2

Running, Rising, Stepping, Scaling

Dilating Figures on the Coordinate Plane

WARM UP

Scale up or scale down to determine the value of the variable in each equivalent ratio.

1. $3 : 1 = 25.5 : z$

2. $2 : 5 = a : 30$

3. $1 : 4 = x : 80$

4. $9.9 : 10 = 99 : p$

LEARNING GOALS

- Dilate figures on a coordinate plane.
- Understand the dilation of a figure on the coordinate plane as a scaling up or scaling down of the coordinates of the figure.
- Describe how a dilation of a figure on a coordinate plane affects the coordinates of the figure.

You have used transformations called dilations to create similar figures. How can you use coordinates to determine whether two figures are similar?

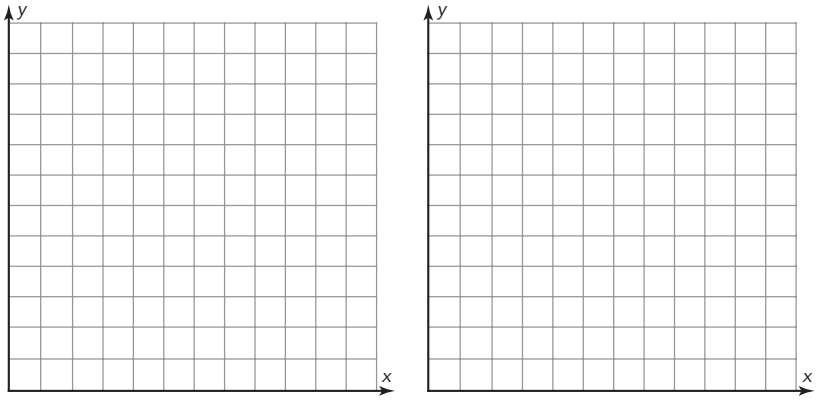
The Escalator or the Stairs

Bob is riding an escalator. The escalator starts at (0, 0) and drops Bob off at (12, 8).

1. **Use the coordinate planes given to represent Bob's journey.**

   a. **Draw a line to show Bob's path on the escalator.**

   b. **Alice takes the stairs. Draw steps starting at the origin that will take Alice to the same location as Bob. Make all of the steps the same.**



2. **How is taking the stairs similar to riding the escalator? How is it different? Explain your reasoning.**

3. **Compare the steps that you designed for Alice with your classmates' steps. How are these steps similar to your steps?**

ACTIVITY 2.1

Scaling Up and Down on the Coordinate Plane

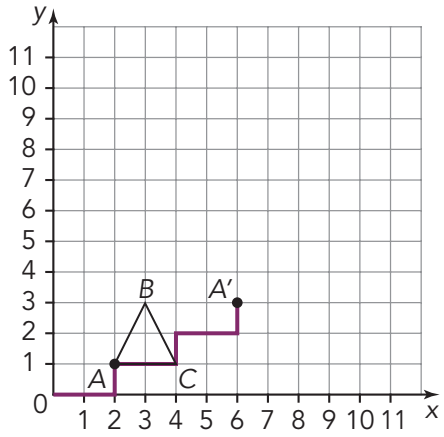
NOTES

You know that a translation moves a point along a line. A sequence of repeated horizontal and/or vertical translations also moves a point along a line. You can use this fact to dilate figures.

WORKED EXAMPLE

Dilate $\triangle ABC$ by a scale factor of 3 using the origin as the center of dilation.

Let's start by dilating Point *A*, which is located at (2, 1). In other words, Point *A* is translated from the origin 2 units right and 1 unit up.



To dilate point *A* by a scale factor of 3, translate Point *A* by three repeated sequences: 2 units right and 1 unit up from the origin.

1. Describe the repeated translations you can use to scale point *B* and point *C*. Then plot point *B*' and point *C*' on the coordinate plane in the Worked Example.

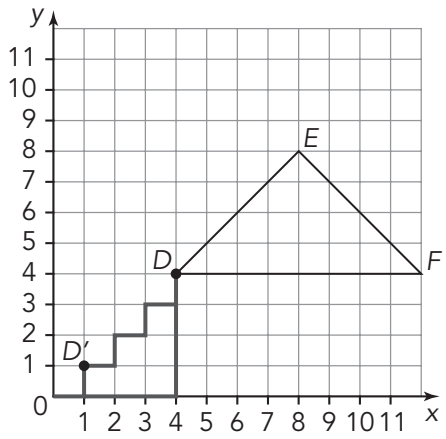
a. point *B* to point *B*′

b. point *C* to point *C*′

2. Draw $\triangle A'B'C'$ on the coordinate plane in the example. Is $\triangle ABC$ similar to $\triangle A'B'C'$? Explain your reasoning.

WORKED EXAMPLE

Dilate ΔDEF by a scale factor of $\frac{1}{4}$ using the origin as the center of dilation.



Point D is translated from the origin 4 units right and 4 units up (4, 4). This is the same as four translations of 1 unit right and 1 unit up.

Therefore, scaling point D to (1, 1) represents a dilation by a scale factor of $\frac{1}{4}$.

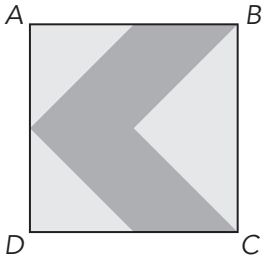
3. Determine the coordinates of points E' and F'. Explain how you determined your answers. Then, draw $\Delta D'E'F'$ on the coordinate plane in the example.

