

Archdiocese of Chicago: Mathematics Curriculum Framework

State Goal 9: Use geometric methods to analyze, categorize and draw conclusions about points, lines, planes and space.

Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Significant to Develop at Preschool level:</i></p> <p>P.09.01 Recognize and name two- and three-dimensional shapes. (9A)</p> <p>P.09.02 Draw two-dimensional shapes. (9A)</p> <p>P.09.03 Build three-dimensional shapes. (9A)</p> <p>P.09.04 Recognize geometric shapes and structures in the environment. (9A)</p> <p>P.09.05 Identify objects that are the same shape. (9B)</p> <p>P.09.06 Sort and classify familiar shapes. (9B)</p>	<p>Cut out shapes. Teacher says “Bring me a circle.”</p> <p>Use a geoboard to make different shapes.</p> <p>Use connecting blocks to make shapes.</p> <p>Have students find examples of rectangles and circles in the room.</p> <p>Match shapes of attribute blocks</p> <p>Sort building blocks by shape, size and place on different shelves. (big, small, “pointy”, round)</p>	<p>Connect to religious symbols: Cut and paste shapes to fill in an outline of a cross. Color each shape with a different color.</p> <p>Connect to art: Draw a picture of the sun and the moon and stars. Make flowers from shapes cut from construction paper.</p> <p>Look at stained glass windows in church or in pictures and discuss shapes.</p>

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<p>P.09.07 Find and name locations with simple words, such as “near”. (9B)</p> <p><i>Useful to Work on at Preschool Level:</i></p> <p>P.09.08 Recognize shapes that have symmetry. (9B)</p>	<p>Students line up in a row. Describe who is near and who is far away from student in front. Have students in pairs act out “over”, “under”. Have students in triples act out “near”, “far” and “between”.</p> <p>Collect leaves and look for symmetry.</p>	<p>Build a lego bridge. Ask students to place a figure, below, over, under, etc. the bridge.</p> <p>Group symmetrical leaves.</p>

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<p><i>Significant to Develop at Kindergarten Level:</i></p> <p>K.09.01 Recognize and name two- and three-dimensional shapes. (9A)</p> <p>K.09.02 Draw and build two- and three-dimensional shapes. (9A)</p> <p>K.09.03 Recognize geometric shapes and structures in the environment. (9A)</p> <p>K.09.04 Identify objects that are the same shape. (9B)</p> <p>K.09.05 Sort and classify familiar shapes. (9B)</p> <p>K.09.06 Find and name locations with simple words, such as “near”. (9B)</p>	<p>Name shapes of attribute blocks by appearance. Name shapes of attribute blocks by feel.</p> <p>Use connecting cubes, count how many different shapes can be made with 5 cubes.</p> <p>Find different shapes in the school.</p> <p>Name shapes in an area. Go on a safari to find “How many objects in the classroom have the same shape as the door?” Make a shape museum.</p> <p>Make a shape puzzle</p> <p>Make a map of the classroom using near, far, between to describe locations.</p>	<p>Use shapes to make a card with a picture of a house for someone in your family.</p> <p>Connect to science: Make shapes of animals and plants.</p> <p>Make a picture using precut shapes.</p> <p>Find shapes in stained glass windows.</p> <p>Read <u>Guess How Much I Love You</u>. Complete a sentence booklet: “I love you as (far as the moon, near as my heart, etc.)</p>

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<p><i>Useful to Work on at Kindergarten Level:</i></p> <p>K.09.07 Recognize shapes that have symmetry. (9A)</p>	<p>Find symmetry in nature. Look at flowers and leaves. “Is the leaf the same on both sides?” Find shapes in classroom that exhibit symmetry.</p>	<p>Make snowflakes from paper cutting.</p>

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<p><i>Critical for Mastery at Grade 1:</i></p> <p>1.09.01 Identify two-and three-dimensional shapes. (9A)</p> <p>1.09.02 Model two-dimensional geometric shapes by drawing or building. (9A)</p> <p>1.09.03 Describe and interpret relative positions in space and apply concepts of relative positions. (e.g., above and below) (9A)</p> <p>1.09.04 Recognize and describe shapes that have line symmetry. (9A)</p> <p>1.09.05 Identify geometric shapes and structures in the environment. (9A)</p>	<p>Identify shapes: triangle, rectangle, and square using attribute blocks. Sort three-dimensional shapes: sphere, cone, and cylinder by looking at examples.</p> <p>Draw shapes: triangle, rectangle, and square by looking at examples.</p> <p>Stack blocks of different colors. Students identify above, below, between, near.</p> <p>Fold and cut construction paper</p> <p>Go on a safari in the building or classroom. Assign groups to locate specific shapes.</p>	<p>In Social Studies, create a mural of a country and city scene using specific shapes. Discuss the difference between the two scenes.</p> <p>Connect to art: Draw picture incorporating shapes. Employing language art skills, describe the picture with terms such as the sun is “near” the moon or the sun is “over” the house.</p> <p>Make ornaments for a Christmas tree.</p>

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<p>1.09.06 Identify objects that are the same shape. (9B)</p> <p>1.09.07 Compare and sort two- and three-dimensional objects. (9B)</p> <p><i>Significant to Develop at Grade 1:</i></p> <p>1.09.08 Recognize and explain geometric pattern. (9C)</p> <p><i>Useful to Work on at Grade 1:</i></p> <p>1.09.09 Explore the effects of translations (slides), reflections (flips), and rotations (turns) with concrete objects. (9A)</p>	<p>Play a game called “What’s My Rule” (I have three sides, who am I?)</p> <p>Sort attribute blocks. Make polygons using students’ hands and string as a loop.</p> <p>Use pattern blocks to make a design. Explain the design.</p> <p>Use mirrors against objects to see reflections. Show rotation using clock angles</p>	<p>Make a card for someone you like using a pattern block design.</p> <p>Use carbon paper to make a mirror image of your name written in manuscript.</p>

