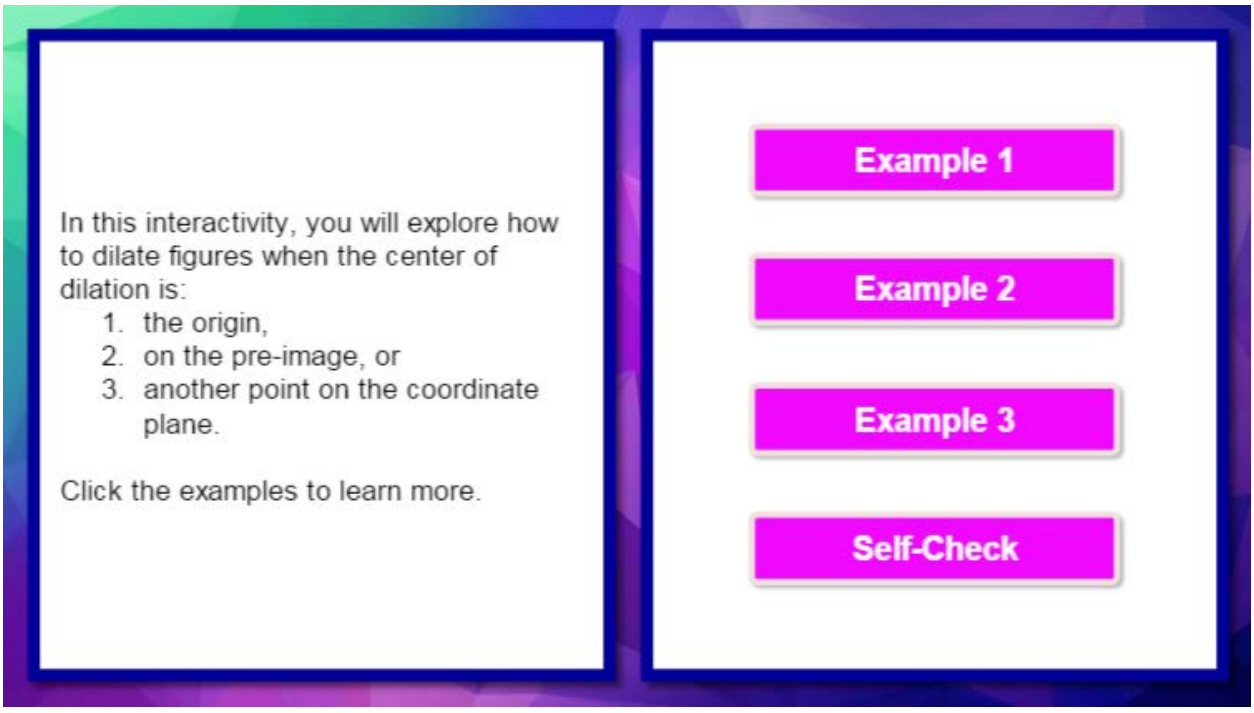
Module 4: Symmetry and Transformations
Topic 5 Content: Dilations on the Coordinate Plane

