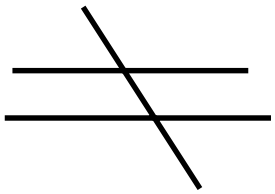
The learner will understand and use properties and relationships of geometric figures in the coordinate plane.

Notes and textbook references

3

3.01 Identify and describe the intersection of figures in a plane.

A. **Little House of Angles** This activity shows students how interior and exterior angles are formed when using a transversal to cross a set of parallel horizontal lines. Students should begin by drawing a set of parallel lines in the center of their paper. (Have the students use a piece of 8.5 by 11 paper oriented horizontally.) Have them draw a transversal through the parallel lines and then label the angles that are created, A-H. Explain to the students that the angles inside the two parallel lines are interior angles and that the angles outside the parallel lines are exterior angles. Students can complete their house design by using the lines as a framework.
Extension: Students can identify the follow angles: alternate interior, alternate exterior, corresponding, vertical and supplementary.



B. **Line Sketches** Ask students to draw three lines three times.

- three lines that do not intersect (students should realize that they must be parallel and label them)
- three lines that intersect without any right angles (label them intersecting)
- three lines that intersect with right angles (label them perpendicular)

Students should then label any exterior and interior angles (if there are any – there will not be for the first one.)
The class can have a discussion on why they can not draw three lines, with only two intersecting. (If they don't believe you, have them try it!)

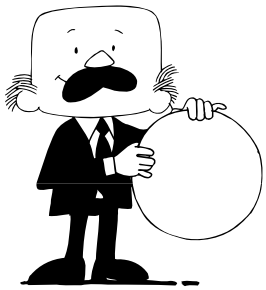
Notes and textbook references

C. Line Search This activity should be used after teaching the students the concepts of intersecting and parallel lines. Have the students work in pairs to find five examples of each type of lines: intersecting and parallel. Remind the students that a plane is a flat surface (for example, the front wall of their classroom). Examples of intersecting may be the top of the whiteboard and the side of the whiteboard, two pieces of paper that touch on their desk, etc.) Have the students classify the intersecting lines as perpendicular or not. Examples of parallel: horizontal line for concrete blocks on the wall, the mini-blinds, etc.)

3.02 Identify the radius, diameter, chord, center, and circumference of a circle; determine the relationships among them.

Notes and textbook references

A. String Along Have a display of cylindrical containers (jars, glasses, cans). Use a string to measure the circumference of the object and its diameter. Record your findings on cards, one measurement on the back and the other on the front. Have students use the information on one side of the card to predict the other measure, then check.



B. Can It! Ask each student to bring two or three different size empty cans. Working together, each pair should measure the diameter of a can using string. Record the length of the string in centimeters. Using the string again, measure the circumference of the can. Measure the string and record its length. Repeat the activity ten times: Ask students to write what they have observed about the relationships of the diameter of a circle to its circumference.

Circle Investigation

Can	Radius	Diameter	Circumference
A			
B			
C			
D			
E			

C. Measuring Activity

Materials needed: Tape measure, a variety of round lids. Have students measure the circumference and diameter of each lid. Record the results and calculate the ratio of circumference to diameter. Use these data to introduce the concept of π as a ratio. If the data are graphed, a nearly linear pattern should form.

D. Sir Cumference and the First Round Table

Sir Cumference and the First Round Table, by Cindy Neuschwander, is a tale about why and how King Arthur's round table became round. It highlights the characteristics of various shapes and gives meaning to the names radius, circumference, and diameter.

Notes and textbook references

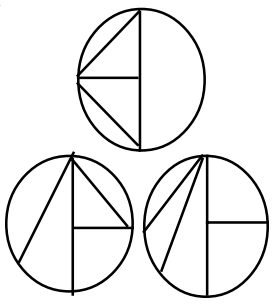
E. **Drawing Circles** Give the students opportunities to practice drawing circles with their compasses. Have them create a design of eight overlapping circles, each having a different radius. Create a stained glass effect by coloring the intersections.

