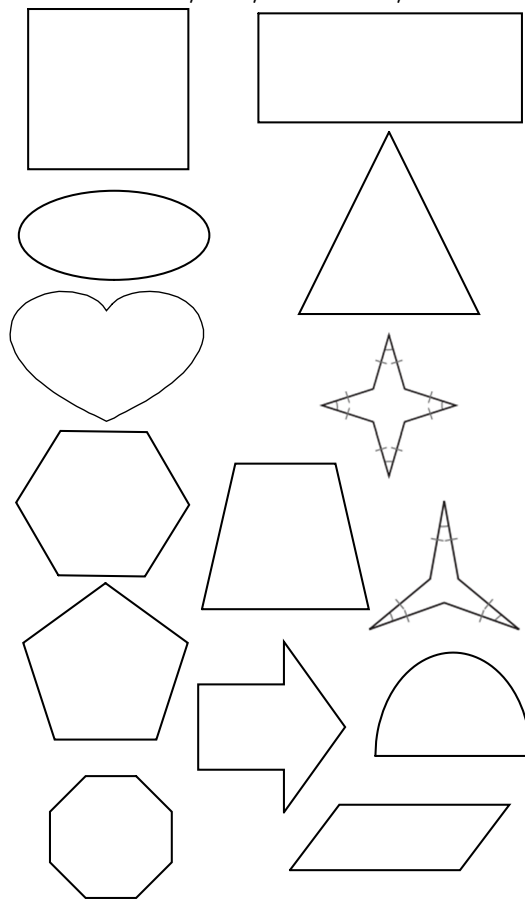


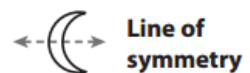
2.4 Symmetry Cut-Out Activity



## 2.4 Investigating Symmetry

### Explore 1 Identifying Line Symmetry

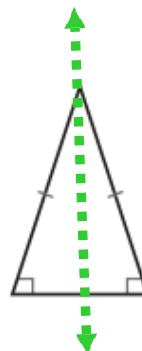
A figure has **symmetry** if a rigid motion exists that maps the figure onto itself. A figure has **line symmetry** (or *reflectional symmetry*) if a reflection maps the figure onto itself. Each of these lines of reflection is called a **line of symmetry**.



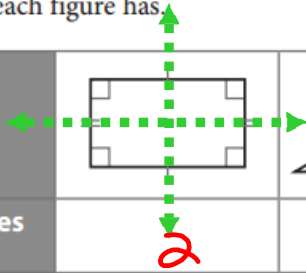
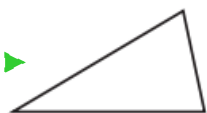
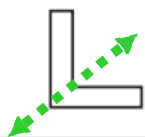
You can use paper folding to determine whether a figure has line symmetry.

(A) Sketch any lines of symmetry on the figure.

The figure has 1 line of symmetry.



- D Draw the lines of symmetry, if any, on each figure and tell the total number of lines of symmetry each figure has.

Figure			
How many lines of symmetry?	2	0	1

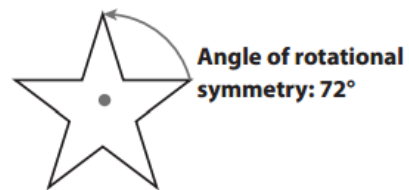
**Reflect**

- What do you have to know about any segments and angles in a figure to decide whether the figure has line symmetry?  
Pairs of segments in the figure must have the same length and pairs of angles must have the same measure, so that one half of the figure will coincide with the other half when folded along the line of symmetry.
- What figure has an infinite number of lines of symmetry? a circle
- Discussion** A figure undergoes a rigid motion, such as a rotation. If the figure has line symmetry, does the image of the figure have line symmetry as well? Give an example.  
Yes. The line of symmetry also undergoes the rigid motion.

