Informal Geometry

MA.912.D.6.In.a **Determine whether "if, then" statements for common events in real-world situations are true or false.**

If, Then Discuss the meaning of "if, then" statements with students. Provide several common situations and ask students to explain the meaning of the statement and to determine if the statement is true or false by giving examples and counter-examples. Ask students to write their explanations in a math journal. Several examples of "if, then" statements are provided below.

1. If the menu lists potato, tomato, and bean soup, then Marcella must order tomato soup with her dinner. False; She can also order potato soup, bean soup, or no soup.
2. If the landlord says that rent for May is due on the May 1, then the rent is late if it is paid on May 3. True; May 3 comes after May 1, so the rent will be considered late on May 3.
3. If Justine, Marcus, Armando, and Felicia are the only members of their bowling team, then Anna is not a member of their bowling team. True; Anna cannot be a team member since only Justine, Marcus, Armando, and Felicia are on the team.

MA.912.D.6.Su.a **Use pictures and objects to determine whether statements about common events in real-world situations are true or false.**

Yearbook Use the latest class yearbook to create "if, then" statements. Provide real-world "if, then" statements about such information as the page number where group pictures can be found or the names of students in a particular club or on a sports team. Ask students to explain the meaning of the statement and to determine if the statement is true or false by giving examples and counter-examples. Ask students to write their explanations in a math journal.

MA.912.D.6.Pa.a **Recognize whether the solution to problems involving quantities to 10 in real-world situations is correct or incorrect.**

Check Solutions Challenge students to solve a real-world problem, such as the clothing drive problem below, using mental math or paper-and-pencil methods. Then have them use manipulatives or a different problem-solving strategy to check their solution.

CLOTHING DRIVE Latoya is collecting coats for a clothing drive. She wants to collect a total of 10 coats. To date, she has collected 6 coats. How many more coats does Latoya need to collect to reach her goal? 4 coats

Possible checks for the stated problem include:

- Using 6 connecting cubes to represent the collected coats and adding one cube at a time to reach the goal of 10 coats.

- Applying the work backward problem-solving strategy by starting with 10 and counting backward 6 to 4.

Have students present their methods for checking solutions.

MA.912.G.1.In.a **Find the length and midpoint of line segments in real-world situations.**

Materials: picture frames, rulers, maps

Real-Life Measures Students can work alone or in pairs. Ask students to find the length of one side of an 8 x 10 picture frame. Next, have them find the midpoint along the "top" of the picture frame in order to determine the place to set the hanger. How would their answer change if they turned the frame?

Repeat this activity using a variety of real-world examples. Another option is to ask students to plan a long-distance trip and decide to stop at a city at the midpoint. For example, the distance between Dayton, OH and Sarasota, FL is about 1,000 miles. How far should they travel before stopping at the midpoint? Provide students with maps and rulers and encourage them to calculate the distance using the map's key.

MA.912.G.1.In.b **Locate angles formed when a line intersects two parallel lines and classify the angles as obtuse, acute, or right angles.**

Using Grid Paper Emphasize to students that grid paper is a good manipulative for identifying angles as acute, obtuse, or right. Show students how to align one corner of a grid box with the vertex of the angle, and how to align one ray of the angle with a line of the grid (which includes the vertex). Students can use the grid boxes to determine if the angle is less than 90° (acute), equal to 90° (right), or greater than 90° (obtuse).

Next, have students draw parallel lines on the grid paper and then draw one line that intersects both of the parallel lines (called a transversal). Students should locate 8 separate angles. Students will then be able to determine if each of the angles created are acute, right, or obtuse. Ask students to compare the angles and note any similarities between the angles.

MA.912.G.1.Su.a **Determine the midpoint of a line.**

Midpoint Provide each pair of students with a six-inch paper ruler. Explain to students that a ruler can be seen as a line segment. Ask them to identify the number in the middle of the ruler and explain that the point in the middle of the line segment is called the midpoint.

Ask students to explain why 3 is a good guess for the midpoint. Students should recognize that $6 \div 2 = 3$. Students can check their answers by folding the ruler in half. (Be certain that the edges of the ruler are marked as zero and 6 inches, as some rulers start the zero mark about an eighth-inch away from the edge.)

This activity can be repeated using other common “linear” objects, such as plastic straws, pipe cleaners, and ribbon. First, ask students to measure the length of the object. Then, instruct them to determine the midpoint by using division before folding the object into two equal parts.

MA.912.G.1.Su.b **Differentiate between intersecting and parallel lines.**

Real-World Examples Provide students with a variety of real world examples that show parallel and intersecting lines. Street maps of downtown areas often show parallel and intersecting streets in a grid pattern. Other examples, such as railroad tracks, bookshelves, and architectural drawings can also be used.

MA.912.G.1.Su.c **Match types of angles, such as obtuse, acute, and right angles, using physical models and drawings.**

Using Grid Paper Emphasize to students that grid paper is a good manipulative for identifying angles as acute, obtuse, or right. Show students how to align one corner of a grid box with the vertex of the angle, and how to align one ray of the angle with a line of the grid (which includes the vertex). Students can use the grid boxes to determine if the angle is less than 90° (acute), equal to 90° (right), or greater than 90° (obtuse). Choose grid paper with a lighter weight so that the angles can be seen through the grid paper. Use the grid paper to match sets of two congruent drawings of various angles, such as obtuse, acute, and right angles.

