OzoBot Lesson 03: Ozobot Likes Geometric Shapes

For Grades: 3-6 *Time/Duration:* 60 min (may be stretched to an additional 60 minute session)

Question: What types of lines and shapes will Ozobot follow?

Overview: When working with robots, we need to know what they can do and what they cannot do. We know that Ozobot can follow lines, but what are the limits on the types of lines, angles, curves, and shapes that it can follow? This lesson explores those boundaries by trying out different shapes with varying angles and types of lines.

Prior Knowledge:

Operation of Ozobot, Drawing geometric shapes, Use of math tools

Materials:

- Ozobot (one per group)
- Math tools (ruler, compass, protractor, sharp pencils) (one set per group)
- Markers (Crayola or Sharpies) wide tip(one set per group)
- Several sheets of plain white paper or grid paper per group
- (optional) Tablet or phone to take picture or video of drawing

Standards:

CCSS.MATH.GEOMETRY: Reason with shapes and their attributes

CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically.

Objectives:

1. Draw lines and define the types of lines that Ozobot will follow
2. Draw intersecting lines and define the angles that Ozobot will turn.
3. Draw quadrilaterals and define the types that Ozobot will follow
4. Draw triangles and define the types that Ozobot will follow.
5. Draw circles and ovals and define the types that Ozobot will follow
6. Create a drawing using various geometric shapes that Ozobot will follow.

Vocabulary:

- ruler

- compass
- protractor
- geometric shapes
- parallel lines
- straight line
- Line segments
- Intersecting line
- Quadrilaterals
- Square,
- Rectangle,
- Rhombus,
- Parallelogram,
- Trapezium,
- Kite
- Triangles
- Acute triangles
- Obtuse triangles
- Right triangles
- Equilateral triangles
- Isoceles triangles
- Scalene triangles

Activity Teacher Tips:

This lesson may seem too much like math class to some students, but one goal is to demonstrate how math can be used in the real world. Express that the experiments in the activities are designed to determine the limits of the angles and lines that Ozobot can follow. At the conclusion, they will have fun creating a drawing that they know Ozobot can follow.

Differentiations:

Grades 3-4: Some students may have difficulty using the math tools. Practice activities may be needed. Students may not have had exposure to all the types of geometric shapes. You may opt to have them draw only the ones they know or use this as an opportunity to teach the shapes they do not know.

Grades 5-6: Teachers may coordinate this lesson with other math lessons or take the opportunity to include extra math activities such as calculating the area, perimeter, or equations using the length of sides for geometric shapes.

Assessments:

- Worksheet
- Grading Rubric (to be developed)
- Quiz Questions (to be developed)

Student instructions:

OzoBot Lesson 03: Ozobot Likes Geometric Shapes

Question: What types of lines and shapes will Ozobot follow?

Overview: When working with robots, we need to know what they can do and what they cannot do. We know that Ozobot can follow lines, but what are the limits on the types of lines, angles, curves, and shapes that it can follow? This lesson explores those boundaries by trying out different shapes. After we know what it can do, we then will create a drawing that Ozobot can play on.

Objectives:

1. Draw lines and define the types of lines that Ozobot will follow
2. Draw intersecting lines and define the angles that Ozobot will turn.
3. Draw quadrilaterals and define the types that Ozobot will follow
4. Draw triangles and define the types that Ozobot will follow.
5. Draw circles and ovals and define the types that Ozobot will follow
6. Create a drawing using various geometric shapes that Ozobot will follow.

Activity:

Instructions:

For all of these drawing activities, use a pencil and a drawing tool such as a ruler, compass, or protractor to draw the lines, angles, or geometric shapes. After you have the shape drawn, then trace over it with a marker. Try to keep the pencil line in the center of the marker line.

Use the techniques learned in a prior lesson to create marker lines that Ozobot can see. Also use the colors of markers that we learned that Ozobot can detect. Use the worksheet to record results as you do each part of an activity.