F. **Circle Designs** Have the students construct circles on drawing paper using a compass. Set the compass at the length of the radius of the circle. Place the compass point on any point of the circle. Draw an arc from one point on the circle, through the center, to another point. Repeat the process to create a design. Vary this activity by using oral or written directions.

G. **Radius, Diameter, and Circumference** Have the students trace a circular object, marking the center on the circles. Have students measure the radius with one color of string, the diameter with another color, and the circumference with a third color. Use the strings to determine the relationships between the radius, diameter, and circumference. Because yarn stretches, use colored string if possible.

H. **Make Your Own Logo** Using a compass to draw a circle with a radius of 6 cm, create a logo for yourself. Make a border around the edge by drawing a second circle inside the original one. The circles should have the same center and the smaller circle should have a radius of 2 cm.

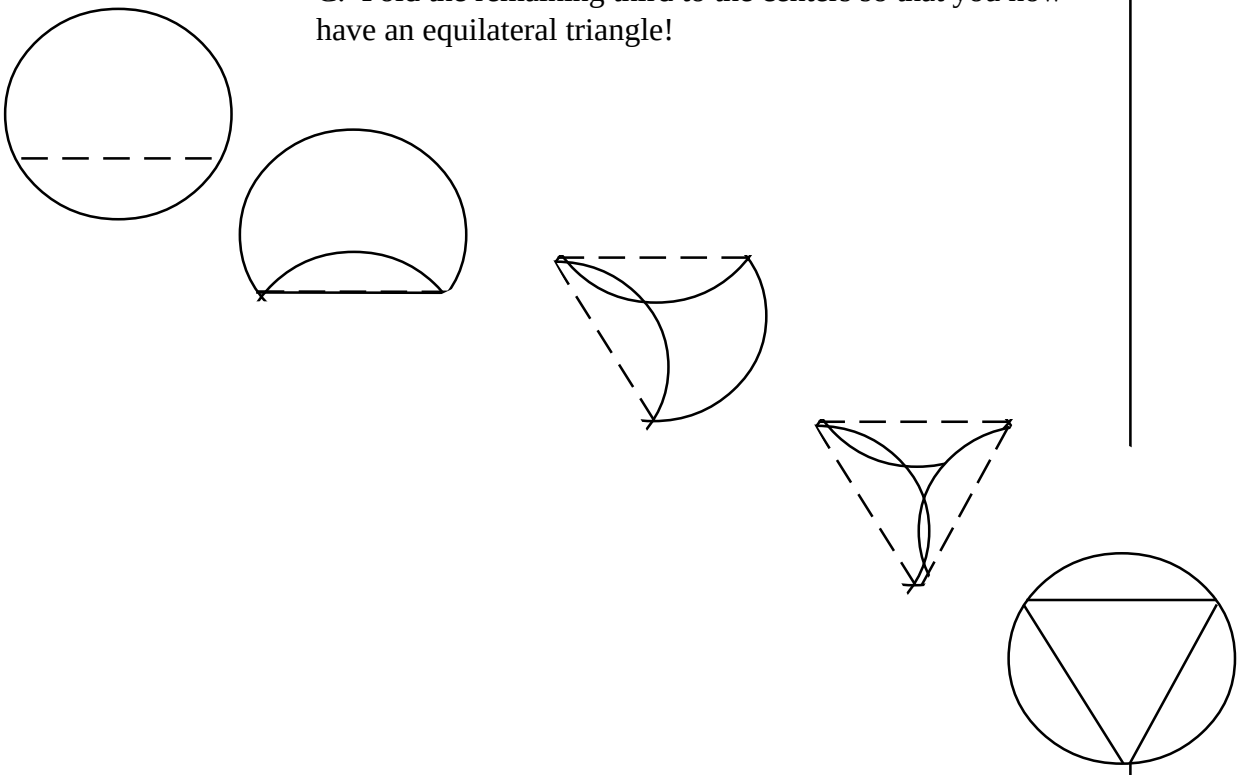
I. **Drawing Circles - Part II** Another activity might include giving oral directions such as "Draw a circle with a 2″ radius." "Draw a vertical diameter." "Draw two chords, each with an end point where the diameter intersects the circumference." "Draw a radius perpendicular to the diameter." Then have students compare their drawings. How are they alike? How are they different? Have students give oral directions while others draw. They might be asked to write out the directions first, in case there are any questions about what was said.