Introduction

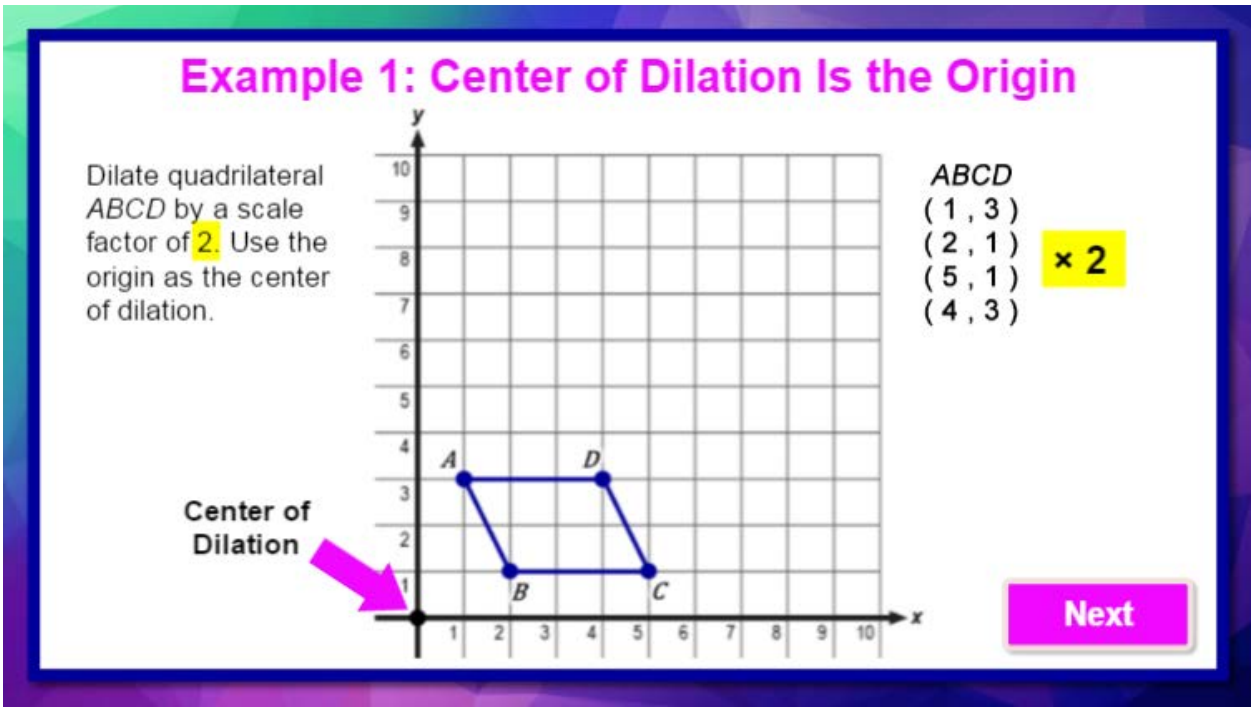


In this interactivity, you will explore how to dilate figures when the center of dilation is:

1. the origin,
2. on the pre-image, or
3. another point on the coordinate plane.

Click the examples to learn more.

Example 1: Center of Dilation Is the Origin



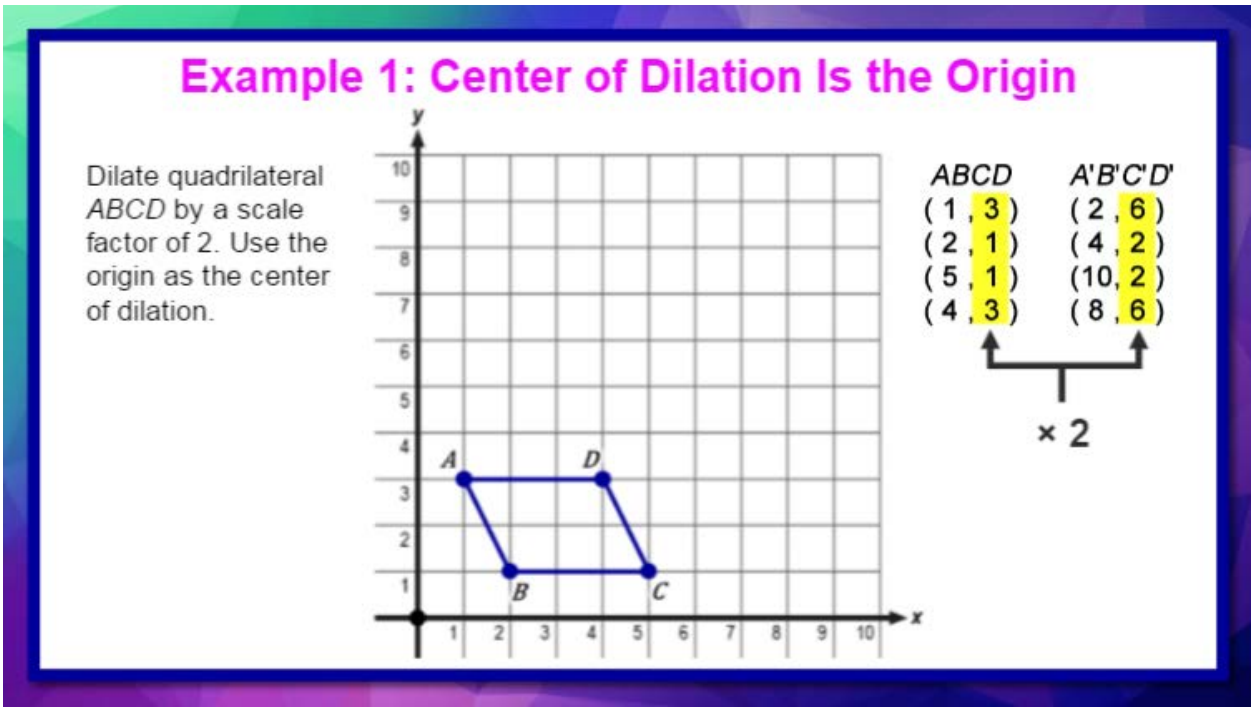
Dilate quadrilateral *ABCD* by a scale factor of 2. Use the origin as the center of dilation.