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<p><i>Critical for Mastery at Grade 2:</i></p> <p>2.09.01 Investigate and predict the results of putting together and taking apart two- and three-dimensional shapes. (9A)</p> <p>2.09.02 Describe and interpret direction and distance in navigating space, and apply concepts of direction and distance. (9A)</p> <p>2.09.03 Perform translations (slides), reflections (flips), and rotations (turns) with concrete objects. (9A)</p> <p>2.09.04 Create and complete shapes that have line symmetry. (9A)</p>	<p>Combine triangles and rectangles to make other shapes. Make shapes on geo boards.</p> <p>Look at a simple map of town. Show streets that are parallel and non-parallel line segments. Show and explain how to get from one place to another.</p> <p>Use templates to trace mirror images. Act out slides, flips, turns.</p> <p>Use dot paper to draw figures: draw a segment on dot paper. Instruct one student to draw a shape on one side of segment. Another student repeats the image that first student made on other side of segment.</p>	<p>Make a garland for a holiday out of shapes.</p> <p>Label the directions (N, E, W, S) on the walls of the room. Locate objects in the room based on directions such as “find the book that is north of the teacher’s desk.” Using a map or maze, students should Follow directions given by the teacher Using N, S, E, W; then ask “Where Did you end up?”</p>

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<p>2.09.05 Identify objects that are congruent. (9B)</p> <p><i>Significant to Develop at Grade 2:</i></p> <p>2.09.06 Compare and contrast attributes of two- and three-dimensional objects using appropriate vocabulary. (9B)</p> <p>2.09.07 Justify an extension of a pattern. (9C)</p>	<p>Use patty paper (pre-cut waxed paper) and straight edge to trace figure to determine congruency to another figure.</p> <p>Classify 3-dimensional shapes by the shape of their bases. Classify 2-dimensional shapes.</p> <p>Assign groups of students to make patterns. Let groups challenge each other to guess the next extension.</p>	<p>Encourage team work: teams go on a scavenger hunt to locate congruent shapes and objects in the room or school.</p> <p>Decorate waste baskets with 2-dimensional shapes and use for recycling.</p>

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<p><i>Critical for Mastery at Grade 3:</i></p> <p>3.09.01 Specify locations using a coordinate system. (9A)</p> <p>3.09.02 Predict and describe the results of translations, rotations, and reflections of two-dimensional shapes. (9A)</p> <p>3.09.03 Identify, draw, and build polygons. (9A)</p> <p>3.09.04 Decompose a three-dimensional object into two-dimensional components. (9B)</p>	<p>Ask one student to give directions to another student for moving around the classroom. Use a grid to locate landmarks for navigation.</p> <p>Make a “human coordinate plane” using masking tape and chalk.</p> <p>Teach students to use phrases such as “turn it 90 degrees” or “flip it” vertically to describe the mathematical situation. Using a grid and a figure, describe a translation and have students try to visualize and explain the result.</p> <p>Using straws, popsicle sticks, or toothpicks and “Dot” candies, build polygons of 5 or more sides-- Explain side, vertex, angle.</p> <p>Using a box as a model of a prism, ask students to create a net. Challenge students to create more than one.</p>	<p>Connect to values: Make a map for incoming first graders to use around the school.</p> <p>Create irregular 2-dimensional shapes; use reflections to make another shape that has symmetry.</p> <p>Use the polygon for a frame around a picture.</p>

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<p>3.09.05 Describe the difference between congruence and similarity. (9B)</p> <p>3.09.06 Apply geometric ideas and relationships to problems that arise in the classroom or in everyday life. (9B)</p> <p><i>Significant to Develop at Grade 3:</i></p> <p>3.09.07 Identify and build a three-dimensional object from two-dimensional representations of that object. (9B)</p> <p>3.09.08 Apply geometric ideas and relationships to other disciplines. (9B)</p>	<p>Sort triangles into two piles, those that are congruent and those that have the same shape. Explain why the triangles are congruent or why they are not.</p> <p>Give students a project of making a scale of their bedroom. Provide scaled shapes of appropriate furniture and a room grid. Students place shapes on room grid to fit in space.</p> <p>Using building cubes, make a building out of ten cubes by looking at a front view, top view and left view.</p> <p>Organize students in small groups. Ask them to think of connections to other subjects. Give a prize to the group with the most connections.</p>	<p>Language arts: Students explain their sorting to the class and how they decided where the triangles belonged.</p> <p>Connect to science: Describe how geometric concepts (e.g., inclined plane) relate to science. Demonstrate using “hands-on” materials.</p> <p>In a science book, look at pictures of insects; examine for line symmetry.</p>

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<p>3.09.09 Identify, draw, and label lines, line segments, rays parallel lines, intersecting lines, perpendicular lines, acute, obtuse, right angles, and acute, obtuse, right, scalene, isosceles and equilateral triangles. (9A)</p>	<p>Give students pictures of line relationships and triangles. Students label appropriately. Using straightedge, construct a variety of angles and label. Make an “angle generator” using two paper plates.</p>	<p>Connect to technology and language arts: Create a Powerpoint presentation to be used as a geometry vocabulary book; find examples of angles, intersecting lines, and perpendicular lines in the classroom.</p>
<p>3.09.10 Describe paths and movement using coordinate systems. (9A)</p>	<p>Partners: Using grid white boards, tell one student in each group to designate a location on grid, identify with a token. Have partner move token according to directions and grid locations.</p>	<p>Connect to geography: Using maps, find cities using coordinates on the map; play a “treasure hunt” game in which students must identify latitude and longitude.</p>
<p>3.09.11 Identify and label radius, diameter, chord, and circumference of a circle. (9A)</p>	<p>Use models, ask students to label.</p>	<p>Use a circular margarine lid to make a model of a bicycle wheel. Draw radii for spokes. Measure circumference with a string.</p>
<p>3.09.12 Investigate and describe the results of subdividing and combining shapes. (9A)</p>	<p>Make and use tangrams to create new shapes. Students explain their work.</p>	<p>Connect to art: Use 5-7 tangrams in color to make an abstract drawing.</p>
<p>3.09.13 Determine congruence and similarity of given shapes. (9B)</p>	<p>Play the Touch-and-Match Quadrangles game.</p>	

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<p>3.09.14 Explore polyhedra using concrete models. (9B)</p> <p>3.09.15 Describe a motion or a series of motions that will show that two shapes are congruent. (9B)</p> <p><i>Useful to Work on at Grade 3:</i></p> <p>3.09.16 Match a front, right side and top view drawing with a three-dimensional model built with cubes. (9B)</p> <p>3.09.17 Identify, draw, and build regular, irregular, convex and concave polygons. (9A)</p>	<p>Make a dodecahedron calendar from a net.</p> <p>Place shapes on grid paper. Describe how to move one shape onto the other. This also reinforces naming locations.</p> <p>Do a match game with concrete models and two-dimensional drawings.</p> <p>Group students. Give each group a variety of building materials and a drawing of a polygon to build. Conjecture about concave-convex.</p>	<p>Connect to science: Research how a lens works due to its convex structure.</p>