4. Is ΔDEF similar to $\Delta D'E'F'$? Explain your reasoning.

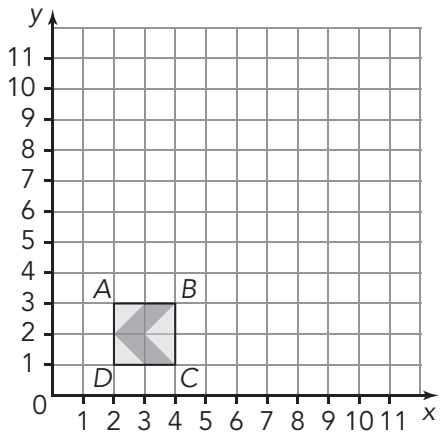
5. How does dilating a figure, using the origin as the center of dilation, affect the coordinates of the original figure? Make a conjecture using the examples in this activity.

ACTIVITY
2.2 Using the Origin as the Center of Dilation

Road signs maintain a constant scale, regardless of whether they are on the road or in the drivers' manual. This sign indicates that the road is bending to the left.



1. Dilate the figure on the coordinate plane using the origin (0, 0) as the center of dilation and a scale factor of 3 to form a new figure.



2. List the ordered pairs for the original figure and for the new figure. How are the values in the ordered pairs affected by the dilation?

3. Compare and contrast the corresponding angles and corresponding side lengths of the new figure and the original figure.

4. **Determine the perimeter and area of the original figure and the new figure.**

	Perimeter	Area
Original Figure		
New Figure		

   a. **How is the perimeter affected by the dilation?**

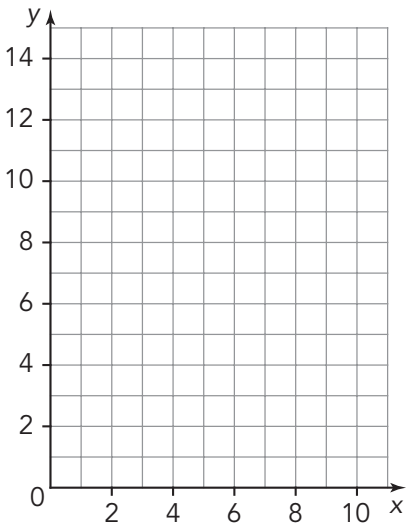
   b. **How is the area affected by the dilation?**

5. **A road sign is represented by the coordinates *A* (2, 1), *B* (2, 12), *C* (6, 12), and *D* (6, 1). Suppose you were to dilate the figure by a scale factor of $\frac{1}{2}$ using the origin as the center of dilation.**

   a. **Predict how the perimeter of the figure will be affected by the dilation.**

   b. **Predict how the area of the figure will be affected by the dilation.**

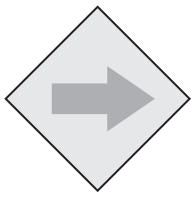
c. **Test your prediction by graphing the original figure and the new figure on the coordinate plane.**



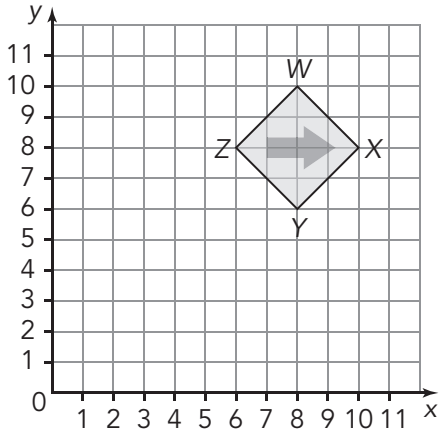
d. **Describe your conclusion.**

6. **How does dilating a figure, using the origin as the center of dilation, affect the perimeter and area of the new figure? Make a conjecture using the examples in this activity.**

Let's consider a different road sign. This sign indicates that the road proceeds to the right.



7. Dilate the figure on the coordinate plane using the origin (0, 0) as the center of dilation and a scale factor of $\frac{1}{2}$ to form a new figure.



8. List the ordered pairs for the original figure and for the new figure. How are the values in the ordered pairs affected by the dilation?

9. Compare and contrast the corresponding angles and corresponding side lengths of the original figure and the new figure. If the dilation of a figure is centered at the origin, you can multiply the coordinates of the points of the original figure by the scale factor to determine the coordinates of the new figure.

10. Suppose a point is located at (x, y). Write the ordered pair of the point after a dilation by each given scale factor.

a. $\frac{1}{2}$

b. 5

c. $\frac{4}{3}$

NOTES

TALK the TALK

Location, Location, Location

Answer each question to summarize what you know about dilating figures on the coordinate plane. Use your answers to plan a presentation for your classmates that demonstrates what you learned in this lesson.

1. **What strategies can you use to determine if two figures are similar when they are:**

   a. **located on a coordinate plane?**

   b. **not located on a coordinate plane?**

2. **A polygon is graphed on a coordinate plane with (x, y) representing the location of a certain point on the polygon. The polygon is transformed using the rule $(x, y) \rightarrow (ax, ay)$.**

   a. **What will be the impact on the original figure if a is greater than 1?**

   b. **What will be the impact on the original figure if a is between 0 and 1?**