The vertices of the pre-image *ABCD* are *A*(1, 3), *B*(2, 1), *C*(5, 1), and *D*(4, 3).

If the center of dilation is the origin, you can dilate the figure by multiplying each of the coordinates by the scale factor.

Click ***NEXT*** to continue.

Example 1 (continued)



To find the coordinates of $A'B'C'D'$, multiply the x-coordinates of the pre-image by the scale factor 2 to find the x-coordinates of quadrilateral $A'B'C'D'$.

$ABCD$		$A'B'C'D'$
A (1, 3)	$1 \times 2 = 2$	(2, ?)
B (2, 1)	$2 \times 2 = 4$	(4, ?)
C (5, 1)	$5 \times 2 = 10$	(10, ?)
D (4, 3)	$4 \times 2 = 8$	(8, ?)

multiply $ABCD$ by scale factor 2

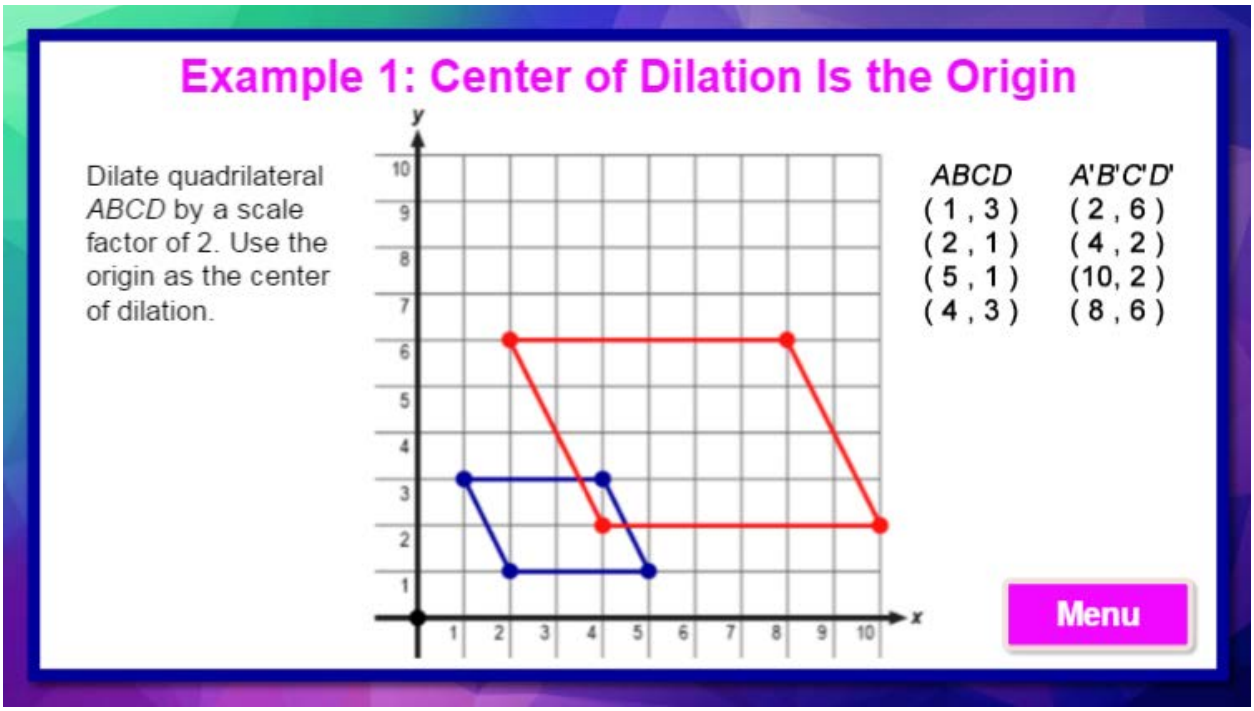
Then multiply the y-coordinates of the pre-image by the scale factor 2 to find the y-coordinates of quadrilateral $A'B'C'D'$.