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<p><i>Critical for Mastery at Grade 4:</i></p> <p>4.09.01 Read and plot ordered pairs of numbers in the positive quadrant of the Cartesian plane. (9A)</p> <p>4.09.02 Explore and describe rotational symmetry of two- and three-dimensional shapes. (9A)</p> <p>4.09.03 Identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes. (9A)</p> <p>4.09.04 Classify two- or three-dimensional shapes according to their properties (e.g., regular and irregular, concave and convex, types of quadrilaterals, pyramids, and prisms). (9A)</p> <p>4.09.05 Describe paths using coordinate systems. (9A)</p>	<p>Specify locations on a grid (such as library, school, church); describe the shortest path between two locations.</p> <p>Draw a star in the upper left hand corner of a piece of patty paper. Flip the paper horizontally and then turn it 180 degrees. Predict where the star will be.</p> <p>Make geometry riddles that give clues to the attributes of geometric shapes.</p> <p>Using attribute shapes, sort shapes by using a variety of descriptors (e.g., all faces rectangles, all faces triangles, only one base, etc.)</p> <p>Use a grid with a variety of locations marked, and ask students to describe paths using proper terminology.</p>	<p>Connect to art: Using coordinates, connect dots to make a picture.</p> <p>Look at a windmill. Talk about the rotation.</p> <p>Connect to spelling: Make a list of vocabulary words related to attributes. Have a spelling bee to promote learning the correct spelling of the terms.</p> <p>Use a map grid to find a location on a map.</p>

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<p>4.09.06 Identify, sketch, and build two- and three-dimensional shapes given attribute clues. (9A)</p>	<p>Build structures with cubes and blocks. Transfer a model of the picture to grid paper.</p>	<p>Connect to religious symbols: Make a manger for a nativity scene out of cubes and blocks.</p>
<p>4.09.07 Determine if two polygons are congruent using measures of angles and sides. (9B)</p>	<p>Divide the class into groups. Give each group the same set of 4 straws of different lengths. Tell students to make a polygon placing straws end to end. Ask students to analyze the shapes and describe them.</p>	
<p>4.09.08 Identify and describe the five regular polyhedrons. (9B)</p>	<p>Make a chart listing the attributes of the solids.</p>	
<p>4.09.09 Analyze quadrilaterals for defining characteristics. (9B)</p>	<p>Give students accurate drawings of a variety of quadrilaterals. In groups, have students measure all sides and diagonals, and all angles. Chart the findings.</p>	
<p>4.09.10 Justify an extension of a pattern. (9C)</p>	<p>Make a frieze pattern, using rotations, reflections and translations.</p>	<p>Use the pattern to decorate the room.</p>

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<p>4.09.11 Make and test conjectures about mathematical properties and relationships and justify the conclusions. (9C)</p> <p><i>Significant to Develop at Grade 4:</i></p> <p>4.09.12 Identify and justify rotational symmetry in two- and three dimensional shapes. (9A)</p> <p>4.09.13 Demonstrate congruence of plane figures using transformations (translations, rotation, reflection). (9B)</p> <p>4.09.14 Match a front, right side, and top view drawing with a three-dimensional model built with cubes. (9B)</p> <p>4.09.15 Copy a line segment or an angle using a</p>	<p>Instruct students to measure sides, angles and diagonals of a rectangle. Encourage them to make conjectures. Ask other students to discover a possible flaw in the conjecture.</p> <p>Explain and demonstrate the rotational symmetry in a pinwheel.</p> <p>Trace a shape twice on patty paper. Place the two shapes on a flat surface. Ask students to find a transformation between the two shapes.</p> <p>Match pictures of buildings with views from the top. Using pieces of styrofoam, make a structure; cut the structure vertically to see a front view.</p> <p>Given specific directions, copy an angle.</p>	<p>Create friezes using transformation techniques.</p> <p>Discuss why buildings are in the shape of rectangular prisms. Are A-frame houses good choices?</p>

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<p>straightedge and compass. (9A)</p> <p>4.09.16 Make and test conjectures about results of subdividing and combining shapes. (9C)</p> <p>4.09.17 Identify and describe how geometric figures are used in practical settings (e.g., construction, art, architecture, advertising). (9A)</p> <p>4.09.18 Construct a circle with a specified radius or diameter using a compass. (9A)</p> <p><i>Useful to Work on at Grade 4:</i></p> <p>4.09.19 Make and test conjectures about mathematical properties and relationships and develop logical arguments to justify conclusions. (9C)</p>	<p>Give students parallelograms made from construction paper. On the parallelograms, draw an altitude from a vertex. Cut off the right triangle and place it against a side. Conjecture about the area. Use tangrams to show combinations of shapes.</p> <p>Analyze pictures and photographs. Assign a project to bring in one picture that contains two geometric shapes.</p> <p>Draw circles using a compass.</p> <p>Using geoboards, make figures and discuss area. Ask students to write out the reasons for their conclusions.</p>	<p>Connect to language arts: Write a story about the picture that was chosen.</p> <p>Connect to values: Make a circular bean bag target board using poster board. Decorate it and use it to play a game of bean toss with the younger students at school.</p> <p>Connect to technology: Use the drawing tools on the computer to draw various polygons.</p>

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<p>4.09.20 Create regular and semi-regular tessellations using pattern blocks, other manipulatives, or technology. (9B)</p>	<p>Have students cut out pictures that may or may not tessellate. Discuss why or why not.</p>	<p>Connect to values: Make a picture using tessellations; give it to someone you like.</p> <p>Connect to art: Analyze Escher drawings.</p> <p>Connect to language arts: Read <u>Cloak for a Dreamer</u>.</p>

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<p><i>Critical for Mastery at Grade 5:</i></p> <p>5.09.01 Determine the distance between points along horizontal and vertical lines of a coordinate system. (9A)</p> <p>5.09.02 Describe sizes, positions, and orientations of shapes under transformations, including dilations. (9A)</p> <p>5.09.03 Determine and describe the relationship between pi, the diameter, the radius, and the circumference of a circle. (9A)</p> <p>5.09.04 Make and test conjectures about mathematical properties and relationships and justify the conclusions. (9C)</p> <p>5.09.05 Make and test conjectures about the results of subdividing and combining shapes. (9C)</p>	<p>Make a grid. Do taxi-cab geometry (determine distance using only horizontal and vertical lines).</p> <p>Using dot paper, draw a rectangle. Using a factor of 2, redraw the new figure and discuss the attribute changes.</p> <p>With a string, measure the distance around a circle. Measure the diameter with a ruler. Students share their results. Chart the quotient of circumference and diameter.</p> <p>Show that a triangle can only contain one right angle by building right triangles.</p> <p>Make a quilt. Verify that the area of the quilt is the sum of the areas of the patches.</p>	<p>Connect to social studies: Determine distance between two points on a grid map of a city.</p> <p>Examine and compare to the blueprints of an architect.</p>