MA.912.G.1.Pa.a **Recognize the ends and middle of a line.**

Midpoint and Ends Provide each pair of students with a six-inch paper ruler. Explain to students that a ruler can be seen as a line segment. Ask them to identify the numbers at each end and the number in the middle of the ruler. Explain that the point in the middle of the line segment is called the midpoint.

Ask students to explain why 3 is a good guess for the midpoint. Students should recognize that $6 \div 2 = 3$. Students can check their answers by folding the ruler in half. (Be certain that the edges of the ruler are marked as zero and 6 inches, as some rulers start and end about an eighth-inch away from the edge.)

This activity can be repeated using other common “linear” objects, such as plastic straws, pipe cleaners, and ribbon. First, ask students to measure the length of the object by identifying the ends of the “line.” Then, instruct them to determine the midpoint by using division before folding the object into two equal parts.

MA.912.G.1.Pa.b **Recognize angles in two-dimensional shapes.**

Angles Draw Diagram *A* on the board.

Diagram *A*

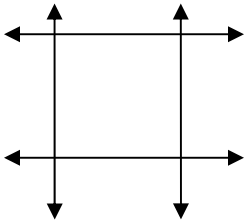
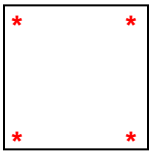


Diagram *B*



Ask students to identify the two-dimensional figure that is created when these lines intersect. A square is created.

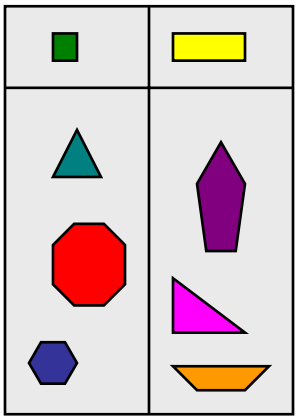
Next, indicate the vertices of the square, or the points at which the lines intersect. Students may also find it helpful to label the vertices as *A*, *B*, *C*, and *D*. Erase the arrow heads to leave only the four line segments that created the square. Explain how to identify the four angles of the square, using the vertices, by placing a small star inside each vertex. (See Diagram *B*.)

Allow student pairs to create two-dimensional figures using grid paper. Ask them to place a small star inside each vertex. Finally, encourage students to identify the figure according to the number of angles. Allow them to use a reference chart or table that names the figures, if necessary.

MA.912.G.2.In.a **Determine if polygons have all sides and angles equal (regular) or have sides or angles that are not equal (irregular) using physical and visual models.**

Materials: cut-out figures, rulers, sorting mats

Equal Lengths Provide students with various cut-out shapes. Provide a mixture of regular and irregular polygons. Begin using familiar figures such as squares and rectangles (that are not squares). Ask students to explain the difference between a square (with sides equal to 3 inches) and a rectangle (with a length equal to 3 inches and a width equal to 5 inches). Students should notice that the rectangle has "long" sides and "short" sides, but that all the sides of a square are equal in length.



Ask them to use rulers and the cut-out shapes to sort the figures into "regular" shapes like the square, and "irregular" shapes, like the rectangle. Provide a sorting mat with a square on the left and a rectangle on the right. Students can glue the cut-out shapes to the correct side of their sorting mat.

MA.912.G.2.In.b **Use tools to measure angles including 45° and 90°.**

Real-World Triangles Provide students with pictures of architecture from around the world. Have students find examples of triangles in the buildings. Include examples which have 45° and 90° angles. Students should trace the triangles onto a sheet of paper. Prompt students to classify the triangles by their sides and angles. Then have the students measure the angles with their protractors.

MA.912.G.2.In.c **Identify triangles and rectangles that are the same shape and size (congruent) and same shape, but not same size (similar) using physical and visual models.**

Flexible Rulers Students can use rulers to determine the length and width of rectangles, and the lengths of the sides and angle measures of triangles. They can compare the sizes of figures based upon measurements.

On-hand manipulatives, such as number cubes from a board game, can also be used to determine the length and width of rectangles and the length of the sides of triangles.

MA.912.G.2.In.e **Find the perimeter and area of rectangles to solve real-world problems.**

State Areas Provide students with a map of the United States. Determine the scale of the map. Using square tiles, have students create and write a plan to determine the area of a state. Students should then use their plans to find the area of a state. States that resemble parallelograms, such as Colorado and Tennessee, may be easiest to determine area.

MA.912.G.2.Su.a **Identify polygons with all sides and angles equal (regular) in the environment.**

Regular Polygons Define regular polygons. Show students examples of pattern blocks, attribute blocks, or cut-out shapes. Demonstrate measuring the lengths of the sides, and the size of the angles using a ruler and a protractor.

Provide students with magazines and newspapers, as well as real-world objects. Ask them to find examples of regular polygons. Street signs, CD cases, self-stick notes, and square picture frames are a few real-world examples of regular polygons. When appropriate, have students measure the lengths of the sides and the size of the angles using rulers and protractors.