Activity 1: Lines

1. Draw a black line about (6 inches, 15 mm in length) on a white piece of paper. Turn Ozobot on and place Ozobot on the line and observe.
2. Use a pencil and ruler to draw another straight line the same length (6 inches, 15 mm). Divide the line into 3 equal segments. Then trace over each segment in different colors: blue, green, red. Let Ozobot drive on these lines and see how Ozobot reads those colors. Observe what happens to Ozobot as it goes over a different segment.
3. Draw parallel lines each about 4 inches long, but vary the distance apart: (6 mm, 4mm, 2 mm). Put Ozobot on one of the lines and observe, does it go onto the

other parallel line? Try this several times (at least 5) to see if it ever jumps over to the other parallel line.

4. Draw one long straight line (8 inches, 20mm length). Divide the line into 5 equal segments. At each segment use a protractor to create an intersecting line, each at different angles: 90 degrees, 60 degrees, 45 degrees, 30 degrees, 15 degrees. Place Ozobot on the straight line and observe which intersections Ozobot can turn onto. After turning onto an intersection, put it back onto the straight line. Try Ozobot on the straight line several times (at least 5) to see which intersections it will turn onto.

5. Draw one long straight line (8 inches, 20mm length). Divide the line into 5 equal segments. At each segment use a protractor to create an intersecting line, each at different angles: 90 degrees, 110 degrees, 130 degrees, 150 degrees, 170 degrees. Place Ozobot on the straight line and observe which intersections Ozobot can turn onto. After turning onto an intersection, put it back onto the straight line. Try Ozobot on the straight line several times (at least 5) to see which intersections it will turn onto.

Activity 2 Quadrilaterals

1. Draw one of each of these quadrilaterals (square, rectangle, rhombus, parallelogram, trapezium, kite). See the handout: Geometric Shapes. To make it large enough, one side of the quadrilateral should be at least 10 mm. Try Ozobot starting on a straight line to see which shapes it will go all the way around.

2. Draw a line to segment each of the quadrilaterals into 2 halves. Place Ozobot near the intersecting line and observe which intersections Ozobot can turn onto. After turning onto an intersection, put it back onto the straight line. Try Ozobot several times (at least 5) to see which intersections it will turn onto.

Activity 3 Triangles

1. Draw triangles with one side at least 10mm in length and different angles of corners (depending on the type of triangle). Create one triangle of each of these types: Acute, Obtuse, Right, Equilateral, Isoceles, and Scalene. See the handout: Geometric Shapes. Put Ozobot on the straight line part of the triangle and see which angles it can turn onto, and which triangles it will go all the way around. Use a protractor to measure the angles of the triangles.

2. Draw a line to divide each of the triangles in half. Once again, start Ozobot on a straight line part just before the segment and see if it will turn onto the dividing line. Try this multiple times (at least 5).

Activity 4 Circle and Ellipse

1. Draw circles of different sizes: the diameter in (20mm, 15mm, 10 mm, 8 mm, 6 mm, 4 mm) or Inches (8 inch, 6 inch, 4 inch, 3 inch, 2 inch). Observe which circles Ozobot can travel and which ones it cannot.
2. Draw lines to segment the largest circle into quarters (four equal parts). Try Ozobot on this circle and observe whether it will go onto the segmented lines.
3. Draw lines to segment the next largest circle into sixths (six equal parts). Try Ozobot on this circle and observe whether it will go onto the segmented lines.
4. Draw an ellipse or ovals of different sizes by making half circles with a compass and then connecting them with a straight line. Try different sizes of radius of the half circle (10 mm, 8mm, 6 mm) and draw an 8 mm line connecting them. (Hint: draw one half circle first, then the straight lines on each end, then the other half circle). Observe which ovals Ozobot can travel all the way around and which ones it cannot.

Activity 5 Other Geometric Shapes

Explore drawing other shapes – stars, octagons, pentagons, hexagons, heart, etc. Make the shape large enough – using your prior experience from other shapes. Observe which shapes Ozobot can travel all the way around and which ones it cannot.

