

Lesson 22

TRANSLATE FIGURES USING COORDINATES NY-8.G.3

WORDS TO KNOW

translation

image

INTRODUCTION

Real-World Connection

Mr. Woods made a blueprint of his living room and drew his couch at the origin. He decided to move the couch 4 feet north and 3 feet east to place it in front of the fireplace. He wants to represent the new location of the couch on his blueprint. Let's practice the skills in the **Guided Instruction** and **Independent Practice** and, at the end of the lesson, see how to show the couch on the blueprint!



What I Am Going to Learn

- How to translate figures in the coordinate plane
- How the coordinates change when a figure is translated

What I May Already Know

- I know how to plot points in the coordinate plane.
- I know how to draw a polygon in the coordinate plane, given coordinates of the vertices.
- I know how to find the lengths of sides in these polygons using the coordinates.

Vocabulary in Action

A **translation** is a type of transformation.

- A translation moves a point a certain distance and direction.
- When a figure is translated, each vertex moves in the same way.
- For any coordinate (x, y) , the point moves a units horizontally and b units vertically: (x, y) becomes $(x + a, y + b)$.
- Point A being translated with coordinates $A(x, y)$ is the **pre-image**.
- The translated point with coordinates $A'(x + a, y + b)$ is the **image**.

THINK ABOUT IT

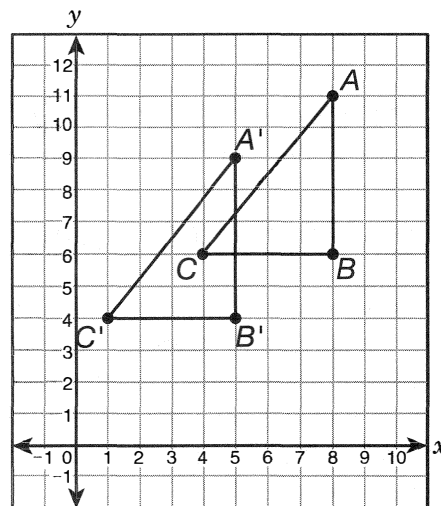
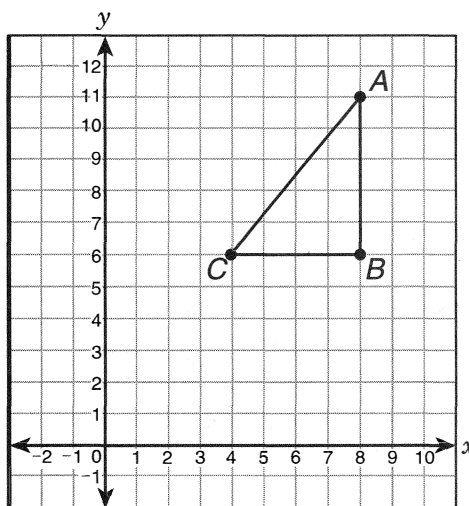
Subtracting (or adding a negative number) moves a point left or down. Adding moves a point right or up.

EXAMPLE

Translate triangle ABC 3 units left and 2 units down.

The coordinates of the triangle are the following:

$$A(8, 11), B(8, 6), C(4, 6)$$



Step One Move left 3 units, $a = -3$; move 2 units down, $b = -2$

$$(x, y) \rightarrow (x - 3, y - 2)$$

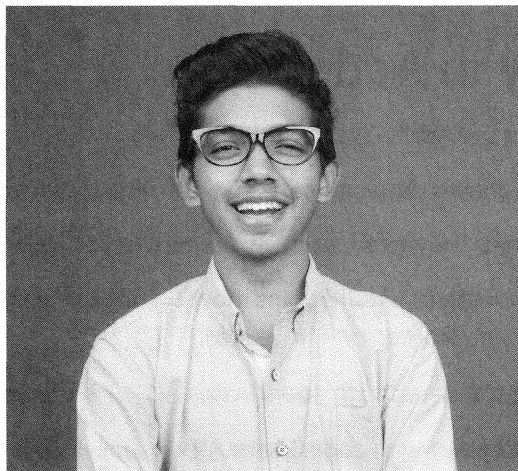
Step Two Apply the rule to each vertex:

$$A(8, 11) \rightarrow A'(8 - 3, 11 - 2) = A'(5, 9)$$

$$B(8, 6) \rightarrow B'(8 - 3, 6 - 2) = B'(5, 4)$$

$$C(4, 6) \rightarrow C'(4 - 3, 6 - 2) = C'(1, 4)$$

Step Three Draw the translated image.