MA.912.G.2.Su.b **Use a model of a right triangle to compare the size of angles, such as acute, obtuse, and right angles.**

Useful Tool Draw a right triangle on a sheet of paper. Have student determine if the angles are larger than 90˚, smaller than 90˚, or equal to 90˚. You can use the corner of an index card to show a 90˚ angle. You can also use a protractor. Angle measures from 0˚ to 180˚ are labeled. A protractor will assist students in determining how to classify a triangle by its angle measures.

MA.912.G.2.Su.c **Match triangles and rectangles that are same shape, but different size (similar) using physical and visual models.**

Size and Shape Students may not understand the difference between *size* and *shape*.

1. Have students identify objects in the room that are examples of "same size" and "different sizes."

2. Discuss that shape refers to the way the sides in a figure are arranged.

Hold up a triangle. **What is the shape of this figure?** triangle

Hold up a rectangle. **What is the shape of this figure?** rectangle

3. Emphasize that the number of sides on each figure is different which makes the shape of the figures different. Ask students to identify objects in the room that are the same and different shapes.

MA.912.G.2.Su.e **Solve real-world problems involving perimeter using visual models.**

Grid Paper Provide students with grid paper and a real-world problem, like the one shown below. Allow students to draw a diagram using the grid paper. Remind students that the perimeter is the distance around a shape or region. Have them count the length of each side to determine the perimeter. Then, ask them to write a number sentence that could be used to find the perimeter.

FENCING Marla wants to place a fence around the outside of her vegetable garden to keep the rabbits from eating her carrots. Her rectangular garden is 4 feet long and 3 feet wide. How many feet of fencing will Marla need to build her fence?
14 feet; 4 + 3 + 4 + 3 = 14

MA.912.G.2.Su.f **Solve real-world problems to find area of a rectangle to identify total square units using visual models.**

Grid Paper Provide students with grid paper and a real-world problem, like the one shown below. Allow students to draw a diagram using the grid paper. Remind students that the area is the number of square units needed to cover a region or plane figure. Have them count the number of square units to determine the area. Then, ask them to write a number sentence that could be used to find the area.

GARDENS Marla wants to plant vegetable garden in her backyard. Her rectangular garden is 4 feet long and 3 feet wide. What is the area of Marla's garden? 12 square feet; 4 × 3 = 12

MA.912.G.2.Pa.a **Identify objects or pictures with polygons.**

Polygon Collage Allow students to cut out pictures from magazines and newspapers that show examples of different polygons. They may choose to cut out photos of CD cases to show squares, or picture frames to show rectangles.

If necessary, provide a work mat with a sample of different polygons. Place examples of polygons, such as squares, rectangles, pentagons, and hexagons, in columns at the top of the mat. Ask students to glue pictures of real-world objects in each column that exemplify each of these shapes.

MA.912.G.2.Pa.b **Match two or more objects with polygons based on a given feature in real-world situations.**

Manipulative Storage Different math manipulatives often come in various-shaped storage containers. For instance, rectangular fraction strips are often stored in rectangular boxes and memo cubes are comprised of square sheets of paper. Encourage students to compare the lid or the base of the storage container with the two-dimensional shape of the math manipulative. Consider using other storage containers and household items as additional examples.

MA.912.G.2.Pa.c **Identify objects, pictures, or signs with polygons in real-world situations.**

Safety Walk Take a short walk around the school campus. Point out various signs that are used to promote safety as you walk. Encourage students to describe the shape of the signs and include information about the number of sides of each sign.

Show students photos from magazines, newspapers, or other printed media. Encourage students to compare the shapes of various street and road signs, such as yield signs, stop signs, county road markers, and no parking signs. Ask students to identify the shape of each sign.

MA.912.G.3.In.a **Identify four-sided shapes (quadrilaterals), such as square, rectangle, rhombus, and diamond, in the environment using visual models.**

Classify Quadrilaterals Provide a table to students that helps them to classify and name quadrilaterals.

Quadrilateral	Sides	Angles
Trapezoid	one set of parallel sides	
Parallelogram	two sets of parallel sides	
Rhombus	two sets of parallel sides; four congruent sides	
Rectangle	two sets of parallel sides	four right angles
Square	two sets of parallel sides; four congruent sides	four right angles

Distribute a variety of cut-out quadrilaterals cut from paper or cardstock. Ask students to classify the quadrilaterals based on the information from the chart.

Finally, ask students to identify different quadrilaterals found in the classroom. Students should draw these objects, classify the quadrilateral, and explain the classification in a math journal.

MA.912.G.3.Su.a **Identify four-sided shapes (quadrilaterals), such as square, rectangle, and diamond, in the environment using physical and visual models.**

Classify Quadrilaterals Provide a table to students that help them to classify and name different quadrilaterals.

Quadrilateral	Sides	Angles
Square	two sets of parallel sides; four congruent sides	four right angles
Rectangle	two sets of parallel sides; two sets of congruent sides	four right angles
Diamond (Rhombus)	two sets of parallel sides; four congruent sides	

Distribute a variety of cut-out paper or cardstock quadrilaterals. Ask students to classify the quadrilaterals based on the information from the chart.

Finally, ask students to identify different quadrilaterals found in the classroom. Students should draw these objects, classify the quadrilateral, and explain the classification in a math journal.

