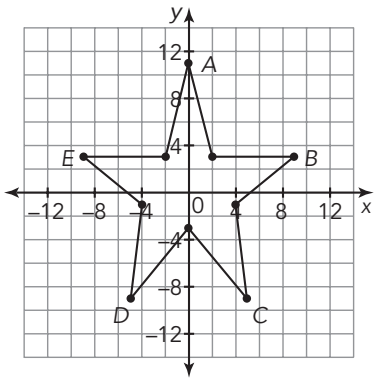
3

Lateral Moves

Translations of Figures on the Coordinate Plane

WARM UP

1. Identify the ordered pairs associated with each of the five labeled points of the star.



LEARNING GOALS

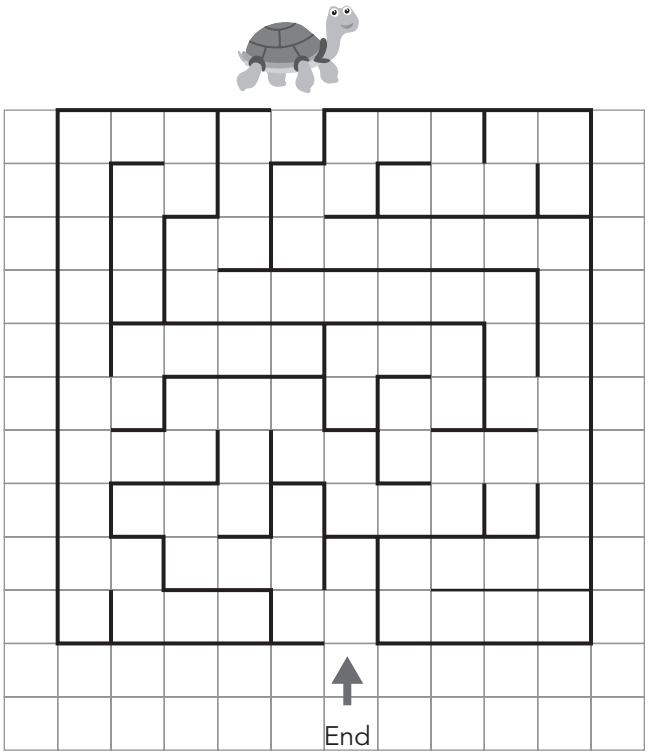
- Translate geometric figures on the coordinate plane.
- Identify and describe the effect of geometric translations on two-dimensional figures using coordinates.
- Identify congruent figures by obtaining one figure from another using a sequence of translations.

You have learned to model transformations, such as translations, rotations, and reflections. How can you model and describe these transformations on the coordinate plane?

Stopping for Directions

Consider the maze shown.

1. **Navigate this maze to help the turtle move to the end. Justify your solution by writing the steps you used to solve the maze.**

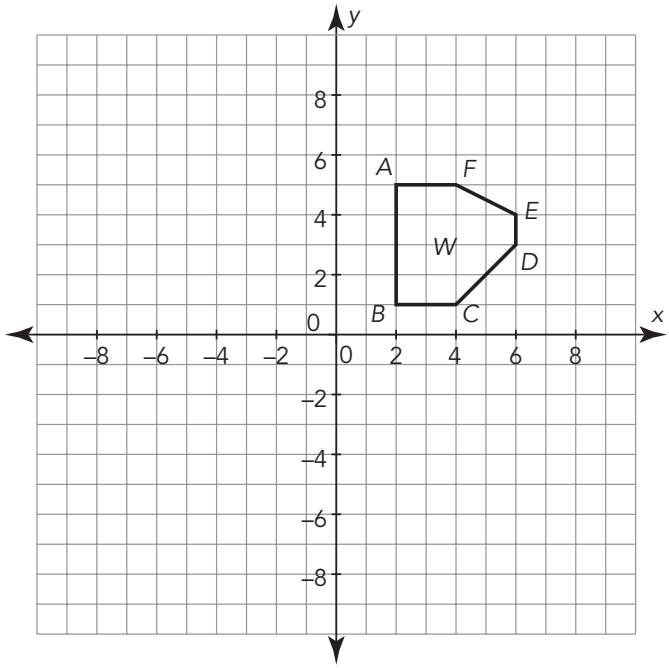


2. **How would your steps change if the turtle started at the end and had to make its way to the start of the maze?**

ACTIVITY
3.1

Modeling Translations on the Coordinate Plane

You know that translations are transformations that "slide" each point of a figure the same distance and the same direction. Each point moves in a line. You can describe translations more precisely by using coordinates.