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<p>5.09.06 Justify that the sum of the angles of a triangle is 180 degrees. (9C)</p> <p><i>Significant to Develop at Grade 5:</i></p> <p>5.09.07 Make, test, and justify conjectures about various quadrilateral and triangle relationships, including the triangle inequality. (9C)</p> <p>5.09.08 Determine unknown angle measures using angle relationships and properties of a triangle or a quadrilateral. (9A)</p> <p><i>Useful to Work on at Grade 5:</i></p> <p>5.09.09 Perform simple constructions (e.g., equal segments, angle and segment bisectors, or perpendicular lines, inscribing a hexagon in a circle) with a compass and straightedge or a mira. (9A)</p>	<p>Draw a triangle on paper. Tear off the corners. Line them up to justify that the sum is that of the degree measure of the straight angle.</p> <p>Experiment with straws to conjecture about the triangle inequality; include straws that are very short or very long.</p> <p>Give two angle measures in a triangle. Find the third angle measure. Use a protractor to measure angles to justify the conjecture.</p> <p>Give directions to construct equal segments. Guide students through the construction of a hexagon inscribed in a circle.</p>	<p>Connect to religious symbols: Use an equilateral triangle to represent the Holy Trinity.</p> <p>Students make a clock using inscribed hexagons (placing a “point” on the circumference at every 10 minutes).</p>

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<p>5.09.10 Create a three-dimensional object from any two-dimensional representation of the object, including multiple views, nets, or technological representations. (9B)</p> <p>5.09.11 Plot and read ordered pairs of numbers in all four quadrants. (9A)</p>	<p>Give a variety of nets. Challenge students to visualize the three-dimensional shape that will be formed. Fold the net to justify conjecture.</p> <p>Name points on the grid.</p>	<p>Make Christmas ornaments for the class tree using the nets.</p> <p>Connect to social studies: Use a local map. Find regions using the map coordinates as on a real estate listing.</p>

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<p><i>Critical for Mastery at Grade 6:</i></p> <p>6.09.01 Describe sizes, positions, and orientations of shapes under transformations, including dilations. (9A)</p> <p>6.09.02 Determine and describe the relationship between pi, the diameter, the radius, and the circumference of a circle. (9A)</p> <p>6.09.03 Make, test, and justify conjectures about various quadrilateral and triangle relationships, including the triangle inequality. (9C)</p>	<p>Use technology (Geometer’s Sketchpad) to investigate transformations. Use a copy machine to make enlargements; measure the “before” and “after” shapes. Have students make their own translations.</p> <p>Design a maze using intersecting, parallel, and perpendicular lines. Include acute, obtuse, and right angles.</p> <p>Measure several circular objects in the classroom: measure the diameter and circumference and find their quotient. For example, set up stations with cylindrical or circular objects at each station and calculate pi.</p> <p>Measure all segments and angles in a variety of quadrilaterals (rhombus, square, kite, etc.). Chart the results. Make conjectures.</p> <p>Draw Venn Diagrams showing the relationship of all types of quadrilaterals.</p>	<p>Connect to art: Find examples of transformations. Have students make their own transformations.</p> <p>Study Escher and create a tessellation.</p> <p>Celebrate Pi Day: 3/14.</p> <p>Connect to technology: Find songs on the internet about Pi Day.</p> <p>Read “Sircumference and the Dragon of Pi”</p>

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<p>6.09.04 Justify that the sum of the angles of a triangle is 180 degrees. (9C)</p> <p>6.09.05 Demonstrate congruence of plane figures using transformations (translation, rotation, reflection). (9B)</p> <p>6.09.06 Make and test conjectures about mathematical properties and relationships and develop logical arguments to justify conclusions. (9C)</p> <p>6.09.07 Plot and read ordered pairs of numbers in all four quadrants. (9A)</p>	<p>Draw a triangle using a straightedge. Tear off the corners of the triangle and lay them side by side on a line so that the vertices touch and show that the sum of the angles of a triangle is 180 degree.</p> <p>Demonstrate two triangles facing each other. Ask students to find the transformation that will map one onto the other. Discuss line of symmetry.</p> <p>Have students make their own flags that demonstrate translations, rotation and reflection.</p> <p>Justify the value of pi by measuring circumference of circle and the diameter.</p> <p>Name points on the grid.</p> <p>Play the game, Battleship.</p>	<p>Celebrate PI day: 3/14</p> <p>Use a local map. Find regions using the map coordinates as on a real estate listing.</p>

