

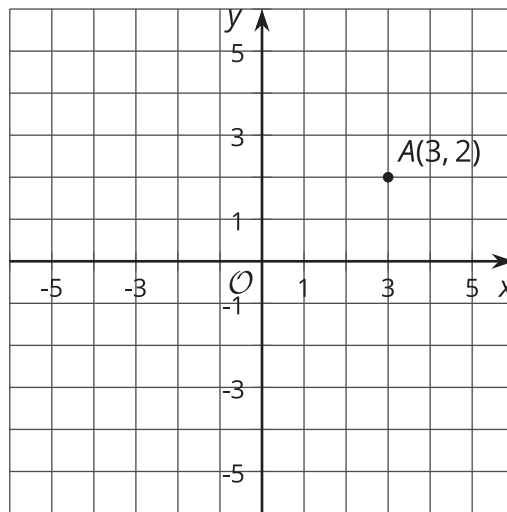


# Transformations as Functions

Let's compare transformations to functions.

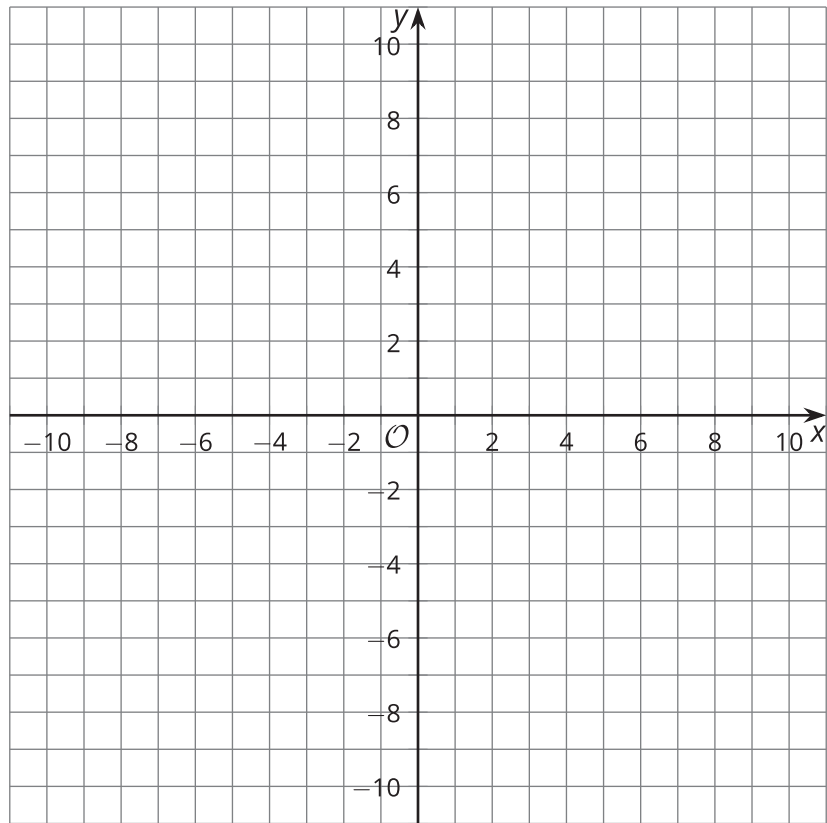
## 2.1 Math Talk: Transforming a Point

Mentally find the coordinates of the image of  $A$  under each transformation.



- Translate  $A$  by the directed line segment from  $(0, 0)$  to  $(0, 2)$ .
- Translate  $A$  by the directed line segment from  $(0, 0)$  to  $(-4, 0)$ .
- Reflect  $A$  across the  $x$ -axis.
- Rotate  $A$  180 degrees clockwise using the origin as a center.

