Name_____ Class_____ Date_____

4-1

Translations, Reflections, and Rotations

COMMON CORE

Essential question: *How can you use coordinates to describe the result of a translation, reflection, or rotation?*

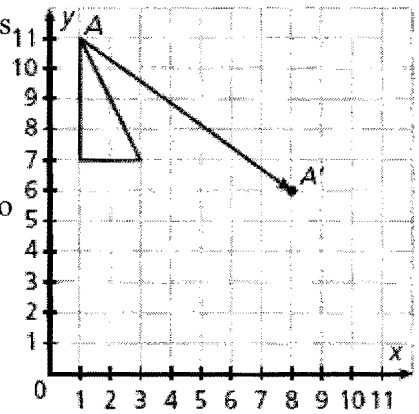
CC.8.G.3

You learned that a function is a rule that assigns exactly one output to each input. A transformation is a type of function that describes a change in the position, size, or shape of a figure. The input of a transformation is called the preimage, and the output of a transformation is called the image.

A translation is a transformation that slides a figure along a straight line. The image has the same size and shape as the preimage.

1 EXPLORE Applying Translations

The triangle is the preimage (input). The arrow shows the motion of a translation and how point A is translated to point A'.



A Trace the triangle on a piece of paper. Slide point A of your traced triangle down the arrow to model the translation.

B Sketch the image (output) of the translation.

C Describe the motion modeled by the translation.

Move _____ units right and _____ units down.

D Complete the ordered pairs to describe the effect of the translation on point A.

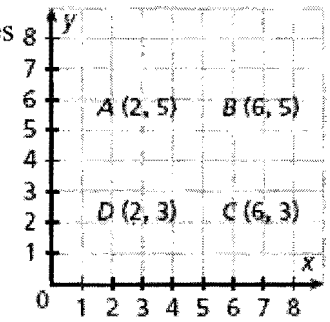
(1, 11) becomes (1 + , 11 +) = (,)

E You can give a general rule for a translation by telling the number of units to move up or down and the number of units to move left or right. Complete the ordered pairs to write a general rule for this transformation.

$(x, y) \rightarrow (x +$, $y +$ $)$

TRY THIS!

1. Apply the translation $(x, y) \rightarrow (x - 2, y + 3)$ to the figure shown. Give the coordinates of the vertices of the image. (The image of point A is point A'.)



A':(_____, _____)

B':(_____, _____)

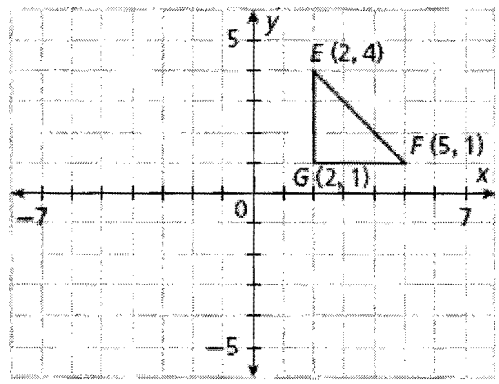
C':(_____, _____)

D':(_____, _____)

A reflection is a transformation that flips a figure across a line called the line of reflection. Each point and its image are the same distance from the line of reflection. The image has the same size and shape as the preimage.

2 EXPLORE Applying Reflections

The triangle is the preimage. You will use the x- or y-axis as the line of reflection.



Reflection across the x-axis:

A Trace the triangle and the x- and y-axes on a piece of paper. Fold your paper along the x-axis and trace the image of the triangle on the opposite side of the x-axis.

B Sketch the image of the reflection. Label each vertex of the image. (The image of point E is point E'.)

C Complete the table.

Preimage	(2, 4)	(2, 1)	(5, 1)
Image			

D How does reflecting the figure across the x-axis change the x-coordinates? How does it change the y-coordinates?

_____

E Complete the ordered pair to write a general rule for reflection across the x-axis. $(x, y) \rightarrow (x, y \times \quad)$

Reflection across the y-axis:

F Fold your traced image along the y-axis and trace the image of the triangle on the opposite side of the y-axis.

G Sketch the image of the reflection. Label each vertex of the image. (For clarity, label the image of point E as point E''.)

H Complete the table.

Preimage	(2, 4)	(2, 1)	(5, 1)
Image			

I How does reflecting the figure across the y-axis change the x-coordinates? How does it change the y-coordinates?

_____

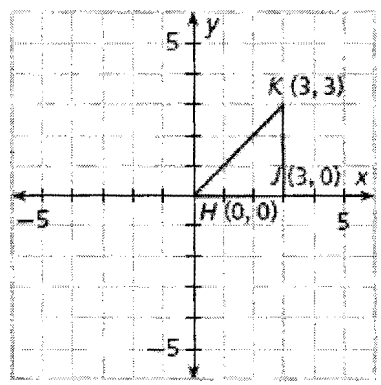
J Complete the ordered pair to write a general rule for reflection across the y-axis. $(x, y) \rightarrow$ (,)

Rules for Reflections	
Across the x-axis	$(x, y) \rightarrow (x, -y)$
Across the y-axis	$(x, y) \rightarrow (-x, y)$

A rotation is a transformation that turns a figure around a given point called the center of rotation. The image has the same size and shape as the preimage.