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<p>6.09.08 Analyze quadrilaterals for defining characteristics. (9B)</p> <p><i>Significant to Develop at Grade 6:</i></p> <p>6.09.09 Perform simple constructions (e.g., equal segments, angle and segment bisectors, or perpendicular lines, inscribing a hexagon in a circle) with a compass and straightedge or a mira. (9A)</p> <p>6.09.10 Create a three-dimensional object from any two-dimensional representation of the object, including multiple views, nets, or technological representations. (9B)</p>	<p>Chart the attributes and sort the quadrilaterals.</p> <p>Perform constructions: use patty paper for segment bisector and angle bisector.</p> <p>Give a variety of nets. Challenge students to visualize the three-dimensional shape that will be formed. Fold net to justify conjecture.</p>	<p>Connect to values: Make a box from poster board using a net. Decorate the box and put a sign on it requesting people to make donations for the missions.</p> <p>In art have students create a 3-D design.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Critical for Mastery at Grade 7:</i></p> <p>7.09.01 Determine unknown angle measures using angle relationships and properties of a triangle or a quadrilateral. (9A)</p> <p>7.09.02 Draw geometric shapes with specified properties, such as side lengths or angle measures. (9A)</p> <p>7.09.03 Examine and describe line or rotational symmetry of objects in terms of transformations. (9A)</p> <p>7.09.04 Classify and order quadrilaterals according to their properties. (9B)</p>	<p>Solve open sentence problems: given two angles of the triangle, find the third angle measure.</p> <p>Draw a pair of segments of equal lengths that are perpendicular bisectors of each other. Connect the endpoints of the segments. Name the quadrilateral.</p> <p>Using cut-outs, compose several transformations on grids. Describe the end result.</p> <p>Chart the attributes and sort the quadrilaterals.</p>	<p>Make a pattern using transformations. Color to create a border for the bulletin board</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p>7.09.05 Describe, classify, and justify relationships among types of two- and three-dimensional objects using their defining properties. (9B)</p> <p><i>Significant to Develop at Grade 7:</i></p> <p>7.09.06 Perform constructions of congruent angles or parallel lines using a compass and straightedge, paper folding, or a mira. (9A)</p> <p>7.09.07 Justify the relationship between vertical angles. (9C)</p> <p>7.09.08 Make and test conjectures about the relationships between side length and angle measure in various triangles and quadrilaterals. (9C)</p> <p><i>Useful to Work on at Grade 7:</i></p> <p>7.09.09 Justify the properties of angles formed by parallel lines cut by a transversal using appropriate terminology. (9C)</p>	<p>Make a net. Fold to form the three-dimensional shape. Unfold and describe the properties.</p> <p>Use a mira to make constructions. Analyze the construction and the concept of reflection.</p> <p>Draw vertical angles on patty paper. By folding paper, show that they are congruent.</p> <p>Draw quadrilaterals on patty paper. Fold paper and test conjectures.</p> <p>If available, use Geometer’s Sketchpad to investigate parallel lines cut by a transversal. Draw a transversal on ruled notebook paper. Analyze the angles that are formed.</p>	<p>Connect to social studies: Research the construction of castles.</p> <p>In art, make a castle from shapes such as cans, boxes, balls.</p> <p>Discuss the appearance of parallel lines in art. Look at train tracks.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Critical for Mastery at Grade 8:</i></p> <p>8.09.01 Examine and describe a geometric shape, such as a regular polygon or a quadrilateral with pairs of parallel or perpendicular sides, using coordinate geometry. (9A)</p> <p>8.09.02 Draw transformations of figures in a plane to match specified criteria. (9A)</p> <p>8.09.03 Solve problems that involve vertical, complementary, and supplementary angles. (9B)</p> <p>8.09.04 Solve problems using properties of polygons and circles. (9B)</p>	<p>Map a quadrilateral on a grid. Use coordinates to find lengths of sides, slope of opposite sides.</p> <p>On a grid, draw a geometric shape. Describe a transformation and move shape. Explore the characteristics of flips, rotations.</p> <p>Write equations to solve problems about vertical, complementary and supplementary angles.</p> <p>Use wooden craft sticks and glue to model angles of various measure. A 3rd stick can be used to illustrate complementary, supplementary, and vertical angles.</p> <p>Use properties of circles to find the area of circles.</p>	<p>Connect to science: Discuss planetary motion.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p>8.09.05 Justify the area formulas for triangles, parallelograms, and trapezoids based on the formula for the area of a rectangle. (9C)</p> <p><i>Significant to Develop at Grade 8:</i></p> <p>8.09.06 Determine the relationship among the number of edges, faces, and vertices in a three-dimensional object. (9A)</p> <p>8.09.07 Determine the relationships between the number of vertices or sides in a polygon, the number of diagonals, and the sum of its angles. (9B)</p> <p>8.09.08 Create and critique arguments concerning geometric ideas and relationships, such as the number of diagonals in a polygon, or the formula for the sum of the interior angles of any polygon. (9C)</p> <p>8.09.09 Analyze the relationship between sides of right triangles using the Pythagorean theorem. (9D)</p>	<p>Using paper models, decompose a rectangle to form a trapezoid; analyze the formula for the area of a trapezoid. Do the same as above for triangles and parallelograms.</p> <p>Make a chart to sort the observations. Different groups of students analyze several types of three-dimensional figures.</p> <p>Make a chart to sort the observations. Use models to analyze the relationships. Have students derive the formulas.</p> <p>Assign several groups different polygons. Chart the result of observation on the regular polygon with respect to number of diagonals.</p> <p>Do a visual representation of the Pythagorean Theorem using tiles.</p>	<p>Determine the area of your cafeteria. How much space does each student have?</p> <p>Connect to science: Look at examples of rock and precious stone. Discuss the geometric shapes.</p> <p>Connect to technology: Use Word to create a chart in table format.</p> <p>Connect to technology: Make a chart on Excel to organize the results</p> <p>Discuss how distance is measured along a diagonal street.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
8.09.10 Solve problems that involve the use of proportions and the Pythagorean theorem in similar right triangles with whole number side lengths. (9D)	Draw a variety of right triangles. Use the Pythagorean theorem to find the length of a missing side.	Read about the history of the Pythagorean Theorem and the society of gentleman who met secretly to study math.