MA.912.G.3.Pa.a **Identify objects, pictures, or signs with four-sided shapes (quadrilaterals) in real-world situations.**

Classify Quadrilaterals Distribute a variety of cut-out paper or cardstock quadrilaterals, including squares, rectangles, and rhombi. Ask students to describe the similarities and differences between these figures.

Finally, ask students to identify different quadrilaterals found in the classroom. Students should draw a picture of these objects, and describe the shape of the object in a math journal. Ask students to number the sides of each object that was drawn in their math journals.

MA.912.G.3.Pa.b **Match two or more objects with four-sided shapes (quadrilaterals), based on a given feature, such as length of side or size of the area.**

Materials: rulers, a variety of cut-out rectangles and squares on paper or cardstock, real-world objects

Match Quadrilaterals Distribute a ruler, a variety of cut-out rectangles and squares, and several real-world objects to each pair of students. Use real-world objects, such as a self-stick note or a greeting card. Make sure that one of the cut-out shapes is congruent to each real-world object.

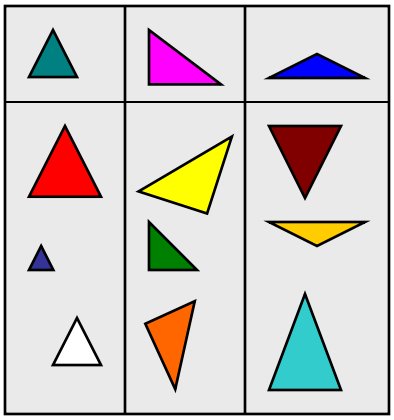
Students should compare the length of each side of the paper figures with the length of each side of various real-world objects using a ruler. Ask students to match the cut-outs to a real-world object based on lengths of the sides.

As an extension to this activity, students can also calculate the area of different cut-out figures and real-world objects. Have them identify which figures and objects have equivalent area. Use at least one pair that has an equal area, but a different shape, such as a square that is 4 inches by 4 inches, and a rectangle that is 2 inches by 8 inches.

MA.912.G.4.In.a **Discriminate between triangles that have equal sides and angles (equilateral), triangles that have two equal sides and two equal angles (isosceles), and triangles that have one right angle (right triangle) using visual and physical models.**

Materials: protractors, rulers, triangle cut-outs, sorting mat

Equal Lengths Provide students with various cut-out triangles, including equilateral, isosceles, and right triangles, made from paper or cardstock.



Ask students to use rulers to measure the length of each side of the cut-out triangles. Students should use protractors to measure each angle of the triangles. Allow them to write their measurements on the triangles. Finally, have students sort the figures into three categories; equilateral, isosceles, and right. Provide a sorting mat with one column for each type of triangle. Students can glue the cut-out shapes to the correct column of their sorting mat.

Triangles Create a set of three index cards. On each card, draw an image of an isosceles triangle, an equilateral triangle, and a scalene triangle. Arrange students into pairs and give each group a geoboard. Have one student select an index card. The other student makes the figure on the geoboard. Point out that finding an angle measure on a geoboard is difficult, so try to classify the figures by side lengths and parallel sides.

MA.912.G.4.In.b **Identify the height (altitude) in equilateral and isosceles triangles using physical and visual models.**

Number Cubes Have students measure the height of equilateral and isosceles triangles using number cubes. Provide construction paper cutouts of equilateral and isosceles triangles of various sizes. They should line the cubes up along the altitude and count the number of cubes to determine the measurement. The can use grid paper or the corner of a rectangular piece of paper to create a right angle from the vertex of the correct angle to the midpoint of the correct side. Students can compare the sizes of triangles based upon the number cube measurements.

MA.912.G.4.In.c **Measure sides and angles of triangles to determine whether triangles are the same size and shape (congruent) or the same shape, but different size (similar).**

Materials: index cards, flexible rulers

Comparing Size Prepare a set of index cards by drawing or printing triangles of different sizes on each card. Give groups of 3 or 4 students a set of index cards and flexible rulers.

- Have 2 students each select a card. Ask them to decide whether the figures are the same or different in size.
- Have the students use rulers and protractors to measure the triangles to see if they are correct. Tell them to keep track of whether their guesses were correct or incorrect.

MA.912.G.4.Su.a **Discriminate between triangles that have equal sides and angles (equilateral) and triangles that have two equal sides and two equal angles (isosceles) using physical models.**

Geoboards Draw or print pictures of isosceles and equilateral triangles on index cards, write the name of the triangle on the card. The student turns over a card with the name of a figure and says the name. The student models the figure on a geoboard. Students should then compare the figure on the card to the model on the geoboard to see if they match.

MA.912.G.4.Su.b **Measure the length of sides of triangles to verify if two triangles are the same shape and size (congruent).**

Materials: centimeter rulers, pairs of triangle cut-outs

Congruent Triangles Provide students with various pairs of cut-out triangles. Be sure to include pairs of right triangles, isosceles triangles, scalene triangles, and equilateral triangles. If possible, choose triangles that can be measured to a whole centimeter. Have students use centimeter rulers to measure each side of each triangle. Encourage students to mark the measurements along the correct side of each triangle. Finally have students compare the lengths of the sides in order to determine which triangles are congruent.