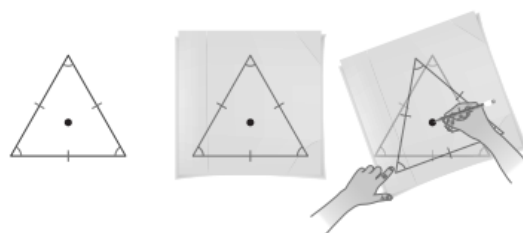
**Explore 2 Identifying Rotational Symmetry**

A figure has **rotational symmetry** if a rotation maps the figure onto itself. The **angle of rotational symmetry**, which is greater than  $0^\circ$  but less than or equal to  $180^\circ$ , is the smallest angle of rotation that maps a figure onto itself.

An angle of rotational symmetry is a fractional part of  $360^\circ$ . Notice that every time the 5-pointed star rotates  $\frac{360^\circ}{5} = 72^\circ$ , the star coincides with itself. The angles of rotation for the star are  $72^\circ$ ,  $144^\circ$ ,  $216^\circ$ , and  $288^\circ$ . If a copy of the figure rotates to exactly match the original, the figure has rotational symmetry.

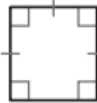
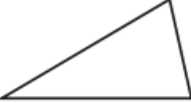



- A Trace the figure onto tracing paper. Hold the center of the traced figure against the original figure with your pencil. Rotate the traced figure counterclockwise until it coincides again with the original figure beneath.



By how many degrees did you rotate the figure?  $120^\circ$   
 What are all the angles of rotation?  $120^\circ, 240^\circ$

B Determine whether each figure has rotational symmetry. If so, identify all the angles of rotation less than  $360^\circ$ .

Figure			
Angles of rotation less than $360^\circ$	$90^\circ, 180^\circ, 270^\circ$	NO	$180^\circ$

**Reflect**

- What figure is mapped onto itself by a rotation of any angle? circle
- Discussion** A figure is formed by line  $l$  and line  $m$ , which intersect at an angle of  $60^\circ$ . Does the figure have an angle of rotational symmetry of  $60^\circ$ ? If not, what is the angle of rotational symmetry?

No,  $180^\circ$



**Explain 1 Describing Symmetries**

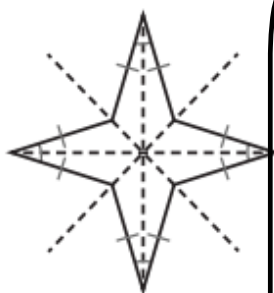
A figure may have line symmetry, rotational symmetry, both types of symmetry, or no symmetry.

**Example 1** Describe the symmetry of each figure. Draw the lines of symmetry, name the angles of rotation, or both if the figure has both.

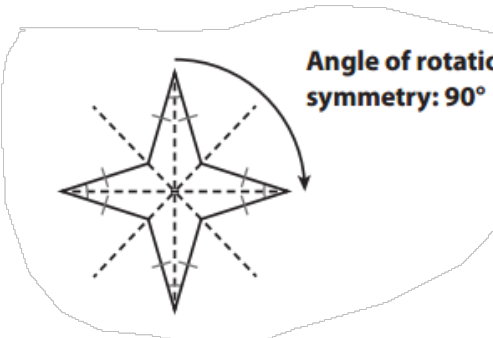
A

Step 1 Look for lines of symmetry.

line symmetry



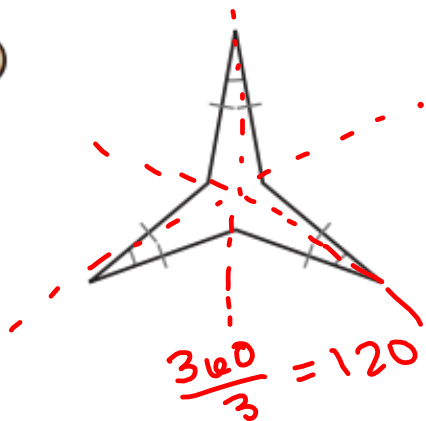
rotational symmr



Step 2 Now look for rotational symmetry. Think of the figure rotating about its center until it matches the original figure. It rotates around the circle by a fraction of  $\frac{1}{4}$ . Multiply by  $360^\circ$  to find the angle of rotation, which is  $90^\circ$ . Find multiples of this angle to find other angles of rotation.

