colspan="3" align="center">Desired Student Performance</td></tr>
<tr><td>A student should know
• Attend to precision.
• Properties of two-dimensional figures.
• Properties of three-dimensional figures.
• Calculate measures of geometric shapes such as area and volume.</td><td>A student should understand
• Properties of real-world objects can be determined using features of similar geometric shapes.</td><td>A student should be able to do
• Model with mathematics.
• Compose or decompose a figure into manageable geometric shapes.
• Represent real-world objects as geometric shapes.
• Estimate measures of real-world objects by calculating measures of the geometric shapes such as area and volume.</td></tr>
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MODELING WITH GEOMETRY			
Apply geometric concepts in modeling situations			Major
G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Properties of two-dimensional figures. • Properties of three-dimensional figures. • Calculate measures of geometric shapes such as area and volume. • Convert units.	• Whether to use area or volume to model a given real-world situation.	• Model with mathematics. • Compose or decompose a figure into manageable geometric shapes. • Calculate area or volume to model a given real-world situation. • Calculate density in a real-world situation using area and volume.

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MODELING WITH GEOMETRY			
Apply geometric concepts in modeling situations			Major
G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Attend to precision. • Properties of two-dimensional figures. • Properties of three-dimensional figures. • Calculate measures of geometric shapes such as area and volume.	• Whether to use area or volume to model a given real-world situation.	• Model with mathematics. • Design an object to satisfy given constraints.