3 EXPLORE Applying Rotations

The triangle is the preimage. You will use the origin as the center of rotation.



A Trace the triangle on a piece of paper. Rotate the triangle 90° counterclockwise about the origin. The side of the triangle that lies along the x-axis should now lie along the y-axis.

B Sketch the image of the rotation. Label each vertex of the image. (The image of point H is point H'.)

C Give the coordinates of the vertices of the image.

H': (_____, _____)

J': (_____, _____)

K': (_____, _____)

TRY THIS!

3a. Rotate the original triangle 180° counterclockwise about the origin. Sketch the result on the coordinate grid above. Label each vertex of the image. (For clarity, label the image of point H as point H''.)

3b. Give the coordinates of the vertices of the image.

H'': (_____, _____)

J'': (_____, _____)

K'': (_____, _____)

REFLECT

3c. Compare the image of a counterclockwise rotation of 180° about the origin to the image of a clockwise rotation of 180° about the origin.

_____

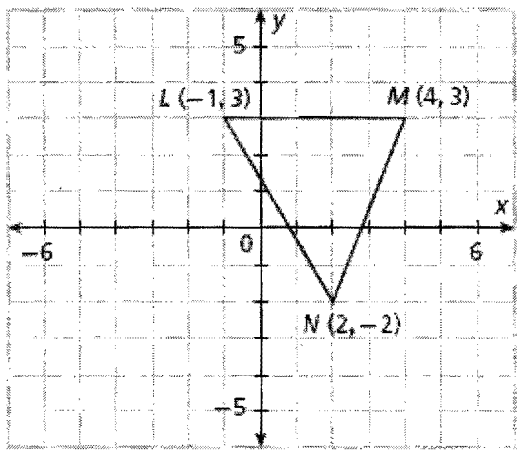
3d. Through how many degrees would you need to rotate a figure for the image to coincide with the preimage? Explain.

_____

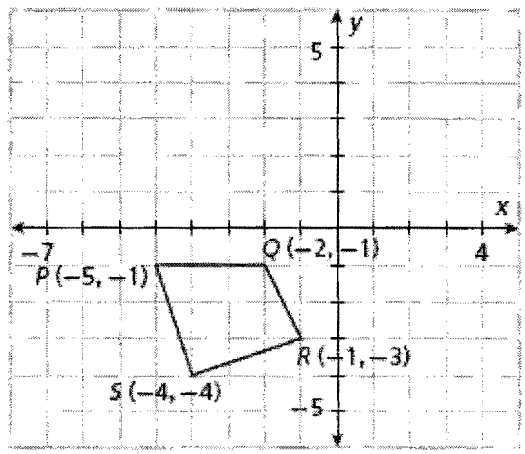
PRACTICE

Sketch the image of the figure after the given transformation. Label each vertex.

1. Translation: $(x, y) \rightarrow (x - 3, y + 1)$

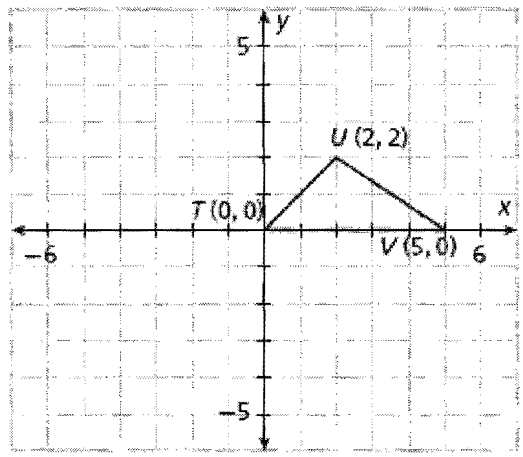


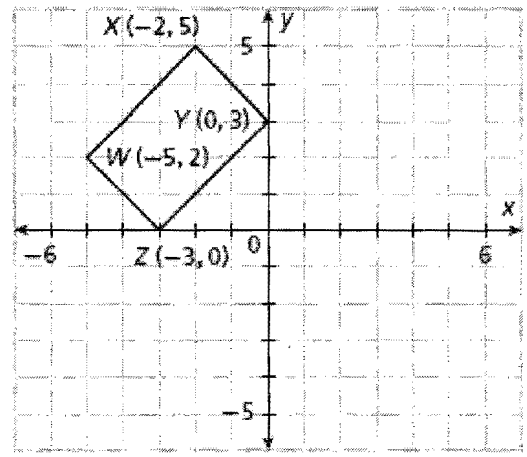
2. Reflection: $(x, y) \rightarrow (x, -y)$



3. Rotation: 90° clockwise about the origin

4. Reflection: $(x, y) \rightarrow (-x, y)$





Apply each transformation to the vertices of the original rectangle, and give the coordinates of each vertex of the image.

	Vertices of Rectangle	(2, 2)	(2, 4)	(−3, 4)	(−3, 2)
5.	$(x, y) \rightarrow (x, -y)$				
6.	$(x, y) \rightarrow (x + 2, y - 5)$				
7.	$(x, y) \rightarrow (-x, y)$				
8.	$(x, y) \rightarrow (-x, -y)$				
9.	$(x, y) \rightarrow (x - 3, y + 1)$				