1. **Place patty paper on the coordinate plane, trace Figure *W*, and copy the labels for the vertices on the patty paper.**

   a. **Translate the figure down 6 units. Then, identify the coordinates of the translated figure.**

   b. **Draw the translated figure on the coordinate plane with a different color, and label it as Figure *W′*. Then identify the pre-image and the image.**

   c. **Did translating Figure *W* vertically change the size or shape of the figure? Justify your answer.**

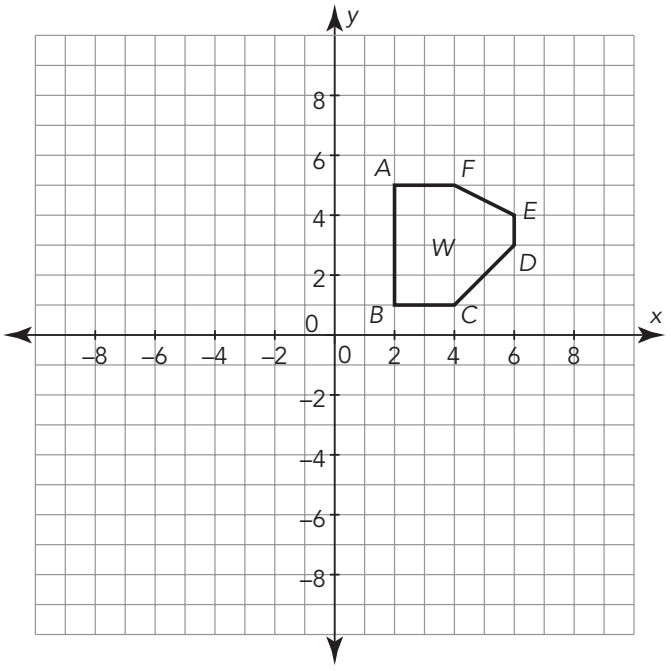
   d. **Complete the table with the coordinates of Figure *W′*.**

   e. **Compare the coordinates of Figure *W′* with the coordinates of Figure *W*. How are the values of the coordinates the same? How are they different? Explain your reasoning.**

Coordinates of *W*	Coordinates of *W′*
A (2, 5)	
B (2, 1)	
C (4, 1)	
D (6, 3)	
E (6, 4)	
F (4, 5)	

Now, let's investigate translating Figure *W* horizontally.

2. Place patty paper on the coordinate plane, trace Figure *W*, and write and copy the labels for the vertices.



a. Translate the figure left 5 units.

b. Draw the translated figure on the coordinate plane with a different color, and label it as Figure *W*″. Then identify the pre-image and the image.

c. Did translating Figure *W* horizontally change the size or shape of the figure? Justify your answer.

Coordinates of *W*	Coordinates of *W*″
A (2, 5)	
B (2, 1)	
C (4, 1)	
D (6, 3)	
E (6, 4)	
F (4, 5)	

d. Complete the table with the coordinates of Figure *W*″.

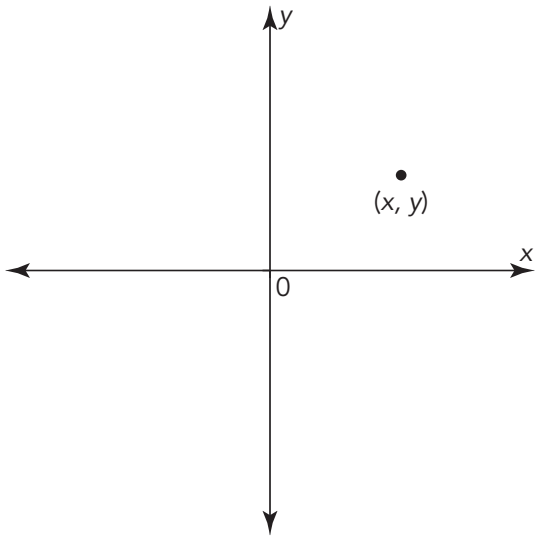
e. Compare the coordinates of Figure *W*″ with the coordinates of Figure *W*. How are the values of the coordinates the same? How are they different? Explain your reasoning.