GUIDED INSTRUCTION

1. Parallelogram $ABCD$ is shown. Draw the image $A'B'C'D'$ after the parallelogram is translated 6 units left.

Step One Write the vertices of $ABCD$.

$$A(0, 3), B(4, 3), C(7, -2), D(3, -2)$$

Step Two Translate 6 units left, $a = -6$.

$$(x, y) \rightarrow (x - 6, y)$$

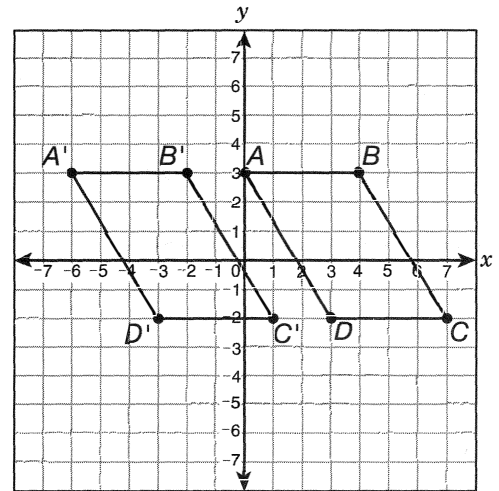
$$A(0, 3) \rightarrow A'(0 - 6, 3) = A'(-6, 3)$$

$$B(4, 3) \rightarrow B'(4 - 6, 3) = B'(-2, 3)$$

$$C(7, -2) \rightarrow C'(7 - 6, -2) = C'(1, -2)$$

$$D(3, -2) \rightarrow D'(3 - 6, -2) = D'(-3, -2)$$

Step Three Plot the new coordinates and draw $A'B'C'D'$.



2. Identify the translation used on triangle KLM to make its image $K'L'M'$. Is the translation horizontal or vertical?

Step One The translation is vertical because we can see that the triangle moved directly down.

This means that the x -coordinates will not change.

Step Two To find the rule, choose a point and substitute the vertices for

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

$$K(-4, 9) \rightarrow K'(-4, -2)$$

$a = 0$ because the x -coordinate does not change.

$$b = y' - y = -2 - 9 = -11$$

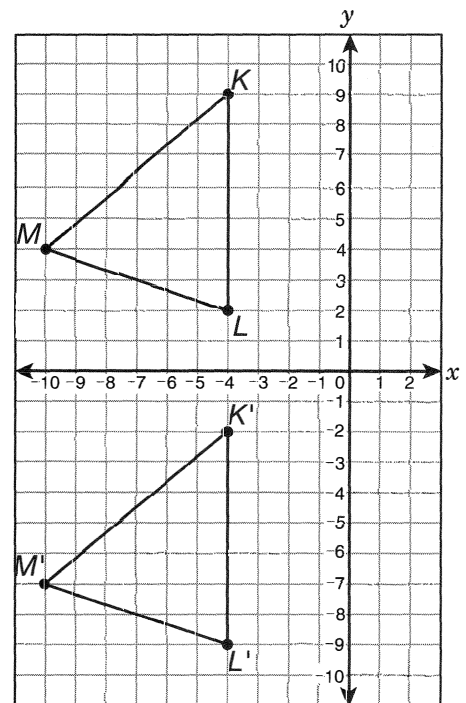
Step Three Write the translation rule.

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

The triangle moved vertically \quad units.

TURN AND TALK

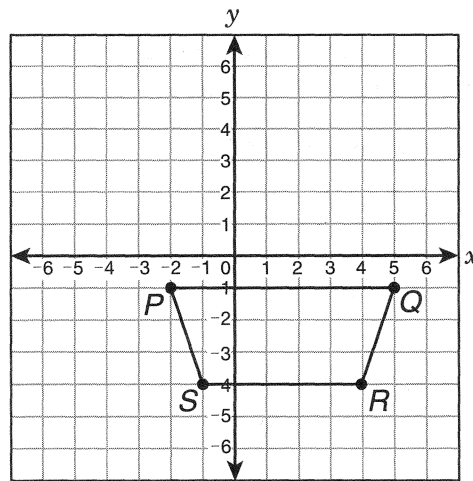
If a figure moves in only one direction, which coordinate stays the same?