Number of lines of symmetry: 4      Angles of rotation:  $90^\circ, 180^\circ, 270^\circ$

B



Step 1 Look for lines of symmetry.

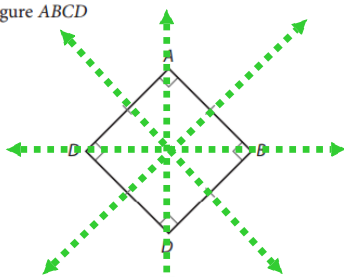
Step 2 Now look for rotational symmetry. Think of the figure rotating about its center until it matches the original figure. It rotates around the circle by a fraction of \_\_\_\_\_. Multiply by  $360^\circ$  to find the angle of rotation, which is \_\_\_\_\_. Find multiples of this angle to find other angles of rotation.

Number of lines of symmetry: 3      Angles of rotation:  $120^\circ$   
 $240^\circ$

**Your Turn**

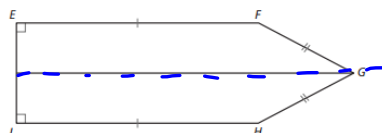
Describe the type of symmetry for each figure. Draw the lines of symmetry, name the angles of rotation, or both if the figure has both.

6. Figure ABCD



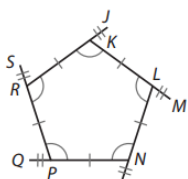
Types of symmetry: line + rotational  
Number of lines of symmetry: 4  
Angles of rotation:  $90^\circ, 180^\circ, 270^\circ$

7. Figure EFGHI



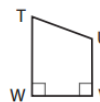
Types of symmetry: line  
Number of lines of symmetry: 1  
Angles of rotation: none

8. Figure KLNPR



Types of symmetry: rotational  
Number of lines of symmetry: 0  
Angles of rotation:  $72^\circ, 144^\circ, 216^\circ, 288^\circ$

9. Figure TUVW



Types of symmetry: none  
Number of lines of symmetry: 0  
Angles of rotation: none

**Elaborate**

10. How are the two types of symmetry alike? How are they different?

both types of symmetry are rigid motions. In line symmetry, the figure is mapped onto itself by reflection, and in rotational symmetry, the mapping is by rotation.

11. **Essential Question Check-In** How do you determine whether a figure has line symmetry or rotational symmetry?

To identify line symmetry, look for a line of reflection that divides the figure into mirror-image halves. To identify rotational symmetry, think of the figure rotating around its center. The figure has rotational symmetry if a rotation of at most 180 degrees produces the original figure.

# Homework

## Worksheet

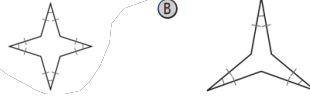
2.4 Symmetry Handout



D Draw the lines of symmetry, if any, on each figure and tell the total number of lines of symmetry each figure has.

Figure			
How many lines of symmetry?			

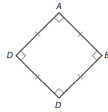
Describe the symmetry of each figure. Draw the lines of symmetry, name the angles of rotation, or both if the figure has both.



Your Turn

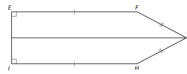
Describe the type of symmetry for each figure. Draw the lines of symmetry, name the angles of rotation, or both if the figure has both.

6. Figure ABCD



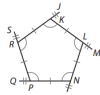
Types of symmetry: \_\_\_\_\_  
 Number of lines of symmetry: \_\_\_\_\_  
 Angles of rotation: \_\_\_\_\_

7. Figure EFGH



Types of symmetry: \_\_\_\_\_  
 Number of lines of symmetry: \_\_\_\_\_  
 Angles of rotation: \_\_\_\_\_

8. Figure KLNPR



Types of symmetry: \_\_\_\_\_  
 Number of lines of symmetry: \_\_\_\_\_  
 Angles of rotation: \_\_\_\_\_

9. Figure TUVW



Types of symmetry: \_\_\_\_\_  
 Number of lines of symmetry: \_\_\_\_\_  
 Angles of rotation: \_\_\_\_\_