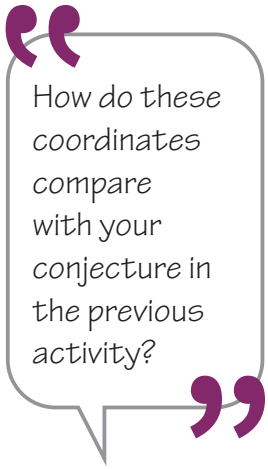
3. Make a conjecture about how a vertical or horizontal translation affects the coordinates of any point (*x*, *y*).

ACTIVITY
3.2

Translating Any Points on the Coordinate Plane

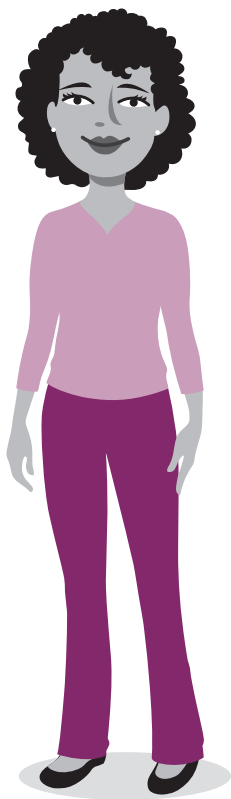
Consider the point (x, y) located anywhere in the first quadrant on the coordinate plane.





1. Consider each translation of the point (x, y) according to the descriptions in the table shown. Record the coordinates of the translated points in terms of x and y.

Translation	Coordinates of Translated Point
3 units to the left	
3 units down	
3 units to the right	
3 units up	



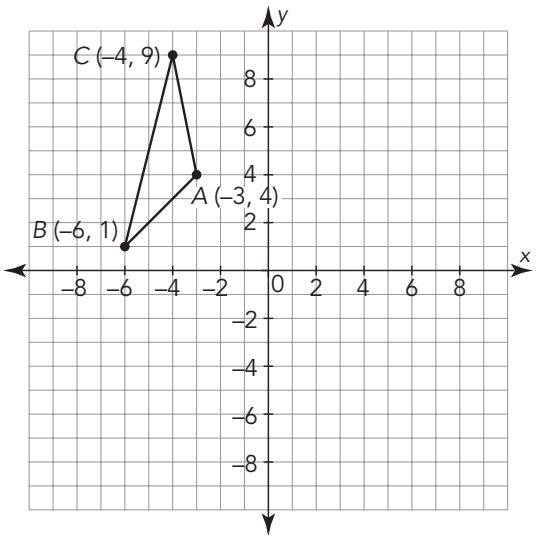
2. Describe a translation in terms of *x* and *y* that would move any point (*x*, *y*) in Quadrant I into each quadrant.

a. Quadrant II

b. Quadrant III

c. Quadrant IV

Let's consider Triangle *ABC* shown on the coordinate plane.



3. Use the table to record the coordinates of the vertices of each translated triangle.

a. Translate Triangle *ABC* 5 units to the right to form Triangle *A′B′C′*. List the coordinates of points *A′*, *B′*, and *C′*. Then graph Triangle *A′B′C′*.

b. Translate Triangle *ABC* 8 units down to form Triangle *A″B″C″*. List the coordinates of points *A″*, *B″*, and *C″*. Then graph Triangle *A″B″C″*.

NOTES

Original Triangle	Triangle Translated 5 Units to the Right	Triangle Translated 8 Units Down
ΔABC	$\Delta A'B'C'$	$\Delta A''B''C''$
A (−3, 4)		
B (−6, 1)		
C (−4, 9)		

Let's consider translations of a different triangle without graphing.