$ABCD$		$A'B'C'D'$
A (1, 3)	$3 \times 2 = 6$	(2, 6)
B (2, 1)	$1 \times 2 = 2$	(4, 2)
C (5, 1)	$1 \times 2 = 2$	(10, 2)
D (4, 3)	$3 \times 2 = 6$	(8, 6)

multiply $ABCD$ by scale factor 2

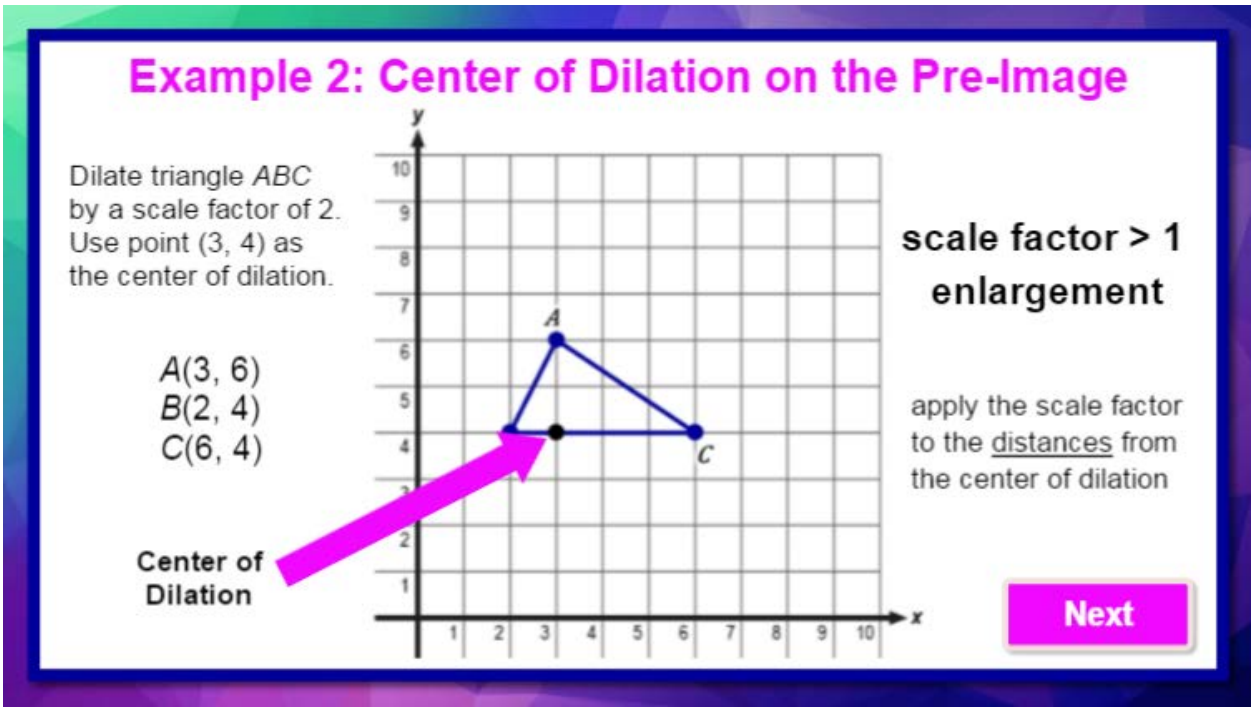
Click ***NEXT*** to continue.

Example 1 (continued)



Now plot the coordinates of the dilated image. The vertices of quadrilateral $A'B'C'D'$ are $A'(2, 6)$, $B'(4, 2)$, $C'(10, 2)$, and $D'(8, 6)$.

Example 2: Center of Diltion on the Pre-Image



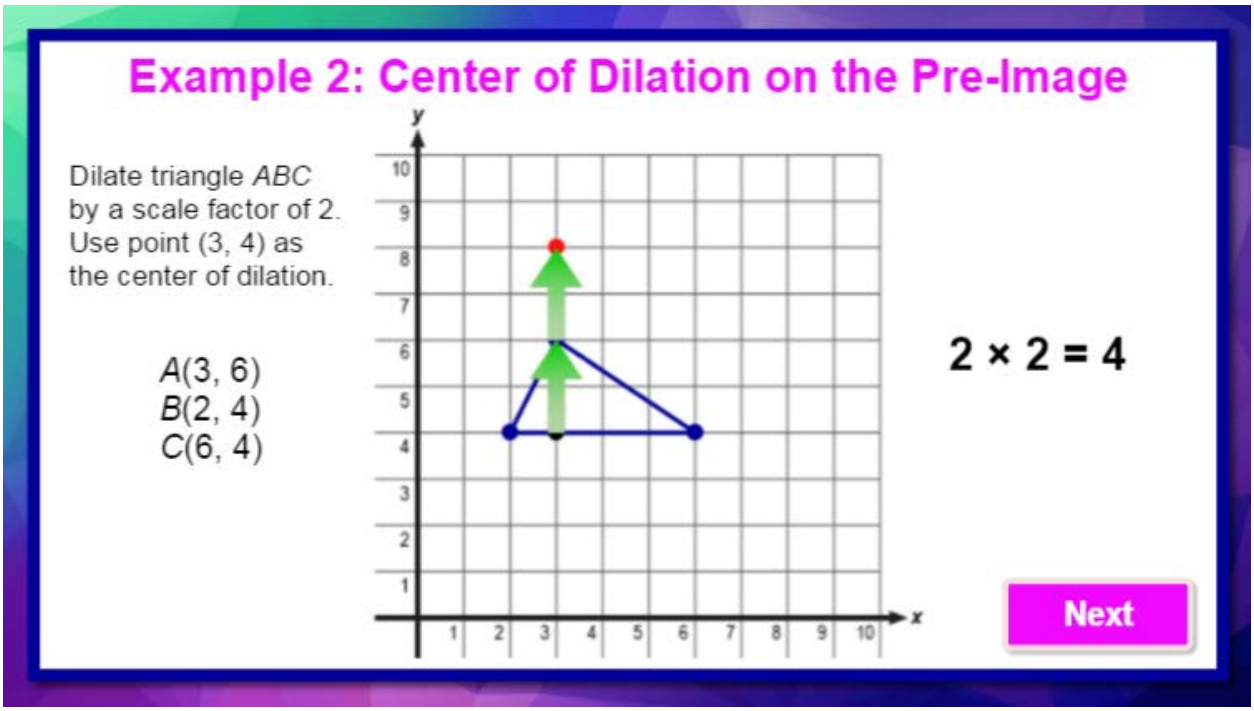
Dilate triangle *ABC* by a scale factor of 2. Use point (3, 4) as the center of dilation.