SKETCH IT

You can use the image to help solve the problem. From each vertex, move 4 units up and 1 unit left, and write down the coordinates of the new vertex. Then compare the new vertices with the answer choices.

3. Trapezoid $PQRS$ is translated 4 units up and 1 unit left.



Which one of the following is coordinates of the vertices of the image, $P'Q'R'S'$?

- (A) $(2, -2)$ and $(1, 0)$
- (B) $(-2, 0)$ and $(4, 3)$
- (C) $(4, 3)$ and $(2, -2)$
- (D) $(5, 0)$ and $(-2, 0)$



Learning Together

Working with a partner, use the squares on a tiled floor as a grid. Use colored tape to mark the x - and y -axes. Then record videos of each other's feet demonstrating a starting point and translating that point according to set rules. Make your rules so that they work within the size of your grid.



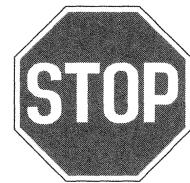
How Am I Doing?

What questions do you have?

In the margin, draw two identical triangles in different parts of the coordinate plane. What is the rule for how the second triangle moved from the first triangle?

What is an example of a translation you see in everyday life?

Circle the sign that shows how you are doing with the skill.



I am stuck.



I almost have it.

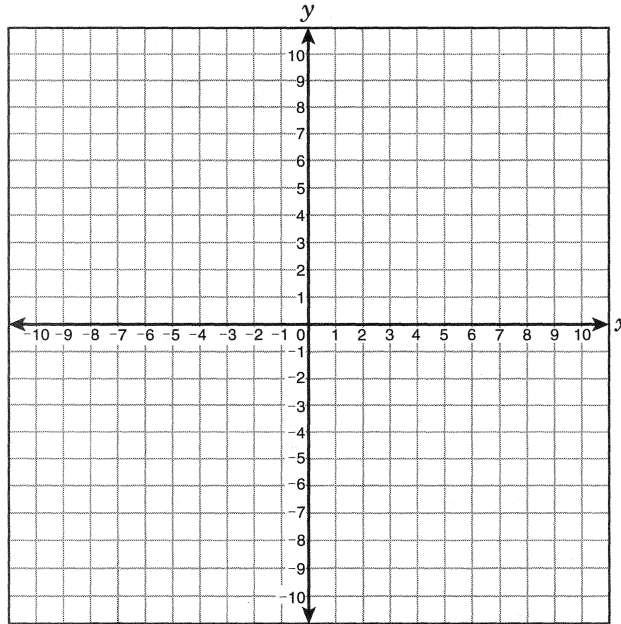


I understand the skill.

INDEPENDENT PRACTICE 1

1

Use the grid below to help you visualize the answer.



Angie translated trapezoid $RSTU$ to trapezoid $R'S'T'U'$. Vertex T was at $(-4, 3)$. If vertex T' is at $(3, -1)$, which **best** describes this translation?

- A Move 3 units right and 3 units down.
- B Move 7 units right and 4 units down.
- C Move 4 units left and 1 unit up.
- D Move 8 units left and 2 units up.

TIPS AND HINTS

When you are working with a coordinate plane, one "unit" is one square.

2

A square is the image after a translation according to the rule $(x, y) \rightarrow (x - 7, y - 2)$. The square has vertices at $(-2, 4)$, $(-8, 4)$, $(-2, -2)$, $(-8, -2)$. Which of the following is a vertex of the pre-image?

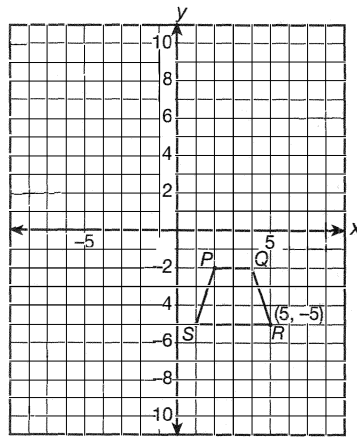
- A $(-1, 0)$
- B $(-9, 2)$
- C $(-6, 5)$
- D $(-7, -2)$

TIPS AND HINTS

Remember that a "vertex" of a square is a corner.

3

Trapezoid $PQRS$ and the coordinates of point R are shown on the coordinate plane below.



SKETCH IT

Drawing the translated image might help to clarify this answer.

