# Symmetry

**Strand:** Reasoning, Lines, and Transformations

**Topic:** Investigating symmetry

**Primary SOL:** G.3 The student will solve problems involving symmetry and transformation. This will include:
   c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point.

**Related SOL:** G.3d

## Materials

- Symmetry activity sheet (attached)
- Pattern blocks

## Vocabulary

*line symmetry, point symmetry, regular polygon, rotate, rotation, rotational symmetry, symmetric*

## Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Introduce order of rotational symmetry and degrees of rotational symmetry, using examples. (They are defined at the top of the Symmetry activity sheet.)

2. Distribute the Symmetry activity sheet to each student, and have students work in pairs to complete it. Each student should record his/her own findings and discuss them with their partners. Discuss findings as a whole group.

## Assessment

- **Questions**
    - If a figure has 60 degrees of rotational symmetry, what other rotational symmetries must it have? Explain.
    - Does a regular octagon have 90 degrees of rotational symmetry? Explain.
    - A hexagon has point symmetry. What can you say about the opposite sides? Explain.
    - Is a parallelogram always symmetrical? Explain.

- **Journal/Writing Prompts**
    - How can you determine whether a figure has rotational symmetry and what the order is, if it does?
    - Describe a practical example of an object that demonstrates rotational symmetry. Include the order in your description.
    - Write a journal entry summarizing the symmetry activity.

- **Other Assessments**
    - Have students find words or phrases that have point or line symmetry (at least when written in all capital letters.)

o   Have students draw a figure that has rotational symmetry but not line symmetry.
o   Have students create or find designs that illustrate various symmetries.

**Extensions and Connections (for all students)**

- Show students graphs of equations, such as $y = x^2$, $y = (x - 1)^2$, $y = x^2 + 1$, $y = x^3$, $x^2 + y^2 = 1$, $y = \sin x$, and $y = \cos x$, and ask which graphs are symmetric with respect to the *y*-axis and which have point symmetry with respect to the *x*-axis.

- Show students a picture that illustrates reflectional symmetry, and ask what it has to do with transformations.
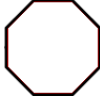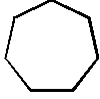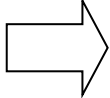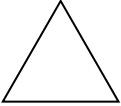
**Strategies for Differentiation**

- Depending on the level of students, it may be necessary to introduce the vocabulary before students start the activity.

- Depending on the level of students, it may be necessary to work through a couple of examples with the class before they complete the activity.

- Use of an interactive whiteboard is encouraged.

- Use mirrors or image reflectors to explore line symmetry.

- Use patty paper to explore rotational symmetry. Use a dot to mark the rotation point.

- Use pegboards to demonstrate symmetry.

**Note: The following pages are intended for classroom use for students as a visual aid to learning.**

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# Symmetry

**Name** _____ **Date** _____

- A figure has **line symmetry** if there is a line that divides the figure into mirror images.
- A figure has **rotational symmetry** if it looks the same when rotated some angle measure less than 360 degrees. Its **order of rotational symmetry** is the number of positions a figure can be rotated, without changing the way it looks. It has *n* degrees of rotational symmetry (for example 90 degrees of rotational symmetry) if it looks the same when rotated *n* degrees.
- A figure has **point symmetry** if it looks the same upside-down, or rotated 180 degrees. Such a figure also has rotational symmetry of order 2.

1. Identify the apparent number of lines of symmetry and order of rotational symmetry for each figure. Assume polygons that appear to be regular are.

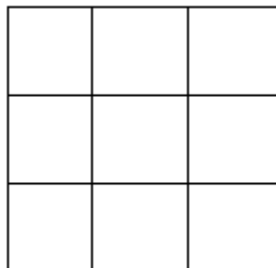|  | Number of Lines of Symmetry | Order of Rotational Symmetry | Degrees of Rotational Symmetry | Does this figure have point symmetry? |
|---|---|---|---|---|
| ◇ | 4 | 4 | 90, 180, 270, 360 | yes |
| ▭ |  |  |  |  |
| ⬡ |  |  |  |  |
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| **M** |  |  |  |  |

| | Number of Lines of Symmetry | Order of Rotational Symmetry | Degrees of Rotational Symmetry | Does this figure have point symmetry? |
|---|---|---|---|---|
| **A** | | | | |
| **T** | | | | |
| **H** | | | | |
| **S** | | | | |

2.  You have been hired by your favorite sports team to create a new logo for their uniforms. They would like the following incorporated into the design:
    - Vertical symmetry
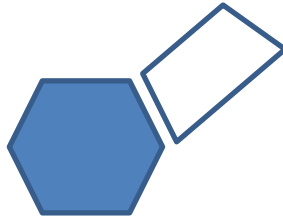    - Horizontal symmetry
    - Rotational symmetry

    Create a logo that meets all of the team's requirements.

3.  How many symmetrical designs can you make by shading whole squares? Explain your thoughts.



4.  Use the pattern blocks to create figures that satisfy the following conditions:
    a.  Two lines of symmetry, two rotational symmetries
    b.  Three rotational symmetries, no lines of symmetry
    c.  Six lines of symmetry, six rotational symmetries

5.  A trapezoid has been attached to a hexagon in this figure:



   a. How many different ways can another trapezoid be attached to this figure to form a figure that has a line of symmetry? Show with your pattern blocks.

   b. How many different ways can one or more trapezoids be attached to form a figure that has more than one rotational symmetry?