MA.912.G.4.Pa.a **Identify objects, pictures, or signs with a triangle in real-world situations.**

Materials: paper, scissors, glue, magazines

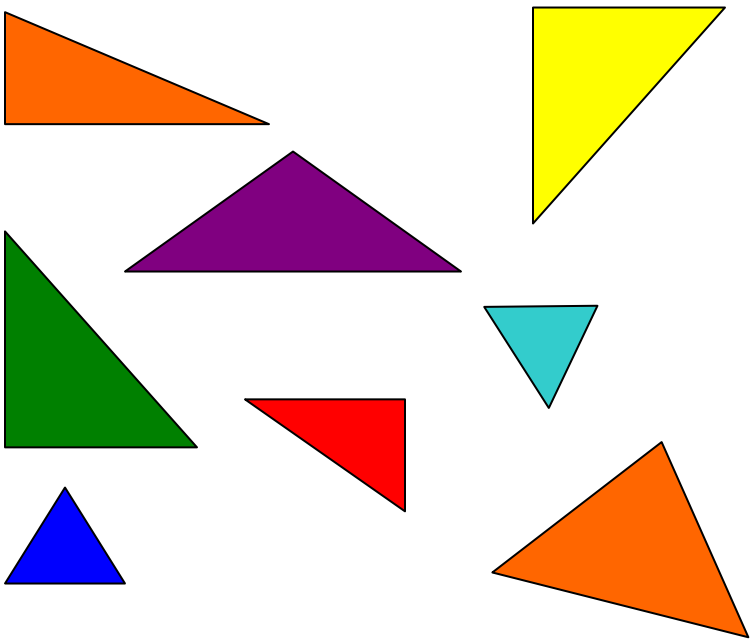
Shape Search

- Have students look through magazines to find pictures of objects containing triangles.
- When students find a triangle, have them cut it out and glue it on their paper.
- Encourage students to explain their choices and allow them to share their work with a partner.

MA.912.G.4.Pa.b **Match two or more objects with a triangle based on a given feature, such as the length of the side or the size of the angle, to complete tasks in real-world situations.**

Side Lengths and Angle Measures Students work in pairs to match triangles according to side lengths and angle measures. Provide each pair of students with a set of triangles, such as those shown below. You may wish to include right triangles in the set. Some triangles have equal side lengths while other triangles have equal angle measures.

Instruct students to find triangles that have equal side lengths. Students can cut out figures and physically match up congruent sides or measure triangle side lengths with a ruler. Students using a ruler can be challenged to find sides with specified lengths. Then instruct students to find triangles with equal angle measures.



MA.912.G.5.In.a **Compare the length of the straight sides in a right triangle with the length of the side opposite the right angle (hypotenuse).**

Materials: grid paper, rulers, right triangle cut-outs

Right Triangles Distribute rulers, grid paper, and cut-outs of various sizes of right triangles. Use common right triangles that are easily measured, such as a triangle with sides that measure 3 inches, 4 inches, and 5 inches.

Emphasize to students that grid paper is a good manipulative for identifying angles as acute, obtuse, or right. Show students how to align one corner of a grid box with each vertex of the triangle, and how to align one side of the triangle with a line of the grid (which includes the vertex). Students can use the grid boxes to determine which angle is the right angle.

Provide a model of a right triangle which shows the right angle and the hypotenuse labeled. Once students have identified the right angle, have them find the hypotenuse. Ask students to measure the length of the hypotenuse using the ruler. Next, have students measure the length of the other two sides (legs). Students should compare the length of the hypotenuse with the lengths of the other two sides of each triangle. Have them note any patterns they find.

MA.912.G.5.In.b **Identify examples of different kinds of right triangles in the environment using physical models.**

Materials: protractors, right triangle cut-outs, real-world right triangle examples

Right Triangles Distribute protractors, real-world right triangle examples, and cut-outs of various types of right triangles. Use common right triangles that are easily measured, such as a triangles with angles that measure 30°-60°-90° and 45°-45°-90°.

Emphasize to students that the paper cut-outs are good manipulatives for comparing angles. However, to find exact angle measures, student should use the protractors. Show students how to properly use the protractors and paper cut-outs to measure and compare angles.

Once students are comfortable measuring and comparing angles, have them use these tools to evaluate different real-world examples. Provide various examples, such as sketches of roof trusses, children's toys, or decorating tiles. Ask students to identify the type of right triangle by measuring or comparing the measures of the angles.

MA.912.G.5.Su.a **Identify right triangles in the environment using physical models.**

Materials: right triangle cut-outs, real-world right triangle examples

Right Triangles Emphasize to students that the paper cut-outs are good manipulatives for comparing angles. Point out that each right triangle has exactly one right angle. Encourage students to identify and mark each right angle using the appropriate symbol.

Once students are comfortable identifying right angles, have them evaluate different real-world examples. Provide various examples, such as sketches of roof trusses, children's toys, or decorating tiles. Ask students to identify a right triangle by finding the right angle.