Notes and textbook references

J. Circles/Triangles Have students, using their compasses, draw a circle whose radius is 3 inches. Cut out the circles then follow these steps:

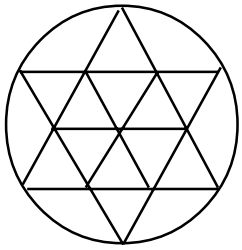
1. Fold the circle in half. Trace the fold with a green crayon. What does this line represent? (diameter)
2. With the circle folded in half, fold it in half again. What does each of the straight edges represent? (a radius) Notice that the curved edge is an arc.
3. Unfold the circle. The intersection of the perpendicular lines represents what part of the circle? (center)
4. Color a radius red.
5. A. Pick any point along the circumference and fold to the center. Unfold and trace this line in blue. What does this line represent? (a chord)
   B. Do it again, using one end point if the first chord is an end point of the second.
   C. Fold the remaining third to the centers so that you now have an equilateral triangle!



Notes and textbook references

K. Several new kinds of compasses are available now with several advantages over the traditional "ball bearing compass". These "Safe-T™" or safe drawing compasses are made of plastic, so they don't rust, and don't have sharp points which dig into furniture and students. Most educational supply companies sell these compasses. Begin by modeling for students how to use a compass to draw an accurate circle. Also, model how to draw a diameter, radius, and chord. Then have them label these as well as the center and circumference. Then have students explore what kinds of "designs" can be made by using these various parts of a circle. Many of these designs begin by marking off the distance of the radius around the circumference. Ask students to think about and explain why the circumference can be divided into about 6 radii. Then various chords, diameters, and radii are drawn to connect these 6 points on the circumference. After exploring on their own, provide other designs and ask students to figure out how to replicate them. Ask students to write a process for creating a design using precise vocabulary.

For example: Draw a circle with a radius of 1.5″. Using the radius, mark off the circumference in step-off fashion, dividing the circumference into 6 sections. Using a straight edge, draw chords connecting every other point on the circumference. This should create two overlapping equilateral traingles and a hexagon in the center of the circle. Then draw line segments from the center of the circle to each intersecting point of the sides of the two triangles, or to the vertices of the hexagon. This divides the regular hexagon in the center of the circle into 6 smaller equilateral triangles.



L. **String Along!** Ask the students to choose a circular object. Have them measure the diameter and, using a compass, draw a circle that is congruent. Label a radius, a diameter, a chord, and the center of the circle. Measure the length of the circumference using a string.

3.03 Transform figures in the coordinate plane and describe the transformation.

Notes and textbook references

A. **Slammin' Sammy** (Blackline Masters III - 1 and III - 2)
Students explore transformations on the coordinate grid by letting Sammy run the bases. His finger, shoulder, back, toe, heel, and fist are the points used to map his journey around the diamond.

B. **Draw it Again, Sam** (Blackline Master III - 3)
Students begin by reproducing the figure of Sam in a different quadrant of the plane. The students will then draw a reflection of Sam in quadrant III. Students will list original and new coordinates of each point. Then students draw their own simple sketch and reproduce it as a translation in quadrant IV and as a reflection in quadrant III. Again, they will provide original and translated coordinates.

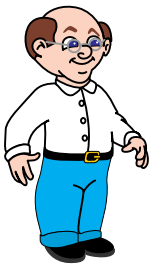
C. **Mira™ Activity** (Blackline Master III - 4)
Using a mirror or "Mira™", students will reflect figures across the x- or y-axis and draw the reflection (a congruent figure). They are to list the coordinates for the original figure and the reflected figure.