The vertices of the pre-image *ABC* are *A* (3, 6), *B*(2, 4), and *C*(6, 4).

Because the scale factor is greater than 1, you know that the dilated image will be an enlargement of the pre-image. Notice that the center of dilation is on the pre-image itself rather than the origin. If the center of dilation is not the origin, you cannot simply multiply the coordinates by the scale factor. Instead, you must apply the scale factor to the distances from the center of dilation. In this example, the distances will be twice as large.

Click ***NEXT*** to continue.

Example 2 (continued)

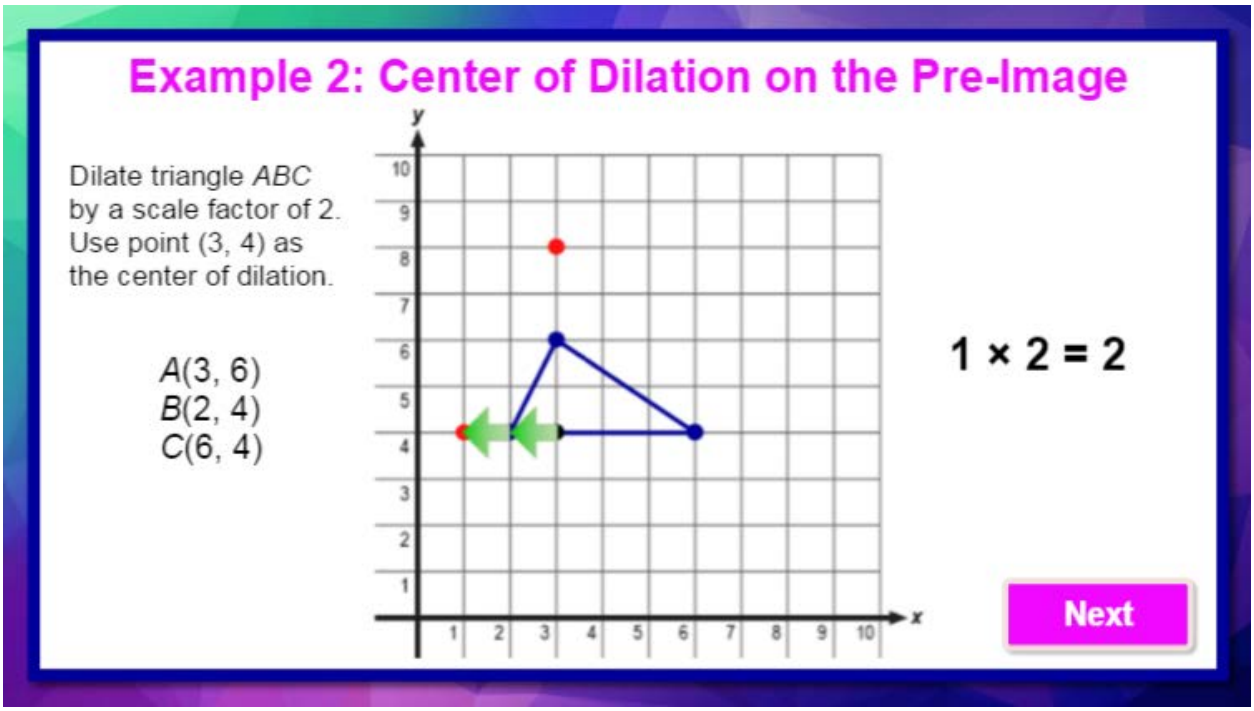


Starting with point *A* at (3, 6), you'll notice the distance from the center of dilation to point *A* is 2 units.