4. The vertices of Triangle *DEF* are *D* (−7, 10), *E* (−5, 5), and *F* (−8, 1).

a. If Triangle *DEF* is translated to the right 12 units, what are the coordinates of the vertices of the image? Name the triangle.

b. How did you determine the coordinates of the image without graphing the triangle?

c. If Triangle *DEF* is translated up 9 units, what are the coordinates of the vertices of the image? Name the triangle.

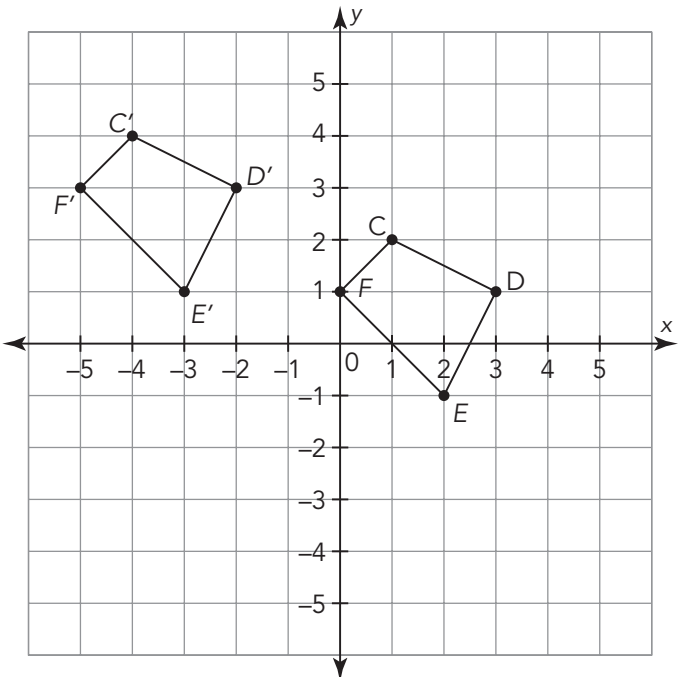
d. How did you determine the coordinates of the image without graphing the triangle?

ACTIVITY
3.3

Verifying Congruence Using Translations

One way to verify that two figures are congruent is to show that the same sequence of translations moves all of the points of one figure to all the points of the other figure.

Consider the two quadrilaterals shown on the coordinate plane.



1. Complete the table with the coordinates of each figure and the translation from each vertex in Quadrilateral *CDEF* to the corresponding vertex in Quadrilateral *C′D′E′F′*.

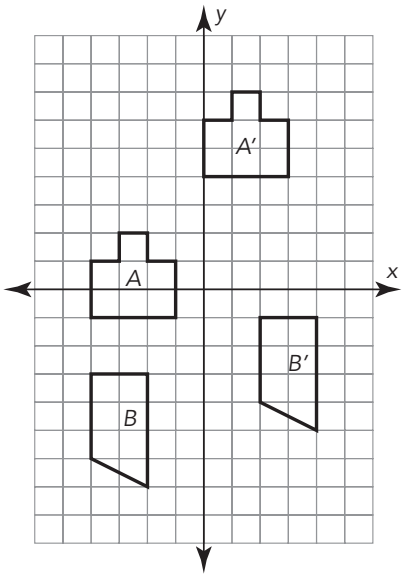
Coordinates of Quadrilateral *CDEF*	Coordinates of Quadrilateral *C′D′E′F′*	Translations

NOTES

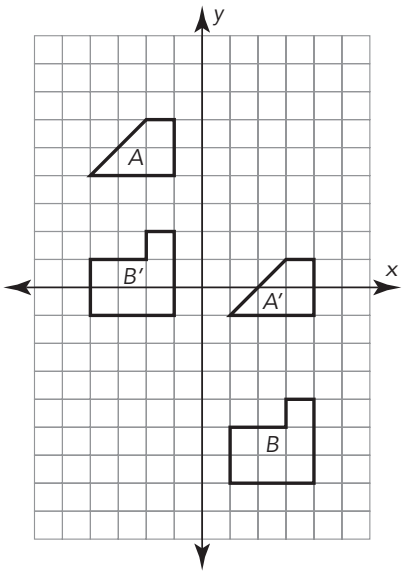
2. Is Quadrilateral *CDEF* congruent to Quadrilateral *C′D′E′F′*? Explain how you know.