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Critical for Mastery at Grade 9:</i></p> <p>9.09.01 Calculate distance, midpoint coordinates, and slope using coordinate geometry. (9A)</p> <p>9.09.02 Solve pictorial or word problems that involve geometric relationships within a single geometric shape or figure, including the Pythagorean theorem. (9A)</p> <p>9.09.03 Analyze geometric situations using Cartesian coordinates. (9A)</p> <p>9.09.04 Represent, solve, and explain numerical and algebraic relationships using geometric concepts. (9C)</p> <p>9.09.05 Solve problems involving similar figures (9B)</p>	<p>Given the coordinates of two points, determine distance between the points using the distance formula. Using midpoint formula find the midpoint. Calculate the slope between the midpoint and the two given points.</p> <p>Given the length and width as variable expressions and the area as an integer, find the dimensions of the rectangle.</p> <p>Determine whether two lines are parallel, perpendicular or neither using the slope formula.</p> <p>Find the measure of an angle if the sum of the measures of its supplement and complement is 162°.</p> <p>Write a proportion using similar triangles and solve for an unknown side.</p>	<p>Overlay a geographical map with a grid and find the distance between two towns using the distance formula.</p> <p>Connect to art/design class: Plan the proper size for a drawing and the surrounding frame.</p> <p>Connect to art: Draw a picture of a shadow cast by a tree and a person walking away from tree and also casting a shadow.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Critical for Mastery at Grade 10:</i></p> <p>10.09.01 Identify possible types of two- or three-dimensional figures that would match a set of given conditions. (9A)</p> <p>10.09.02 Determine if a triangle is possible using side lengths and the triangle inequality. (9A)</p> <p>10.09.03 Create and critique arguments concerning geometric ideas and relationships such as properties of circles, triangles and quadrilaterals. (9C)</p> <p>10.09.04 Develop a formal proof for a given geometric situation on the plane. (9C)</p>	<p>Make a chart with properties of a special parallelogram (four sides congruent, opposite angles congruent, etc) across the top and types of special parallelograms down side. Ask students to check the correct properties or attributes. Use sometimes, always, never.</p> <p>Make available several sets of three straws of different lengths. Ask students to connect them end to end to form a triangle. Find the minimum and maximum length for a possible third side.</p> <p>Give students several printed circles. Ask them to draw several chords and their perpendicular bisectors in each circle. Find the center of the circle.</p> <p>Connect the midpoints of the sides of a quadrilateral and conjecture about the shape.</p> <p>Prove the properties of an isosceles triangle.</p>	<p>Connect to science: Analyze three-dimensional figures in nature. Consider lines of symmetry, rotational patterns.</p> <p>Look at pattern generated by the Fibonacci sequence.</p> <p>Construct a triangle given an adjacent side and opposite side to a given angle.</p> <p>Connect to social studies: Research how archeologists reconstruct broken plates found in ruins.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p>10.09.05 Describe and apply properties of a polygon or a circle in a problem-solving situation. (9A)</p>	<p>Make a sketch showing how to tile a floor using both squares and regular octagons.</p>	<p>Connect to science: Note how often regular polygons are found in nature.</p>
<p>10.09.06 Classify angle relationships for two or more parallel lines crossed by a transversal. (9A)</p>	<p>Cross two parallel lines with a transversal. Mark a pair of alternate interior angles with measures of $(3x+20)$ degrees and $(x+50)$ degrees.</p>	<p>Analyze and discuss the appearance of non-parallelism: for example, examine pictures of railroad tracks.</p>
<p>10.09.07 Represent, solve, and explain numerical and algebraic relationships using geometric concepts. (9C)</p>	<p>Using graph paper, draw two parallel lines and cross with a transversal. Show that the lines are parallel, the slopes are the same, the corresponding angles are congruent.</p>	<p>Research Rhiemann and Lobochevsky geometry.</p>
<p>10.09.08 Provide examples or counter-examples to either illustrate or disprove conjectures about geometric characteristics. (9C)</p>	<p>Prove or disprove that an obtuse triangle cannot contain a right angle.</p>	<p>Draw a triangle on a deflated balloon. Blow up the balloon. Discuss triangle angle sum.</p>
<p>10.09.09 Determine and justify the side length relationships present in 45°-45°-90° triangles and 30°-60°-90° triangles. (9D)</p>	<p>Given the altitude of an equilateral triangle, find the length of the side of the equilateral triangle. Repeat for isosceles right triangle.</p>	

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Learning Standard/Outcome	Sample Assessment	Connections
<p>10.09.10 Solve problems using 45°-45°-90° and 30°-60°-90° triangles. (9D)</p> <p>10.09.11 Identify and apply properties of medians, altitudes, angle bisectors, perpendicular bisectors, and mid segments of a triangle. (9A)</p> <p>10.09.12 Solve problems using triangle congruence and similarity of figures. (9B)</p> <p>10.09.13 Extend knowledge of plane figure relationships to relationships within and between geometric solids. (9B)</p> <p>10.09.14 Identify relationships among circles, arcs, chords, tangents, and secants. (9B)</p>	<p>Each side of a regular hexagon measures 10 inches. Find the lengths of the diagonals from one vertex. Repeat for a square.</p> <p>Find the center of gravity in a triangle. Analyze the Sierpinski Triangle.</p> <p>A utility pole is supported by two guy wires of equal length. Reason why or why not the wires are fastened to the ground at the same distance from the base of the pole.</p> <p>Determine if a cube can have the same number of cubic inches in volume as square inches in total area.</p> <p>Two circles of different radii are tangent. Find the length of their common external tangent.</p>	<p>Analyze the nine-point circle.</p> <p>Connect to environmental values: Connect to the career of wind prospectors.</p> <p>Build a tetrahedral kite; note the space between the tetrahedrons.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p>10.09.15 Create and critique arguments concerning geometric ideas and relationships, such as congruence, similarity, the Pythagorean relationship, or formulas for surface areas or volume of simple three-dimensional objects. (9C)</p> <p>10.09.16 Describe the difference between an inductive argument and a deductive argument. (9C)</p> <p>10.09.17 Determine distances and angle measures using indirect measurement and properties of right triangles. (9D)</p> <p>10.09.18 Create and analyze scale models using proportional reasoning. (9B)</p>	<p>Given two similar cones with a sixty degree angle made by the slant height and axis. Discuss and compare the ratio of axes, ratio of surface areas and ratio of volumes.</p> <p>Instruct students to measure the angles of several triangles using a protractor, and then form a conclusion about the sum of angles in a triangle. (inductive) Have students use parallel lines to prove that the sum of the angles of a triangle is 180. Discuss the two methods.</p> <p>A lumberjack stands 60 feet from the base of a tree and measures the angle of elevation to the top of the tree to be 60 degrees. Is the tree more than 100 feet tall?</p> <p>Draw a replica of a garden with dimensions 48 ft. by 45 ft. The scale choices are 1 in. = 2 ft., 1 in. = 3 ft., and 1 in. = 4 ft. Decide which choice is most reasonable and explain.</p>	<p>Connect to a detective murder mystery. Play the game of Clue.</p> <p>Create a problem about the line of descent for an airplane and the runways at an airport.</p> <p>Analyze a blueprint of your home.</p>

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<p><i>Significant to Develop at Grade 10:</i></p> <p>10.09.19 Solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture using geometric ideas. (9B)</p> <p>10.09.20 Represent and analyze the properties of geometric shapes using coordinate geometry. (9A)</p> <p>10.09.21 Analyze the results of a combination of reflections, rotations, and translations of a figure, and determine alternate motions that could produce the same results. (9A)</p> <p>10.09.22 Design a net that will create a given figure when folded. (9A)</p>	<p>Find the length of a golden rectangle given the width.</p> <p>Using coordinate geometry, prove that the diagonals of a square are perpendicular.</p> <p>Draw a polygon in the corner of a piece of patty paper. Fold the paper in half and then in half again. Trace the resulting image. Discuss the rotation and reflection.</p> <p>Construct a net that will form a rectangular based box with given dimensions.</p>	<p>Look at pictures of buildings constructed by the ancient Greeks. Find the golden rectangles in architecture of the past and of today.</p> <p>Learn about taxicab geometry as it relates to city planning.</p> <p>Determine the minimum length of a full length mirror necessary to see your entire image.</p> <p>How much wrapping paper is needed to wrap a large boxed package. Research the Japanese method of wrapping.</p> <p>Connect to art and culture: Create origami animals or other shapes.</p>