To apply a scale factor of 2, the distance from the center of dilation to point *A*' will be twice as long as the distance from the center of dilation to point *A*, so the new distance will be 4 units. The coordinates of point *A*' are (3, 8).

Click ***NEXT*** to continue.

Example 2 (continued)

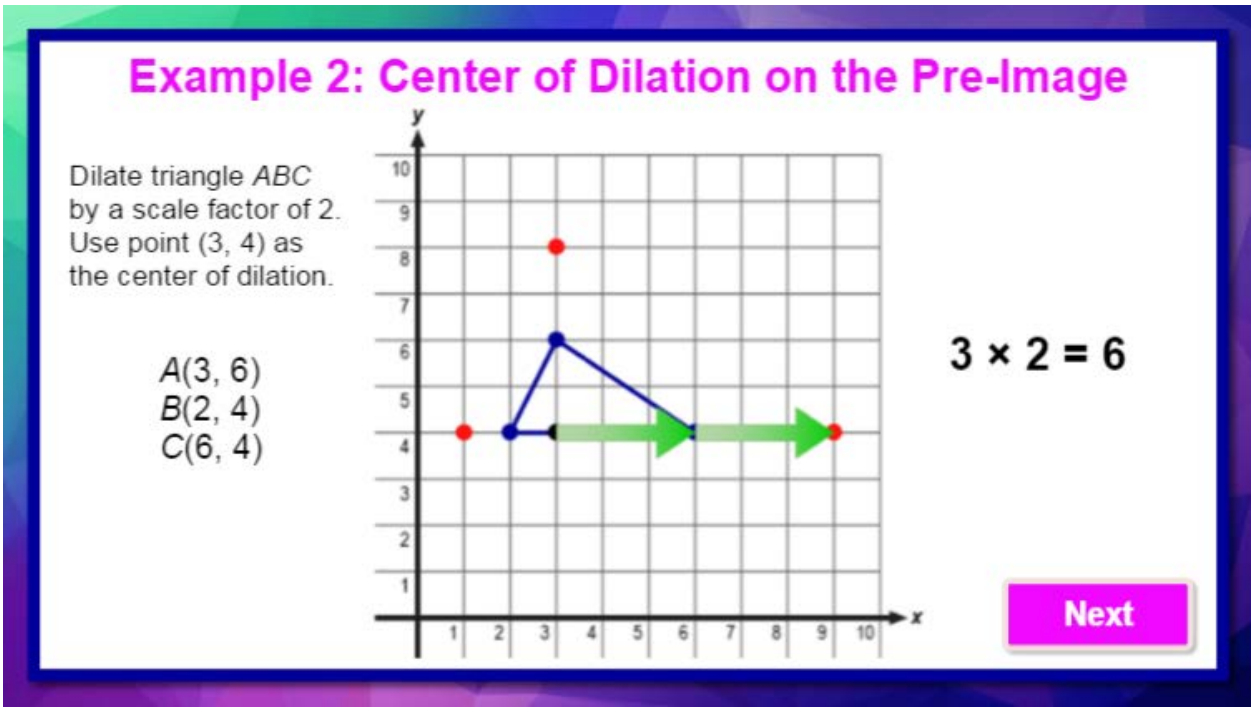


Now double the distances from the other two points to the center of dilation.

The distance from the center of dilation to point $B(2, 4)$ is 1 unit, so the distance from the center of dilation to point B' will be 2 units. The coordinates of point B' are (1, 4).

Click ***NEXT*** to continue.