## 2.2 Inputs and Outputs



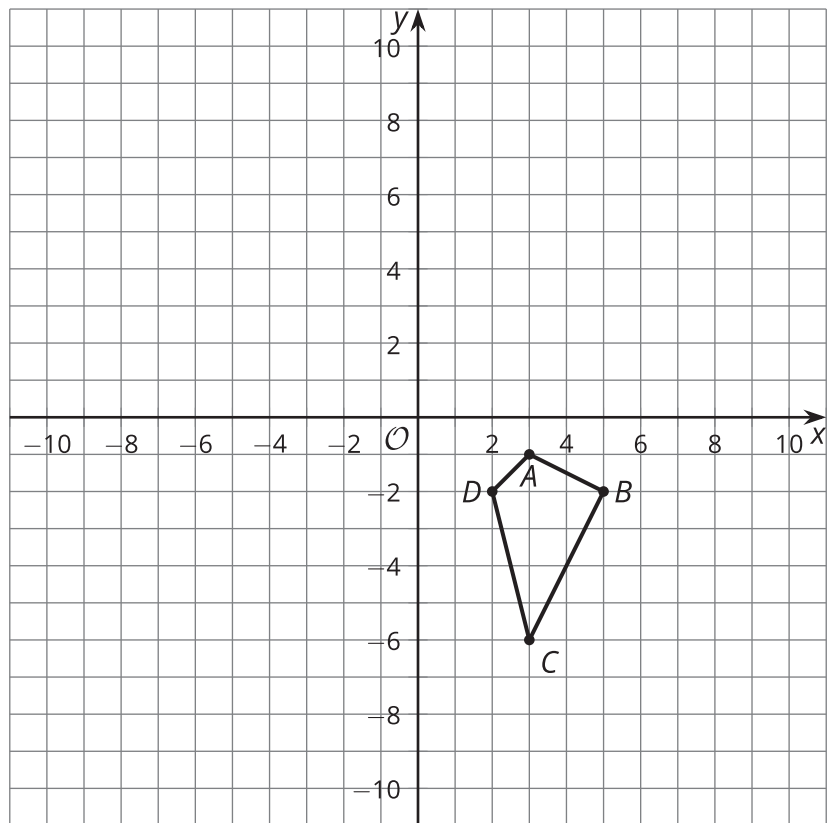
- For each point  $(x, y)$ , find its image under the transformation  $(x + 12, y - 2)$ .
  - $A(-10, 5)$
  - $B(-4, 9)$
  - $C(-2, 6)$
- Next, sketch triangle  $ABC$  and its image on the grid. What transformation is  $(x, y) \rightarrow (x + 12, y - 2)$ ?

3. For each point  $(x, y)$  in the table, find  $(2x, 2y)$ .

| $(x, y)$   | $(2x, 2y)$ |
|------------|------------|
| $(-1, -3)$ |            |
| $(-1, 1)$  |            |
| $(5, 1)$   |            |
| $(5, -3)$  |            |

4. Next, sketch the original figure (the  $(x, y)$  column) and image (the  $(2x, 2y)$  column). What transformation is  $(x, y) \rightarrow (2x, 2y)$ ?

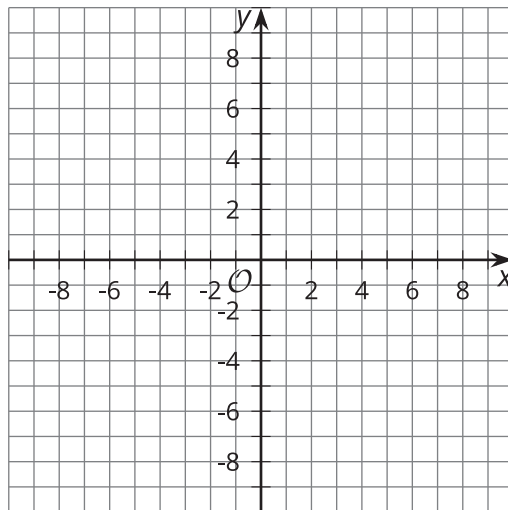
## 2.3 What Does It Do?