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<p>10.09.23 Recognize Pythagorean Triples. (9D)</p>	<p>Show that a triangle with sides that are multiples of 9, 40, and 41 is a right triangle. Explain why the sides of a right triangle cannot be 5, 6, 7.</p>	<p>Connect to history of mathematics and technology: Research the history of triples. Write a calculator program that generates Pythagorean Triples.</p>
<p>10.09.24 Develop conjectures about geometric situations with and without technology. (9C)</p>	<p>Using Geometer’s Sketchpad, list conjectures about the properties of a kite.</p>	
<p>10.09.25 Identify the basic trigonometric ratios in terms of lengths of the sides of a right triangle and an acute angle. (9D)</p>	<p>Given a 3,4,5 triangle, write the sine, cosine and tangent of each of the acute angles.</p>	
<p>10.09.26 Solve for missing side lengths using the trigonometric ratios in right triangles. (9D)</p>	<p>A guy wire is attached to the top of a 75 foot pole. The wire makes an angle of 63 degrees with the ground. Find the length of the wire.</p>	<p>Research the job of a surveyor. Connect the career to geometry.</p>
<p>10.09.27 Determine the ratio of lengths of sides of a right triangle with given measures for its acute angles using appropriate technologies. (9D)</p>	<p>A building casts a 20 foot shadow. The angle of elevation (angle of depression, angle of inclination) of the sun is 40 degrees. Find the height of the building.</p>	

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<p>10.09.28 Visualize a three-dimensional object from different perspectives and describe their cross sections. (9A)</p> <p><i>Useful to Work On at Grade 10:</i></p> <p>10.09.29 Construct a perpendicular bisector of a segment. (9A)</p> <p>10.09.30 Combine simple construction techniques to construct squares, equilateral triangles, or other simple combinations of equal segments, angles, etc. (9A)</p> <p>10.09.31 Solve problems using constructions. (9A)</p> <p>10.09.32 Analyze properties of a shape that enable it</p>	<p>Find the volume of a frustum given the parent pyramid.</p> <p>Find the area of a great circle.</p> <p>Use Geometer’s Sketchpad, if available to construct the perpendicular bisector. Prove that every point that lies on the perpendicular bisector is equidistant from the endpoints of the segment.</p> <p>Use any convenient length, construct an equilateral triangle. Explain how to construct a 30 degree angle.</p> <p>Use a map. Find the shortest path to a distant road from a marked town using a construction.</p> <p>Analyze a simple translation tessellation</p>	<p>Find examples of frustums in pictures in magazines.</p> <p>Connect to social studies: Relate the great circle with latitude and longitude lines on a globe.</p> <p>Connect to maps in geography.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p>to tessellate the plane. (9A) 10.09.33 Analyze properties of a combination of shapes that enable them to tessellate the plane. (9B)</p> <p>10.09.34 Analyze and describe the transformations that lead to successful tessellations of one or more figures. (9B)</p> <p>10.09.35 Represent transformations of an object in the plane using sketches, coordinates, and vectors. (9A)</p> <p>10.09.36 Examine the congruence or similarity of objects using transformations. (9B)</p> <p>10.09.37 Justify constructions using geometric properties. (9C)</p>	<p>by M. C. Escher. Make your own.</p> <p>Make a tessellation of the block letter F. Find other block letters that will tessellate.</p> <p>Analyze pictures of tessellations by M. C. Escher.</p> <p>Draw a non-specific quadrilateral. Find the midpoint of one of its sides. Rotate the original figure around the midpoint and describe what happens.</p> <p>Sketch the image of a figure and give the coordinates of the vertices of the image if the figure is reflected over the $y=x$ line.</p> <p>Prove that the diagonals of a parallelogram bisect each other. (Hint: use half-turns)</p> <p>Justify the construction of a segment congruent to a given segment.</p>	<p>Make tessellations in art class.</p> <p>Connect to technology and art: Create a logo using transformations of your school's name.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p>10.09.38 Justify the simple construction methods used to produce angle bisectors, perpendicular lines, and equilateral triangles. (9C)</p> <p>10.09.39 Solve problems using the Law of Sines and Law of Cosines. (9D)</p>	<p>Justify the construction of an angle bisector.</p> <p>Given an oblique triangle with lengths of three sides given, find the measures of the three angles.</p>	<p>Discuss the importance of accurate measurements in building a bridge. Build a bridge using only constructions, no ruler measurements.</p> <p>Connect to Physics: Enter bridge building contest.</p> <p>Find the area of a plot of land in the shape of a non-specific quadrilateral.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Critical for mastery at Grade 11:</i></p> <p>11.09.01 Draw the image of an object after a combination of transformations. (9A)</p> <p>11.09.02 Gain insights into, and answer questions in, other areas of mathematics using geometric models. (9A)</p> <p>11.09.03 Visualize a three-dimensional object from different perspectives and describe their cross sections. (9A)</p> <p>11.09.04 Apply properties of two- and three-dimensional models to solve problems. (9A)</p>	<p>To practice making a figure eight, a figure skater will skate along two circles etched in the ice. Draw the path of a skater on two externally tangent circles that are 6 feet in diameter so that the center of one circle is at the origin and the center of the other circle is on the positive y-axis.</p> <p>A candy factory needs a box that has a volume of 30 cubic inches. The width should be 2 inches less than the height and the length should be 5 inches greater than the height. Find the dimensions.</p> <p>Intersect a double-napped cone with a plane. Describe the intersections that form an ellipse, circle, parabola and hyperbola. Use patty paper to fold a circle, ellipse, etc. Discuss shapes.</p> <p>A cellular phone transmitter is located 8 miles north and 4 miles west of your house and has a range of 20 miles. A second tower is located 4 miles east and 8 miles south of your house with a range of 10 miles. Is your house covered by both</p>	<p>Create a frieze pattern to use as a border on an invitation to a party or event.</p> <p>Connect to theater: Help design the stage for the school play.</p>