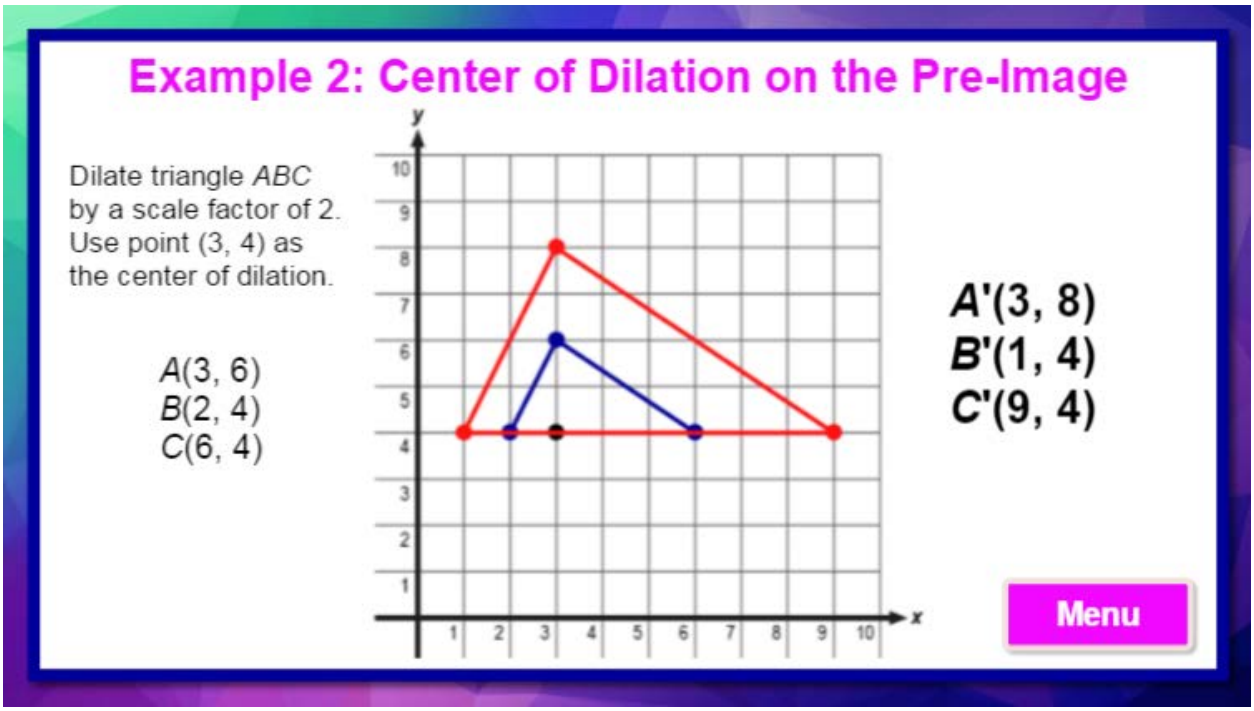
Example 2 (continued)



Finally for the last vertex, the distance from the center of dilation to point $C(6, 4)$ is 3 units, so the distance from the center of dilation to point C' will be 6 units. The coordinates of point C' are (9, 4).

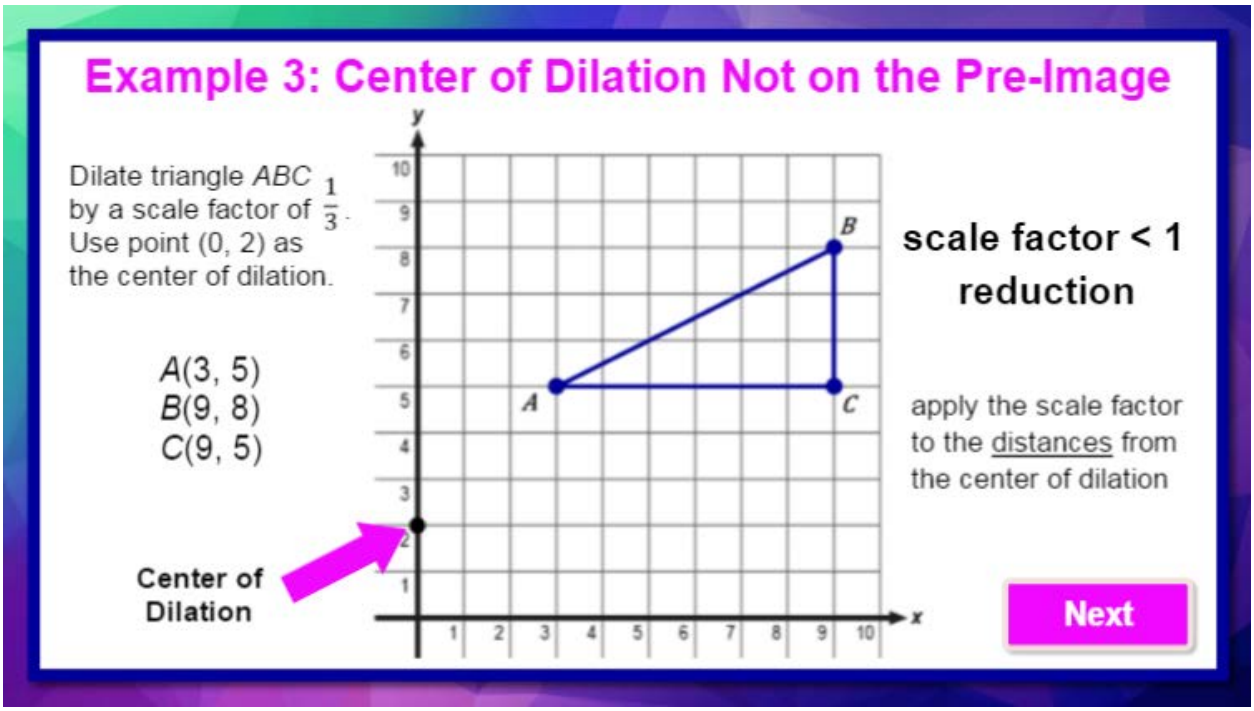
Click ***NEXT*** to continue.