1. Here are some transformation rules. Apply each rule to quadrilateral  $ABCD$ , and graph the resulting image. Then describe the transformation.
  - a. Label this transformation  $Q$ :  $(x, y) \rightarrow (2x, y)$
  - b. Label this transformation  $R$ :  $(x, y) \rightarrow (x, -y)$
  - c. Label this transformation  $S$ :  $(x, y) \rightarrow (y, -x)$



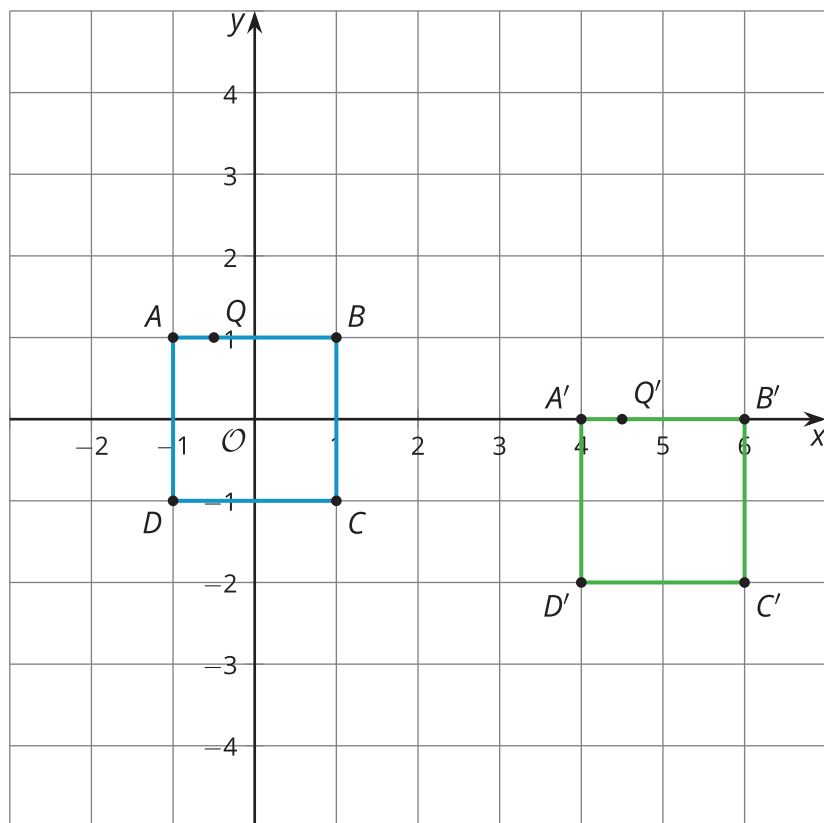
Are you ready for more?



1. Plot the quadrilateral with vertices  $(4, -2)$ ,  $(8, 4)$ ,  $(8, -6)$ , and  $(-6, -6)$ . Label this quadrilateral  $A$ .
2. Plot the quadrilateral with vertices  $(-2, 4)$ ,  $(4, 8)$ ,  $(-6, 8)$ , and  $(-6, -6)$ . Label this quadrilateral  $A'$ .
3. How are the coordinates of quadrilateral  $A$  related to the coordinates of quadrilateral  $A'$ ?
4. What single transformation takes quadrilateral  $A$  to quadrilateral  $A'$ ?

## Lesson 2 Summary

Square  $ABCD$  has been translated by the directed line segment from  $(-1, 1)$  to  $(4, 0)$ . The result is square  $A'B'C'D'$ .



Here is a list of coordinates in the original figure and corresponding coordinates in the image. Do you see the rule for taking points in the original figure to points in the image?

| original figure | image        |
|-----------------|--------------|
| $A(-1, 1)$      | $A'(4, 0)$   |
| $B(1, 1)$       | $B'(6, 0)$   |
| $C(1, -1)$      | $C'(6, -2)$  |
| $D(-1, -1)$     | $D'(4, -2)$  |
| $Q(-0.5, 1)$    | $Q'(4.5, 0)$ |

This table looks like a table that shows corresponding inputs and outputs of a function. A transformation is a special type of function that takes points in the plane as inputs and gives other points as outputs. In this case, the function's rule is to add 5 to the  $x$ -coordinate and subtract 1 from the  $y$ -coordinate.

We write the rule this way:

$$(x, y) \rightarrow (x + 5, y - 1).$$