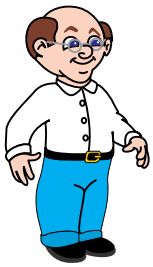
D. **Quilter Challenge** (**Tesselations**) (Blackline Master III - 5)
Students will use two shapes to create a design in a grid. After the completion of the design, they will list coordinates for each parallelogram and each triangle used.

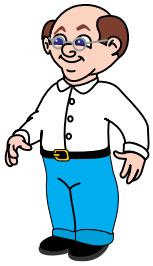
E. **Review - Geometric Transformations** (Blackline Masters III - 6 through III - 8) These sheets may be used to assess students' ability to create transformations involving reflections in all quadrants of the plane.

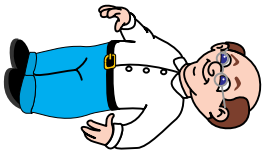
F. **Transformations in the Coordinate Plane** (Blackline Masters III - 9 through III - 15) Students will explore the effect addition and multiplication have on shapes drawn in the coordinate plane in the context of transformations. This activity is reprinted with permission from the *Woodrow Wilson Foundation - 1991 Mathematics Institute.*

Notes and textbook references









G. Body Rotations Using their bodies, students can demonstrate rotations. Stand in front of the room. Tell the students to imagine that the room is a clock and you are standing at the number twelve. Verbally give the students directions similar to the ones below. This activity allows you to quickly identify students who do not understand rotations, clockwise, counterclockwise, and/or 90 degree turns. At first, it is easier to have the students turn to face you before the next degree turn is announced.

Sample directions:

(1) 90° clockwise turn.
(2) 90° counterclockwise turn
(3) 180° clockwise turn
(4) 180° counterclockwise turn

After students master these turns, have them turn from the point at which they are standing after the last turn.

H. Table Top Transformations (Blackline Master III - 16 through III - 21)

Materials: Index card, ruler, inch grid paper, recording sheets, scissors

In this activity, students begin with a set of rigid shapes cut from index cards. Students physically slide, flip, and rotate these shapes on grid paper and record the resultling change in coordinates of the vertices. It is recommended that students work in pairs or small groups.

Students' visualization and spatial skills can be developed as they explore reflections and translations.

3.04 Solve problems involving geometric figures in the coordinate plane.

Notes and textbook references

A. Coordinating Change (Blackline Masters III - 22 through III - 25) Students construct a plane figure by plotting the coordinates of its vertices on grid paper. The students then determine the area and perimeter of the figure. Next, the students change the shape by making described changes in the coordinates. They describe the changes made in the shape as well as changes in area and perimeter.

Notation used in this activity shows what happens to vertex **A** in the original figure by naming it **A′** in each variation of the original figure. Vertex **B** becomes **B′**, etc.

B. Rotations on the Coordinate Plane Provide students with a small equilateral triangle and a square. Have them trace each shape anywhere on a coordinate plane. Then find the images after rotations of 90 degrees and 180 degrees about the origin. Students can record the new coordinates using the notations of **A′** (the image of **A**) for the transformed figure.

C. Mapping Allow students to work in groups or pairs to create a map that show their school and surrounding buildings or students may choose to create a map of their community, neighborhood or town. Have students create a grid system locating major places. They could also make up situations of how to get from one place to another. For example, suppose Tom had a party at his house and he invited several of his friends. What would be the best route to take to get to Tom's house? As a class project you could create an imaginary neighborhood.

D. Transformations Have students make a map of the classroom on a coordinate plane. Then ask them to describe a translation from their desk to another desk. The teacher could pre-make the coordinate plane with the desk arrangements to save instructional time, and then allow the students to make the transformation.

Notes and textbook references

E. Reflecting Have students draw a parallelogram with the vertices of (-1,1), (-3,5), (-7, 5), and (-5, 1). Then have students reflect that parallelogram into the other three quadrants. Using a table of x and y values, have students list the new coordinates for the vertices that are in each quadrant.