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10.2 Similarity and Transformations

For use with Exploration 10.2

Essential Question When a figure is translated, reflected, rotated, or dilated in the plane, is the image always similar to the original figure?

1 EXPLORATION: Dilations and Similarity

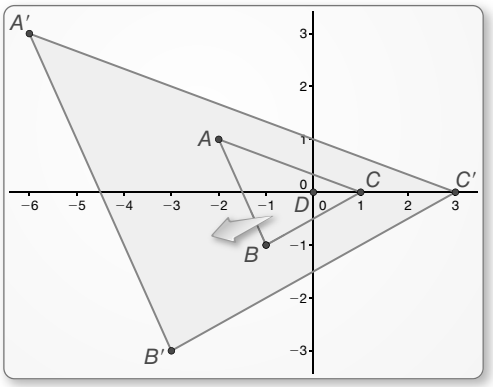
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner.

a. Use dynamic geometry software to draw any triangle and label it $\triangle ABC$.

b. Dilate the triangle using a scale factor of 3. Is the image similar to the original triangle? Justify your answer.

Sample



2 EXPLORATION: Rigid Motions and Similarity

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner.

a. Use dynamic geometry software to draw any triangle.

b. Copy the triangle and translate it 3 units left and 4 units up. Is the image similar to the original triangle? Justify your answer.

c. Reflect the triangle in the y-axis. Is the image similar to the original triangle? Justify your answer.

d. Rotate the original triangle 90° counterclockwise about the origin. Is the image similar to the original triangle? Justify your answer.

Communicate Your Answer

3. When a figure is translated, reflected, rotated, or dilated in the plane, is the image always similar to the original figure? Explain your reasoning.

4. A figure undergoes a composition of transformations, which includes translations, reflections, rotations, and dilations. Is the image similar to the original figure? Explain your reasoning.

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10.2 Practice

For use after Lesson 10.2

Notes:

Worked-Out Examples

Example #1

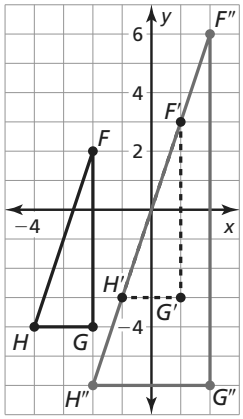
Graph ΔFGH with vertices F(–2, 2), G(–2, –4), and H(–4, –4) and its image after the similarity transformation.

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

Dilation: $(x, y) \rightarrow (2x, 2y)$

Translation $(x, y) \rightarrow (x + 3, y + 1)$: $F(-2, 2) \rightarrow F'(1, 3)$,
$G(-2, -4) \rightarrow G'(1, -3)$, $H(-4, -4) \rightarrow H'(-1, -3)$

Dilation $(x, y) \rightarrow (2x, 2y)$: $F'(1, 3) \rightarrow F''(2, 6)$,
$G'(1, -3) \rightarrow G''(2, -6)$, $H'(-1, -3) \rightarrow H''(-2, -6)$



Example #2

Determine whether the polygons with the given vertices are similar. Use transformations to explain your reasoning.

$A(6, 0)$, $B(9, 6)$, $C(12, 6)$ and $D(0, 3)$, $E(1, 5)$, $F(2, 5)$

yes; *Sample answer:* $\triangle ABC$ can be mapped to $\triangle DEF$ by a dilation with center at the origin and a scale factor of $\frac{1}{3}$ followed by a translation of 2 units left and 3 units up.

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10.2 Practice (continued)

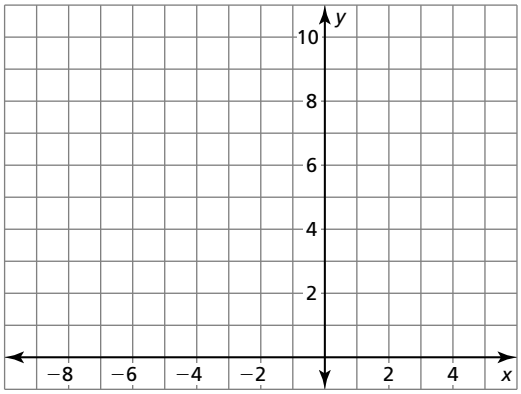
Practice A

In Exercises 1–3, graph the polygon with the given vertices and its image after the similarity transformation.