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<p>11.09.05 Solve problems using relationships between and among figures. (9B)</p>	<p>regions overlapping?</p> <p>A quilt is made up of strips of cloth, starting with an inner square surrounded by rectangles to form successively larger squares. If the inner square and all surrounding rectangles have a width of 1 foot, find an expression using summation notation that will give the sum of the areas of all of the strips of cloth used to make a square quilt of size n by n.</p>	
<p>11.09.06 Represent and describe with the language of geometry intersections and cross sections of three-dimensional objects. (9B)</p>	<p>Aim a flashlight perpendicular to a wall, describe the image. Aim a flashlight at a wall with flashlight held at an angle, describe the image. What is the geometric shape of the light from the flashlight?</p>	
<p>11.09.07 Provide a counter-example to disprove a conjecture. (9C)</p>	<p>Show that not all 2×2 matrices are invertible.</p>	
<p>11.09.08 Prove conjectures about geometric figures on the plane or in space using coordinate geometry. (9C)</p>	<p>On a coordinate system, draw a quadrilateral. Join the midpoints of the sides of the quadrilateral. Prove that the figure formed by connecting the midpoints of the sides with</p>	<p>Connect to narrative proof, such as debaters use. Discuss the differences and similarities. How can mathematical proof help debaters?</p>

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<p><i>Significant to Develop at Grade 11:</i></p> <p>11.09.09 Identify the basic trigonometric ratios in terms of lengths of the sides of a right triangle and an acute angle. (9D)</p> <p>11.09.10 Solve for missing side lengths using the trigonometric ratios in right triangles. (9D)</p> <p>11.09.11 Determine and justify the side length relationships present in 45°-45°-90° triangles and 30°-60°-90° triangles. (9D)</p> <p>11.09.12 Determine distances and angle measures using indirect measurement and properties of right triangles. (9D)</p> <p>11.09.13 Solve problems using 45°-45°-90° and 30°-60°-90° triangles. (9D)</p> <p>11.09.14 Solve problems using the Law of Sines and Law of Cosines. (9D)</p>	<p>segments is a parallelogram</p> <p>Evaluate the six trigonometric functions of the acute angles in a right triangle.</p> <p>Find the value of the side of a right triangle given the length of one of the sides and given the measure of one of the acute angles.</p> <p>Using a unit circle, find the coordinates on the circle associated with angles of measures 30, and 45 degrees and their multiples.</p> <p>Find the distance from an airplane at an altitude of 30000 ft. to the airport if the angle of depression is 70 degrees.</p> <p>Without a calculator, find the area of a regular hexagon with apothem 8.</p> <p>Solve an obtuse triangle given two sides and a non-included angle. Find the area.</p>	<p>Research the career of surveyor. Find out how the transit works.</p> <p>Using a map, find the distance traveled from school to home using several triangles and Law of Sines, Law of Cosines.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Critical for Mastery at Grade 12:</i></p> <p>12.09.01 Analyze geometric situations using Cartesian coordinates and other coordinate systems such as navigational, polar, or spherical systems. (9A)</p> <p>12.09.02 Represent transformations of an object in the plane using function notation and matrices. (9A)</p> <p>12.09.03 Represent and describe with the language of geometry real-life objects, paths and regions in space. (9A)</p> <p>12.09.04 Extend the ideas of formal and informal proof to non-geometric situations. (9C)</p>	<p>Show that the graph of the equation $r=2a \sin\theta$ with $a>0$ is a circle of radius a and center at $(a,0)$, in rectangular coordinates.</p> <p>Describe the transformation formed by $y=cf(x-b)$</p> <p>Ellipses are the paths of planets and comets around the Sun. Describe the orbit of Earth if it has a semi-major axis of 149.598 Gm and an eccentricity of 0.0167.</p> <p>Reason through a solution in paragraph proof form.</p> <p>Using mathematical induction, prove: <i>3 is a factor of $n^3 + 2n$.</i></p>	<p>Explain how a global positioning system locates people in trouble.</p> <p>Connect to physics and the study of circuits.</p> <p>Visit Adler Planetarium. Give a report about the orbits using mathematical terms.</p> <p>Join the debate team. Read the Lincoln-Douglas Debates.</p>

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State Goal 9: Use geometric methods to analyze, categorize and draw conclusions about points, lines, planes and space.

Learning Standard/Outcome	Sample Assessment	Connections
<p>12.09.05 Describe the difference between an inductive argument and a deductive argument. (9C)</p> <p>12.09.06 Relate vector representation and trigonometric functions. (9D)</p> <p>12.09.07 Solve problems using vectors. (9D)</p> <p>12.09.08 Relate circular functions, arcs, and radian measure to triangle trigonometry and degree measure. (9D)</p> <p>12.09.09 Simplify expressions and solve problems using trigonometric identities. (9D)</p>	<p>Explain the Principle of Mathematical Induction.</p> <p>An airplane is flying on a bearing of 170 degrees at 460 mph. Find the component form of the velocity of the airplane.</p> <p>A force of 50 lb. acts on an object at an angle of 45 degrees. A second force of 75 lb. acts on the object at an angle of -30 degrees. Find the magnitude of the resultant force.</p> <p>Find $\sin \theta$ and $\tan \theta$ if $\cos \theta = 2/3$ and $\cot \theta$ is positive.</p> <p>Simplify: $\sqrt{1 - x^2}$, given $x = \cos \theta$</p>	<p>Explain how vectors are used in the Physics course</p> <p>Find out how a sailor analyzes the effect of wind using vectors.</p>

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<p>12.09.10 Solve trigonometric equations using circular functions. (9D)</p> <p>12.09.11 Identify key characteristics of graphs of trigonometric functions and their inverses. (9D)</p> <p>12.09.12 Graph trigonometric functions using translations and dilations. (9D)</p> <p>12.09.13 Graph a given trigonometric function using its characteristics (e.g., period, amplitude). (9D)</p>	<p>Solve: $\cos^2 \theta + \cos \theta = \cos 2\theta$, for $[0, 2\pi]$</p> <p>Analyze the graph of $y = \sin x$, $y = \arcsin x$</p> <p>Analyze the graph of $y = 5 \cos\left(3x - \frac{\pi}{6}\right) + 0.5$</p> <p>Construct and graph a sinusoid with amplitude of 3, period of π, and point on graph of $(0, 0)$.</p>	<p>Research the National Oceanic and Atmospheric Administration and tides. Relate a trigonometric function with data that fits the tide behavior in Juneau, AL.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><i>Significant to Develop at Grade 12:</i></p> <p>12.09.14 Develop formal and informal proofs for three-dimensional figures. (9C)</p> <p>12.09.15 Rotate conic sections using trigonometric functions. (9D)</p>	<p>Using direction angles of vectors in space (α is the angle between \mathbf{v} and the positive x-axis, β is the angle between \mathbf{v} and the positive y-axis, and γ is the angle between \mathbf{v} and the positive z-axis, prove the Property of Direction Cosines: $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$</p> <p>Express the equation $xy=1$ in terms of new $x' y'$ – coordinates by rotating the axes through an angle of 45 degrees.</p>	