What are the coordinates of the image of point R after the trapezoid is translated 8 units to the left?

- A (13, -5)
- B (-3, -5)
- C (5, 3)
- D (-5, -5)

4

Aria rotated Point M 90° to Point M' at $(5, 5)$. What are the coordinates of Point M ?

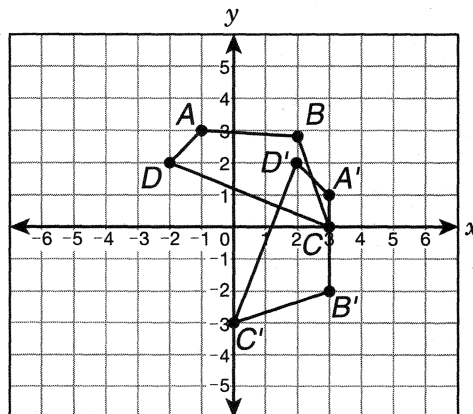
Explain your answer.

THINK ABOUT IT

How can picturing a circle in your mind help you remember how far 90° is?

INDEPENDENT PRACTICE 2

- 1 The coordinate plane below shows two images.



Which answer choice is correct?

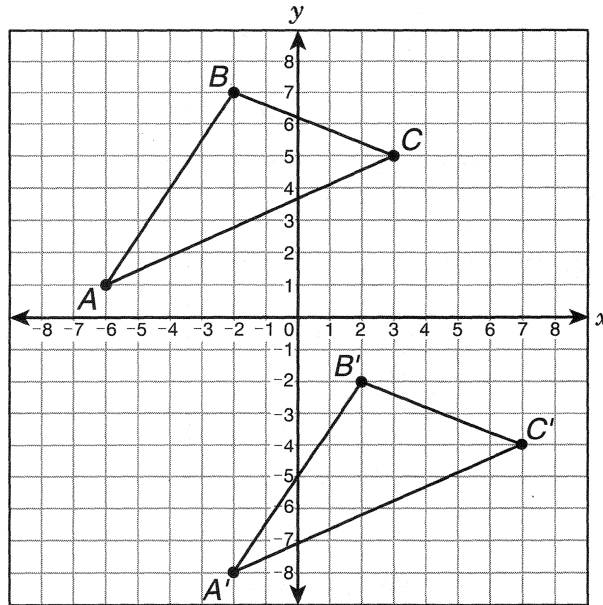
- A Quadrilateral $ABCD$ is vertically translated to form image $A'B'C'D'$.
- B Quadrilateral $ABCD$ is horizontally translated to form image $A'B'C'D'$.
- C Quadrilateral $ABCD$ is vertically and horizontally translated to form image $A'B'C'D'$.
- D Quadrilateral $ABCD$ is not translated to form image $A'B'C'D'$.

- 2 Which option correctly translates a point for the given translation rule or description?

- A The point $(4, -4)$ becomes $(8, 8)$, given the translation $(x, y) \rightarrow (x - 4, y + 4)$.
- B The point $(-5, -2)$ becomes $(-3, 5)$, given the translation $(x, y) \rightarrow (x + 2, y + 3)$.
- C The point $(0, 0)$ becomes $(-3, -4)$, given a translation of 3 units left and 4 units down.
- D The point $(-1, -3)$ becomes $(-3, 2)$, given a translation of 5 units up and 2 units right.

3

The coordinate plane below shows a pre-triangle and a translated triangle.



What is the translation used on triangle ABC to create triangle $A'B'C'$?

- A $(x, y) \rightarrow (x + -9, y + 4)$
- B $(x, y) \rightarrow (x - 9, y + 4)$
- C $(x, y) \rightarrow (x - 4, y + 9)$
- D $(x, y) \rightarrow (x + 4, y - 9)$

4

Which one of the following coordinates is correctly translated under the translation rule $(x, y) \rightarrow (x + 4, y - 3)$?