1. $A(3, 6), B(2, 5), C(4, 3), D(5, 5)$

Translation: $(x, y) \rightarrow (x - 5, y - 3)$

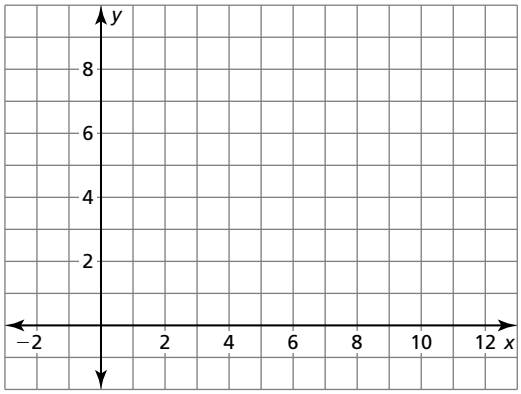
Dilation: $(x, y) \rightarrow (3x, 3y)$



2. $R(12, 8), S(8, 0), T(0, 4)$

Dilation: $(x, y) \rightarrow \left(\frac{1}{4}x, \frac{1}{4}y\right)$

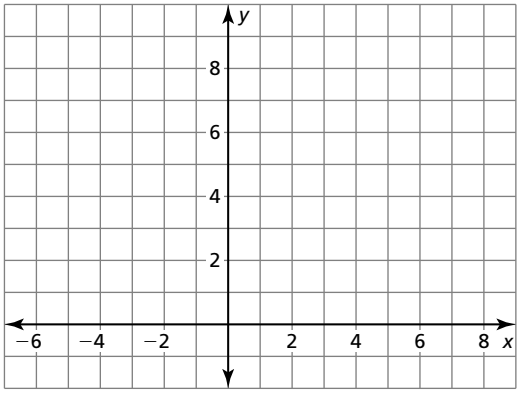
Reflection: in the y-axis



3. $X(9, 6), Y(3, 3), Z(3, 6)$

Rotation: 90° about the origin

Dilation: $(x, y) \rightarrow \left(\frac{2}{3}x, \frac{2}{3}y\right)$



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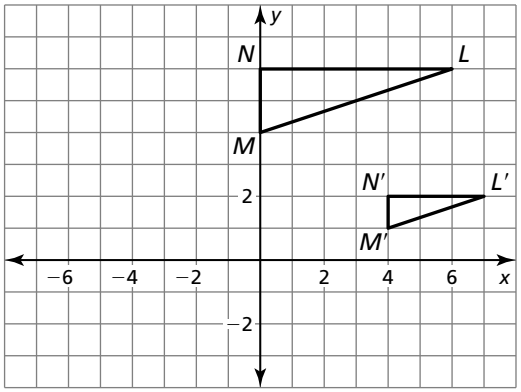
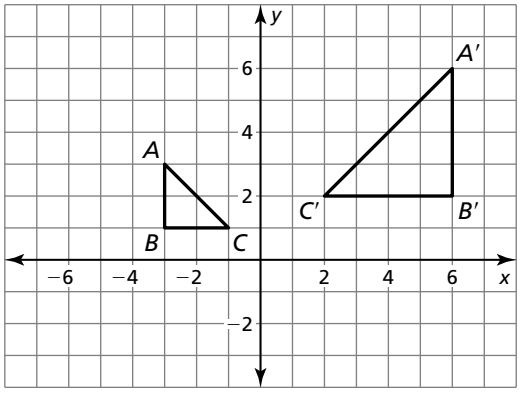
10.2 Practice (continued)

In Exercises 4–6, describe the similarity transformation that maps the preimage to the image.

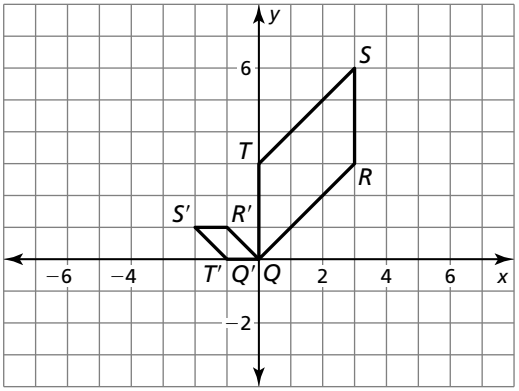
4.



5.



6.



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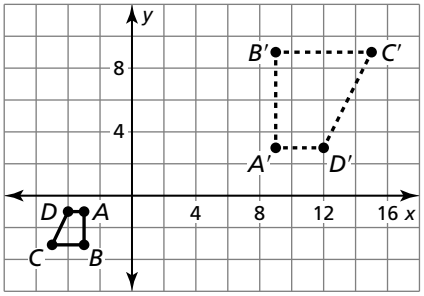
Practice B

In Exercises 1 and 2, graph $\triangle CDE$ with vertices $C(1, 3)$, $D(5, 3)$, and $E(2, 1)$ and its image after the similarity transformation.

1. **Translation:** $(x, y) \rightarrow (x - 5, y - 2)$
   Dilation: $(x, y) \rightarrow (-0.5x, -0.5y)$

2. **Reflection:** in the x-axis
   Dilation: $(x, y) \rightarrow (2x, 2y)$

3. Describe a similarity transformation that maps the black preimage to the dashed image.



In Exercises 4 and 5, determine whether the polygons with the given vertices are similar. Use transformations to explain your reasoning.

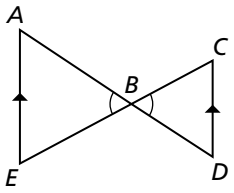
4. $A(-4, 0)$, $B(-4, -2)$, $C(-2, -1)$ and $D(4, 6)$, $E(4, 2)$, $F(8, 2)$

5. $W(0, -1)$, $X(-5, -1)$, $Y(-3, 2)$, $Z(-1, 2)$ and $K(0, -1)$, $L(5, 2)$, $M(3, 4)$, $N(1, 4)$

6. Prove that the figures are similar.

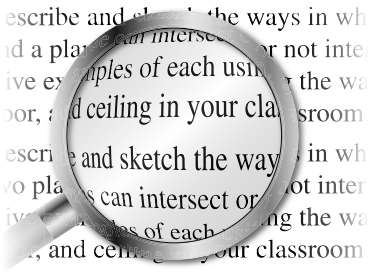
   Given $\angle ABE \cong \angle DBC$, $\overline{AE} \parallel \overline{CD}$

   Prove $\triangle ABE$ is similar to $\triangle DBC$.



7. Is it possible to draw two circles that are not similar? Explain your reasoning.

8. The image shows what text often looks like when viewed through a magnifying glass. Does this represent a similarity transformation? Explain your reasoning.



9. Your friend draws a sketch of triangles in his notebook like the one shown here. He then claims there are the same number of congruent triangles and similar triangles. Is your friend correct? Explain.