Activity 6 Create a Drawing for Ozobot

Now that we know what shapes Ozobot can follow and the shapes and angles that it has difficulty with, we can apply that knowledge to creating a drawing. Use your imagination and create a drawing that includes lines, line segments of different colors, quadrilaterals, triangles, circles, and ovals. Use intersecting lines at different angles to connect shapes together so that Ozobot will travel from one shape to the next.

Use creativity and the shapes can create a scene, such as a house with trees, or a table top with blocks, or a cartoon, or you can create an abstract work of art, or a maze. Try to create a drawing that Ozobot will like and it will follow all the lines and shapes, and display different colors as it goes over the drawing.

LESSON 03 Worksheet

Record observations from the activities here. Remember we want to know Ozobot's limits - what it CAN do and what it CANNOT do. What angle can it turn? What shape can it go around? What angles can it not turn? What size of lines or curves work and which ones don't?

Activity 1: Lines

1. *Black line*
2. *Color Segmented line*
3. *Parallel lines*
4. *Intersecting lines (90, 60, 45, 30, 15 degrees)*
5. *Intersecting lines (90, 110, 130, 150,170 degrees)*

Activity 2 Quadrilaterals

1. *Quadrilaterals:*
    a. *square*
    b. *rectangle*
    c. *rhombus*
    d. *parallelogram*
    e. *trapezium*
    f. *kite*
2. *Quadrilateral halves:*
    a. *square*
    b. *rectangle*
    c. *rhombus*
    d. *parallelogram*
    e. *trapezium*
    f. *kite*

Activity 3 Triangles

1. *Triangles*
    a. *Acute*

   b. *Obtuse*
   c. *Right*
   d. *Equilateral*
   e. *Isoceles*
   f. *Scalene*
2. *Triangle Halves*
   a. *Acute*
   b. *Obtuse*
   c. *Right*
   d. *Equilateral*
   e. *Isoceles*
   f. *Scalene*

Activity 4 Circles and Eliipse

1. *Circles of different sizes*
2. *Quarter circles*
3. *Circle in Sixths*
4. *Ellipse*

Activity 5 Other Geometric Shapes

1. *Star*
2. *Octagon*
3. *Pentagon*
4. *Hexagon*
5. *Other:*

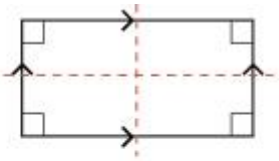
Activity 6 Create a Drawing for Ozobot

Take a picture of your drawing and include it here. Optionally: Create a video of Ozobot traveling on the drawing, post it online, and then link it here.

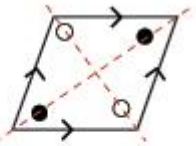
Handout: Geometric Shapes

Quadrilaterals

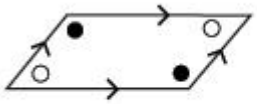
square
(4 equal length sides, 2 sets of parallel sides & 4 right angles)



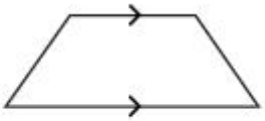
rectangle
(2 pairs of equal length sides, 2 sets of parallel sides & 4 right angles)



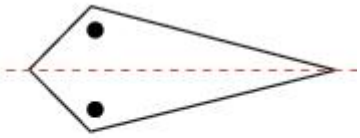
rhombus
(4 equal length sides, 2 sets of parallel sides & opposite angles equal)



parallelogram
(2 pairs of equal length sides, 2 sets of parallel sides & opposite angles equal)



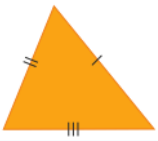
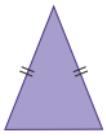
trapezium
(1 pair of parallel sides)



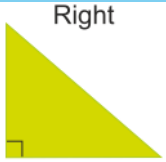
kite
(2 sets of equal length sides & one pair of opposite angles equal)

Triangles

Triangles Based on Sides

Scalene	Isosceles	Equilateral
		
Length of all sides are different	Length of two sides are equal	Length of all sides are equal

Triangles Based on Angles

Acute	Right	Obtuse
		
Each angle is < 90°	One angle is = 90°	One angle is > 90°