3. Describe a sequence of translations that can be used to show that Figures *A* and *A′* are congruent and that Figures *B* and *B′* are congruent. Show your work and explain your reasoning.

a.

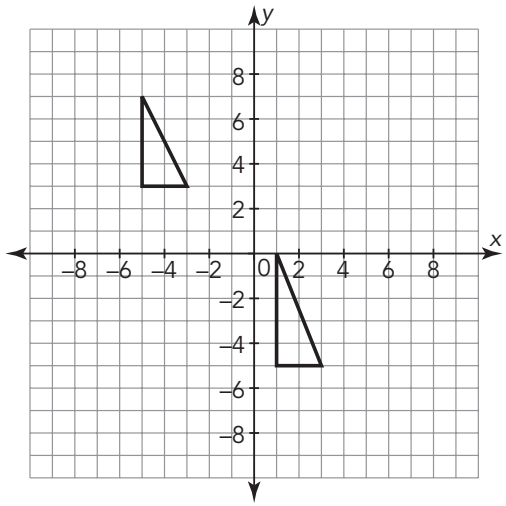


b.



4. **For each example, decide whether the figures given are congruent or not congruent using translations. Show your work and explain your reasoning.**

a.



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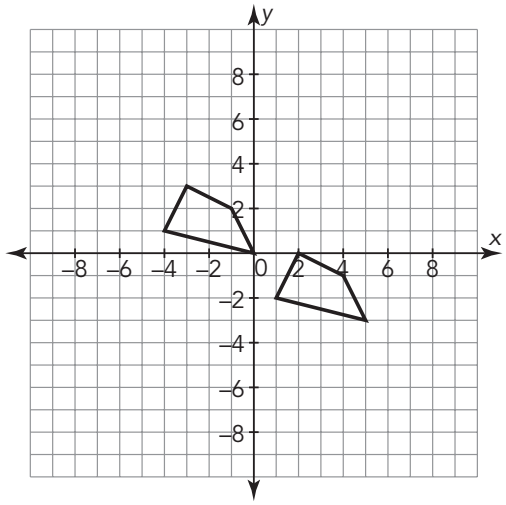
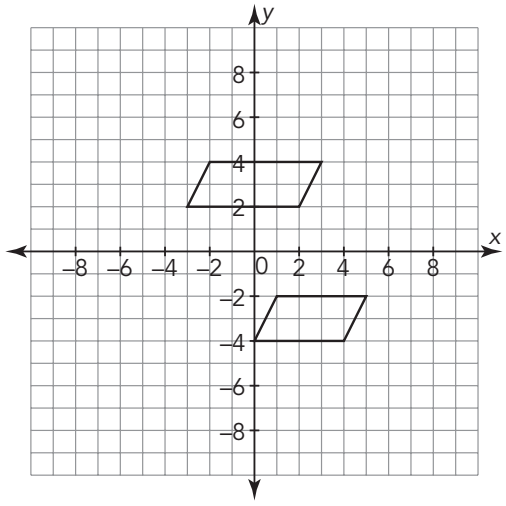


c.



NOTES

TALK the TALK

Left and Right, Up and Down

1. Suppose the point (x, y) is translated horizontally c units.

   a. How do you know if the point is translated left or right?

   b. Write the coordinates of the image of the point.

2. Suppose the point (x, y) is translated vertically d units.

   a. How do you know if the point is translated up or down?

   b. Write the coordinates of the image of the point.

3. Suppose a point is translated repeatedly up 2 units and right 1 unit. Does the point remain on a straight line as it is translated? Draw an example to explain your answer.

NOTES

4. Can you verify that these two figures are congruent using only translations? Explain why or why not.