MA.912.G.5.Su.b **Locate the right angle of right triangles and side opposite the right angle (hypotenuse) in the environment.**

Materials: grid paper, rulers, right triangle cut-outs

Right Triangles Distribute rulers, grid paper, and cut-outs of various sizes of right triangles. Have students use these tools to identify the right angle and the hypotenuse of the triangles.

Emphasize to students that grid paper is a good manipulative for identifying angles as acute, obtuse, or right. Show students how to align one corner of a grid box with each vertex of the triangle, and how to align one side of the triangle with a line of the grid (which includes the vertex). Students can use the grid boxes to determine which angle is the right angle.

Provide a model of a right triangle which shows the right angle and the hypotenuse labeled. Once students have identified the right angle, have them find the hypotenuse. Use common right triangles that are easily measured, such as a triangle with sides that measure 3 inches, 4 inches, and 5 inches. Students should compare the length of the hypotenuse with the lengths of the other two sides of each triangle. Have them note any patterns they find.

MA.912.G.5.Pa.a **Identify objects, pictures, or signs with a right triangle.**

Materials: right triangle cut-outs, real-world right triangle examples

Right Triangles Emphasize to students that the paper cut-outs are good manipulatives for comparing angles. Point out that each right triangle has exactly one right angle. Encourage students to identify and mark each right angle using the appropriate symbol.

Once students are comfortable identifying right angles, have them evaluate different real-world examples. Provide various examples, such as sketches of roof trusses, children's toys, or decorating tiles. Ask students to identify a right triangle by finding the right angle.

MA.912.G.5.Pa.b **Match objects, pictures, or signs with a right triangle by a given feature, such as length of sides.**

Materials: rulers, a variety of cut-out triangles on paper or cardstock, photos of real-world objects

Match Triangles Distribute a ruler, a variety of cut-out triangles, and several photos of real-world objects to each pair of students. Use photos of real-world objects, such as a bridge's trusses. Make sure that one of the cut-out shapes is congruent to each photo.

Students should compare the length of each side on the paper figures with the length of each side of various photos of real-world objects using a ruler. Ask students to match the cut-outs to a photo based on lengths of the sides.

MA.912.G.6.In.a **Identify and describe the circumference, arc, diameter, and radius of circles using physical and visual models.**

Materials: protractors, rulers, circle cut-outs

Explore Vocabulary Draw a circle on the board and ask a student volunteer to identify the diameter of the circle with arrows and blue chalk. Have another student identify the radius of the circle with arrows and red chalk. Finally have another student identify the circumference of the circle with arrows and green chalk. Name points along the circumference of the circle and explain how to name arcs of a circle. Show how to use pi (π) and the other vocabulary words to find the circumference of a circle. It may be helpful to put the information in a chart and post it in the classroom for students to reference.

Have students work in pairs or small groups. Allow students to explore circle concepts with cut-outs made from paper or cardstock. Color-code the cut-outs so that the measures of each color can be easily checked. For example, distribute congruent red circles to each group. Red circles will have a radius of equal measure (such as 3 inches) and *A*, *B*, and *C* marked along the same points of the circle's circumference. Therefore, all arcs on each red circle will be congruent. Have students record the measurements for each circle in their math journals.

MA.912.G.6.In.b **Measure the diameter and radius of circles to solve real-world problems.**

Circles for Partners Arrange students into pairs and give each pair a circular real-world object, such as a CD, a storage container, or a dinner plate. Instruct the pair to find the center of the circle and to measure the diameter and the radius. Provide a real-world situation in which knowing these measurements would be helpful, such creating a case for the CD or finding space in a cabinet for the storage container or the dinner plate.

Advise students that you will be collecting their results, and tell them to record their work in their math journals. When all pairs are done and the work is collected, ask for volunteers to share their work. Ask students to explain their results.

MA.912.G.6.Su.a Identify the circumference, arc, and diameter of circles in real-world situations.

Materials: protractors, rulers, circle cut-outs

Explore Vocabulary Draw a circle on the board and ask a student volunteer to identify the diameter of the circle with arrows and blue chalk. Have another student identify the circumference of the circle with arrows and green chalk. Name points along the circumference of the circle and explain how to name arcs of a circle. Show how to use pi (π) and the other vocabulary words to find the circumference of a circle. It may be helpful to put the information in a chart and post it in the classroom for students to reference.

Have students work in pairs or small groups. Allow students to explore circle concepts with cut-outs made from paper or cardstock. Color-code the cut-outs so that the measures of each colored circle can be easily checked. For example, distribute congruent red circles to each group. Red circles will have a diameter of equal measure (such as 3 inches) and *A*, *B*, and *C* marked along the same points of the circle's circumference. Therefore, all arcs on each red circle will be congruent. Have students record the measurements for each circle in their math journals.

Use real-world examples of circumference, art, and diameter, such as marks on a basketball court, or within a circular space, such as the rotunda of a building or a gazebo.

MA.912.G.6.Su.b Compare the circumference and diameter of circles in real-world situations.

Materials: yarn, scissors, rulers, real-world circular objects

Circles Arrange students into pairs and give each pair a circular real-world object, such as a CD, a storage container, or a dinner plate. Instruct the pair to find the center of the circle and to cut a piece of yarn that is equal to the measure the diameter. Next, have students use the yarn to find the distance around the outside of the circle (the circumference). Finally, ask students to use rulers to measure the length of the diameter and the length of the circumference. Allow students to round measurements to the nearest centimeter.

