Name Key Class Date

Translations, Reflections, and Rotations

COMMON CORE

CC.8.G.3

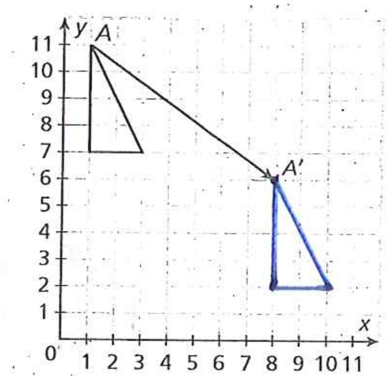
Essential question: *How can you use coordinates to describe the result of a translation, reflection, or rotation?*

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 7 units right and 5 units down.

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

(1, 11) becomes $(1 + 7, 11 + -5) = (8, 6)$

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.

$(x, y) \rightarrow (x + 7, y + -5)$

TRY THIS!

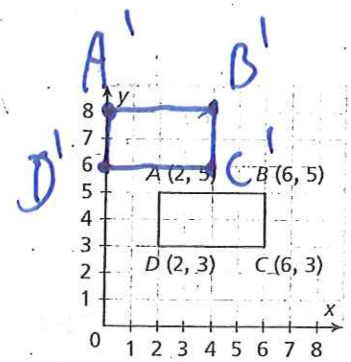
1. Apply the translation $(x, y) \rightarrow (x - 2, y + 3)$ to the figure shown. Give the coordinates of the vertices of the image. (The image of point A is point A'.)

A': (0, 8)

B': (4, 8)

C': (4, 6)

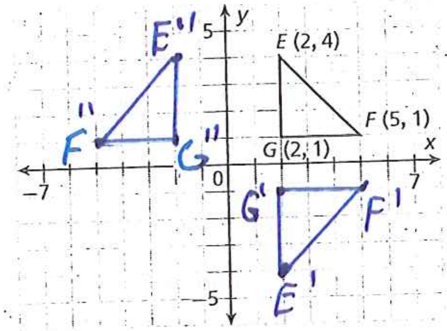
D': (0, 6)



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	(2, -4)	(2, -1)	(5, -1)

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

The x-coordinates stays the same.
The y-coordinates switch signs.

E Complete the ordered pair to write a general rule for reflection across the x-axis. $(x, y) \rightarrow$ (x, y • -1)   (x, y) → (x, -y)

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	(-2, 4)	(-2, 1)	(-5, 1)

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

The x-coordinates switch signs.
The y-coordinates stays the same.

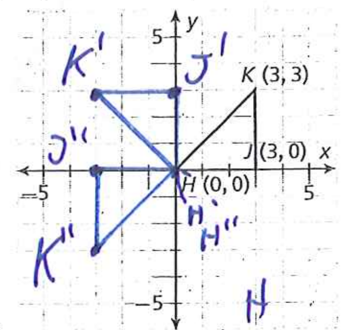
J Complete the ordered pair to write a general rule for reflection across the y-axis. $(x, y) \rightarrow$ (-x , y)

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.



All are at the same point → H' → H''

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': (0 , 0)

J': (0 , 3)

K': (-3 , 3)

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'': (0 , 0)

J'': (-3 , 0)

K'': (-3 , -3)

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.

The image is the same.

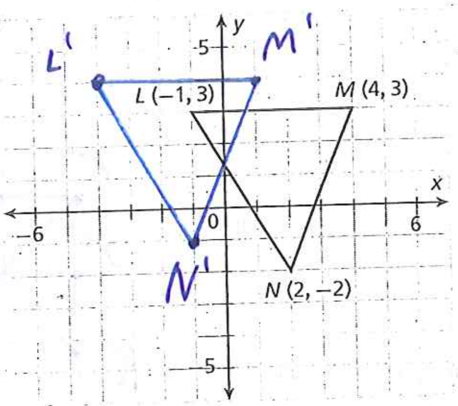
3d. Through how many degrees would you need to rotate a figure for the image to coincide with the preimage? Explain.

360° A rotation of 360° brings the image exactly back to its original position.

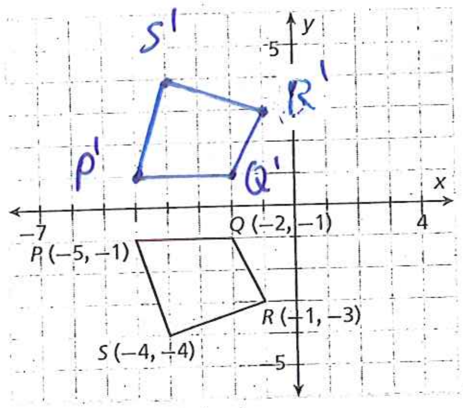
PRACTICE

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

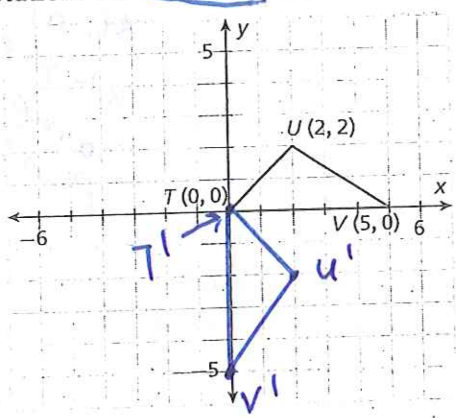
1. Translation: $(x, y) \rightarrow (x - 3, y + 1)$



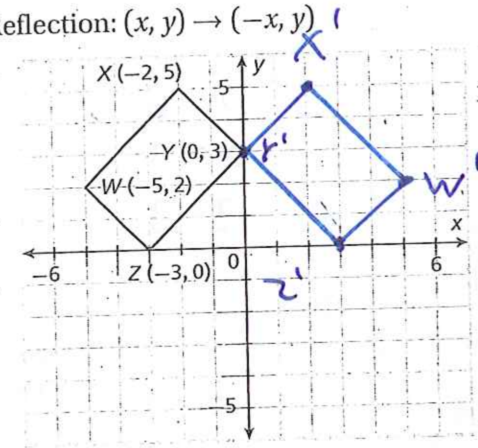
2. Reflection: $(x, y) \rightarrow (x, -y)$



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