- A $(-3, 4) \rightarrow (1, 4)$
- B $(-5, -5) \rightarrow (1, -2)$
- C $(-1, -7) \rightarrow (5, -4)$
- D $(-2, -1) \rightarrow (2, -4)$

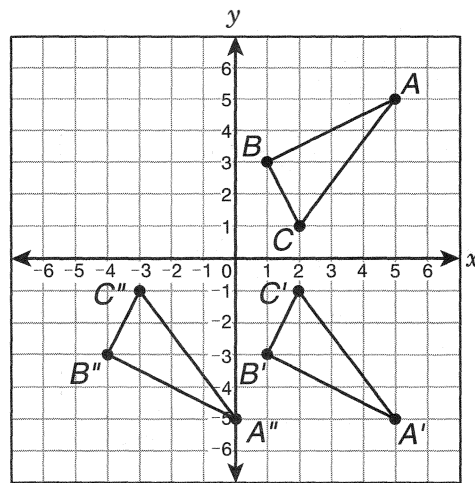
5

A quadrilateral with vertices $P(2, 0)$, $Q(1, 5)$, $R(5, 3)$, and $S(4, 0)$ is translated 6 units right and 4 units down to form its image $P'Q'R'S'$. What are the coordinates of the vertex R' ?

- | | |
|--------------|--------------|
| A $(-1, 7)$ | C $(11, 7)$ |
| B $(-1, -1)$ | D $(11, -1)$ |

6

The graph below shows three triangles: ABC , $A'B'C'$, and $A''B''C''$.

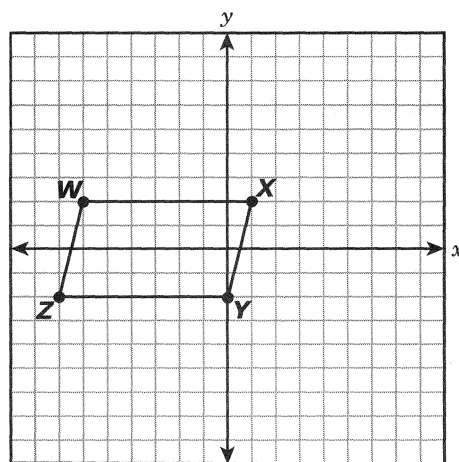


Which statement is true?

- A $\triangle ABC$ is a translation of $\triangle A'B'C'$ 10 units down.
- B $\triangle A''B''C''$ is a translation of $\triangle A'B'C'$ 5 units left.
- C $\triangle ABC$ is a translation of $\triangle A''B''C''$ 3 units down and 3 units left.
- D $\triangle A''B''C''$ is a translation of $\triangle ABC$ 2 units left and 5 units down.

7

Parallelogram $WXYZ$ is translated on the coordinate plane below such that X' is at $(5, 6)$.



If the algebraic rule is expressed as $(x, y) \rightarrow (x + 2n, y + 2n)$, what is the value of n ?

- A 2
- B 3
- C 4
- D 10

8

Triangle ABC is translated to its image triangle $A'B'C'$ using the translation rule $(x, y) \rightarrow (x - 7, y - 6)$.

A student claims that triangle $A'B'C'$ can be translated back to triangle ABC using the translation rule $(x, y) \rightarrow (x - 6, y - 7)$. Is the student correct?

Answer _____ (yes or no)

Explain your answer.

9

A point $S(-3, 7)$, is translated and its image is at the origin. How was the point translated?

Explain your answer.

What would be the translated point?

Explain your answer.

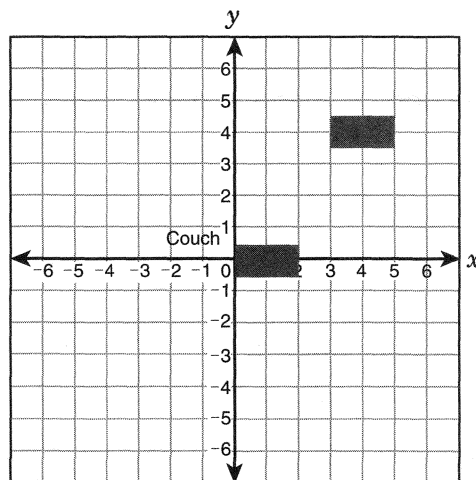
EXIT TICKET

NY-8.G.3

Now that you have mastered translations, let's solve the problem in the Real-World Connection.

Mr. Woods made a blueprint of his living room and drew his couch at the origin. He decided to move the couch 4 feet north and 3 feet east to place it in front of the fireplace. He wants to represent the new location of the couch on his blueprint. In the coordinate plane below, north is represented by a positive change in the y -coordinate, and east is represented by a positive change in the x -coordinate.

The two couch locations are shown on the coordinate plane. What are the coordinates for the left and right sides?



Left side:

Right side:

Explain your answers.