Ask students to measure several different circular objects and to record their measurements in a table. They should compare the measurements of the diameter and circumference and note any patterns they find. Students should notice that the circumference is about 3 times the length of the diameter.

MA.912.G.6.Pa.a **Identify objects, pictures, or signs with a circle in real-world situations.**

Circle Rhymes Students may benefit from learning or making up a rhyme about circles. For example, you may teach students to say, “No sides, one curved line, circles are all mighty fine.” Have students use this rhyme to remind them of the attributes of a circle when they are identifying real-world objects that are in the shape of a circle.

MA.912.G.6.Pa.b **Match two or more objects with a circle based on a given feature, such as the distance around the outside (circumference) or inside (area) in real-world situations.**

Materials: yarn, scissors, rulers, real-world circular objects

Circles Arrange students into pairs and give each pair a circular real-world object, such as a CD, a storage container, or a dinner plate. Instruct the pair to use the yarn to find the distance around the outside of the circle (the circumference). Next, ask students to use rulers to measure the length of the circumference. Allow students to round measurements to the nearest centimeter. Ask students to compare several different objects and to record which objects have the same circumference in a table.

Revise this activity and ask students to calculate and compare the area measurements of several real-world objects. To simplify the process of calculating area, allow students to trace objects onto grid paper and estimate the number of square units that are covered.

MA.912.G.7.In.a **Identify and describe three-dimensional solids, including sphere, cylinder, rectangular prism, and cone in the environment using mathematical names.**

Figures in the Environment Provide a variety of real-world objects with different three-dimensional shapes. Use items that students can easily identify, such as cylindrical storage containers, rectangular tissue boxes, cubic dice, and baseballs.

Have students divide a piece of paper into two columns. Ask students to name the object in the left column and then to describe the solid using its mathematical name in the right column.

Students can also work at a learning center in pairs or small groups to complete this activity.

MA.912.G.7.In.b **Identify a line that divides a sphere in half.**

Great Circles Introduce students to the idea of hemispheres using a globe. Explain that the equator is a line that runs around the circumference of the globe, and it indicates where the two hemispheres meet. Other lines, such as the Prime Meridian, or other lines of latitude and longitude can be used to show that there is more than one line which indicates the meeting of two hemispheres.

Provide students with several plastic foam spheres which have been divided into two parts. If possible, color code the spheres before dividing them so that students can easily determine which parts are from the same sphere. Divide each sphere differently and provide only one sphere that is divided into hemispheres.

Show students the various ways that a plane can intersect a sphere by using a piece of paper to represent a plane. Demonstrate that the plane can intersect in a circle, by placing the paper between the two parts of the sphere.

Allow students to explore the similarities and differences among the spheres. They should notice that every sphere is cut into two parts, and that the plane has intersected the sphere in a circle.

However, only one sphere has been divided into two equal parts, or hemispheres. Students can test this conjecture by comparing the height of each hemisphere. The plane which divides the sphere in half contains the center of the sphere. This intersection is called a great circle.

MA.912.G.7.In.c **Measure rectangular prisms to find the volume using the literal formula: length × width × height.**

Cubic Centimeters Use cubic centimeters to build rectangular prisms. Provide students with the dimensions for length, width, and height. Ask them to create a rectangular prism using these dimensions. Next, ask students to determine the volume by using the formula length × width × height. Finally, have students confirm the volume by counting the number of cubes they used to create the prism.

MA.912.G.7.In.e **Identify the effect of changes in the lengths of the sides of cubes or rectangular prisms on the volume using physical and visual models.**

Cubic Centimeters Use cubic centimeters to build rectangular prisms. Provide students with the dimensions for length, width, and height, such as 2 × 3 × 4. Ask them to create a rectangular prism using these dimensions. Next, ask students to determine the volume by using the formula length × width × height.

Have students change the rectangular prism so that the length is now 3, instead of 2. Ask students to determine the new volume, and then compare the new volume with the previous volume measure. Repeat this activity several times until students can see a pattern. Encourage students to create a table like the one shown below.

Length	**2**	**3**	**4**	**5**
Width	3	3	3	3
Height	4	4	4	4
Volume	**24**	**36**	**48**	**60**

MA.912.G.7.Su.a **Identify properties of three-dimensional solids, such as sphere, cylinder, cube, and cone in the environment, when given the common name.**

Figures in the Environment Provide a variety of real-world objects with different three-dimensional shapes. Use items that students can easily identify, such as cylindrical storage containers, cubic dice, and baseballs.

Have students divide a piece of paper into three columns. Ask students to name the object in the left column and then to describe the solid using its mathematical name in the middle column. In the right column, ask students to describe the attributes of the solids. For example, they might note the two-dimensional shape of the base of the object, whether or not the object can roll or stack, or any other defining property.

Students can also work at a learning center in pairs or small groups to complete this activity.

MA.912.G.7.Su.b Compare volumes of three-dimensional solids in real-world situations.

Compare Volume Provide a variety of three-dimensional solids with one open end, such as a cylindrical container without the lid. Allow students to measure the dimensions of the containers using rulers. Have them make predictions about which containers have a greater volume. Finally, ask students to test their conjectures by measuring the volume using water or rice. Students can compare two solids at a time or use measuring cups to compare the measurements. Ask them to review their predictions, describe any differences, and explain their results in a math journal.

Provide several real-world situations in which finding the volume would be relevant. Storage containers, for example, are often used to store food items, such as rice, to prevent food from spoiling.

MA.912.G.7.Su.c Identify that changes in the lengths of sides of cubes or rectangular prisms will make the volume smaller or larger using physical models.

Cubic Centimeters Use cubic centimeters to build rectangular prisms. Provide students with the dimensions for length, width, and height, such as 2 × 3 × 4. Ask them to create a rectangular prism using these dimensions. Next, ask students to determine the volume by using the formula length × width × height.

Have students change the rectangular prism so that the length is now 3, instead of 2. Ask students to determine the new volume, and then compare the new volume with the previous volume measure. Repeat this activity several times until students can see a pattern. Encourage students to create a table like the one shown below.

Length	2	3	4	5
Width	3	3	3	3
Height	4	4	4	4
Volume	24	36	48	60

MA.912.G.7.Pa.a Identify objects or pictures with three-dimensional solids in real-world situations.

Figures in the Environment Provide a variety of real-world objects with different three-dimensional shapes. Use items that students can easily identify, such as cylindrical storage containers, cubic dice, and baseballs.

Provide students with a table divided into three columns. In the left column, provide a description of the attributes of different solids, such as cylinders, cubes, and rectangular prisms. Ask students to name the solid using its mathematical name, such as "cylinder," in the middle column. Ask students to name or draw a picture of a real-world object in the right column.

Students can also work at a learning center in pairs or small groups to complete this activity.

MA.912.G.7.Pa.b Match two or more objects with three-dimensional solids based on a given feature, such as the number of faces or overall size, in real-world situations.

Materials: a variety of three-dimensional solids from a math manipulative kit, real-world objects

Match Solids Distribute a variety of three-dimensional solids from a math manipulative kit, and several different real-world objects to each pair of students. Use real-world objects that have the attributes of common three-dimensional solids, such as canned food, baseballs, or tissue boxes.

Students should compare the number of faces of each math manipulative to the number of faces of the real-world object. Assist students in creating a table that lists the number of sides for each three-dimensional solid and the shape of each face. Students should match each math manipulative to a real-world object.

MA.912.G.8.In.a Use problem-solving strategies, including visual and physical models and tools, for solving real-world problems involving geometry concepts and skills.

Real-World Solutions Provide students with a variety of real-world situations which include geometric concepts and skills. They may be asked to determine the preferred shape of a vegetable garden, the area of a garden, or the amount (or volume) of top soil they might need for a small vegetable garden. If possible, allow students to use the measurement to plant a small garden outdoors or use a large plastic basin to create an indoor herb garden.

MA.912.G.8.In.b **Use estimation and resources to determine if solutions to problems involving geometry concepts and skills are reasonable.**

Estimate Volume Practice estimating length using visual discrimination. Encourage students to “guess” the length of common classroom objects, such as pencils, textbooks, and math manipulatives. Allow them to compare the length of these objects to a nonstandard unit of measure, such as the length of a small paper clip. Students should check their estimates by measuring the lengths with a ruler.

Once students are comfortable with this process, provide them with various rectangular prisms, and ask them to estimate the volume using visual discrimination. They will need to visual estimate the length, height, and width of the prism and then use these estimates to calculate the volume. Encourage students to check their answers by using a ruler to measure the dimensions of the prism.

MA.912.G.8.Su.a **Use given problem-strategies, including using visual or physical models, for solving real-world problems involving geometry concepts and skills.**

Real-World Solutions Provide students with a variety of real-world situations which include geometric concepts and skills. They may be asked to determine the preferred shape of a vegetable garden, the area of a garden, or the amount (or volume) of top soil they might need for a small vegetable garden. If possible, allow students to use the measurement to plant a small garden outdoors or use a large plastic basin to create an indoor herb garden.

MA.912.G.8.Su.b **Use resources, such as calculators and conversion charts to verify accuracy of solutions to problems involving geometry concepts.**

Metric and Customary Volume Practice comparing volume measured in metric and standard units of measurement. Provide a variety of three-dimensional solids with one open end, such as a cylindrical container without the lid. Allow students to measure the dimensions of the containers using rulers in metric and customary units of measure. Students can compare the measurements and place them in a table. Ask them to review their measurements by using conversion charts and completing the mathematical calculations using a calculator. Students should explain their results in a math journal.

MA.912.G.8.Pa.a **Solve real-world problems involving objects with two- and three-dimensional shapes and match the result to the correct answer to determine accuracy.**

Real-World Solutions Provide students with real-world problem-solving opportunities, such as the exercise below.

CRAFT KITS Damion is building a bird house for the backyard. The craft kit comes with two square boards, and 4 rectangular boards. What three-dimensional shape is his birdhouse?

Allow students to use square and rectangular paper cut-outs and tape to assemble a model of the birdhouse. After students have had a chance to complete their birdhouse model, provide a rectangular prism and ask them to compare their model to the rectangular prism.