Example 2 (continued)



The vertices of triangle $A'B'C'$ are $A'(3, 8)$, $B'(1, 4)$, and $C'(9, 4)$.

Example 3: Center of Dilation Not on the Pre-Image



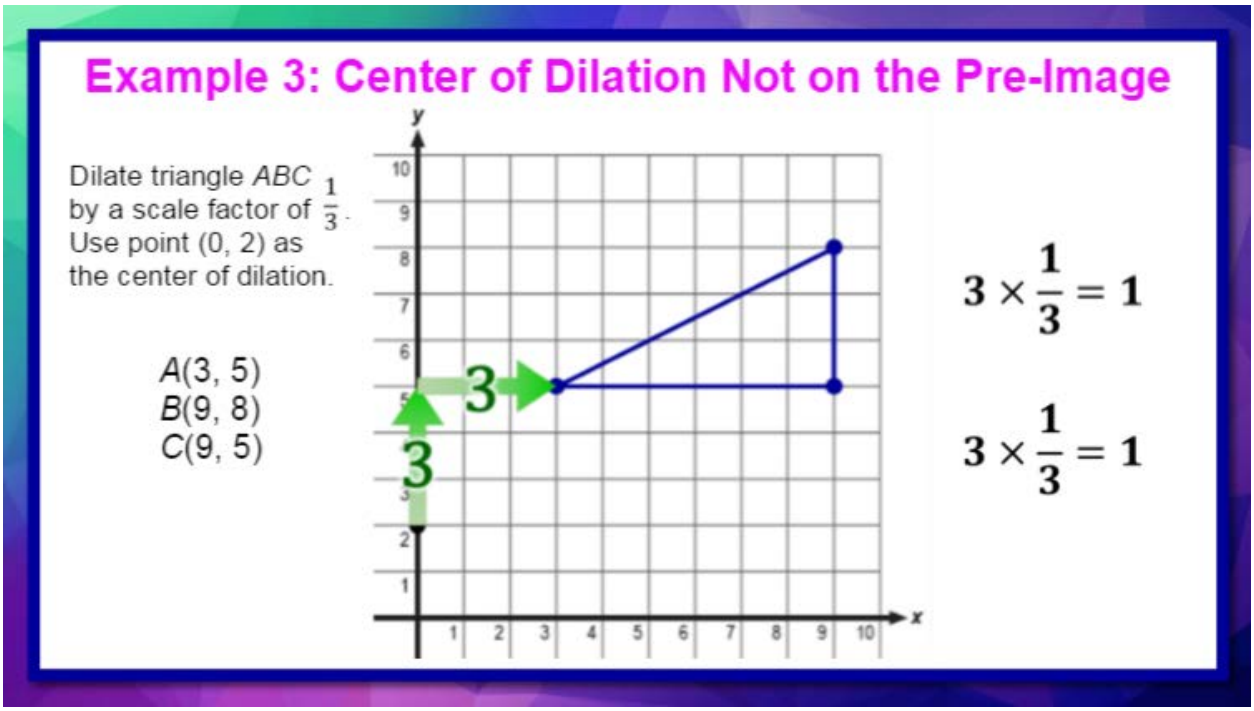
Dilate triangle ABC by a scale factor of $\frac{1}{3}$. Use point (0, 2) as the center of dilation.

The vertices of the pre-image ABC are $A(3, 5)$, $B(9, 8)$, and $C(9, 5)$.

Because the scale factor is less than 1, you know that the dilated image will be a reduction of the pre-image. Notice that the center of dilation is a point outside of the pre-image and not the origin. Since the center of dilation is not the origin, you cannot simply multiply the coordinates by the scale factor. Instead, you must apply the scale factor to the distances from the center of dilation. In this example, the distances will be $\frac{1}{3}$ as large.

Click ***NEXT*** to continue.

Example 3 (continued)

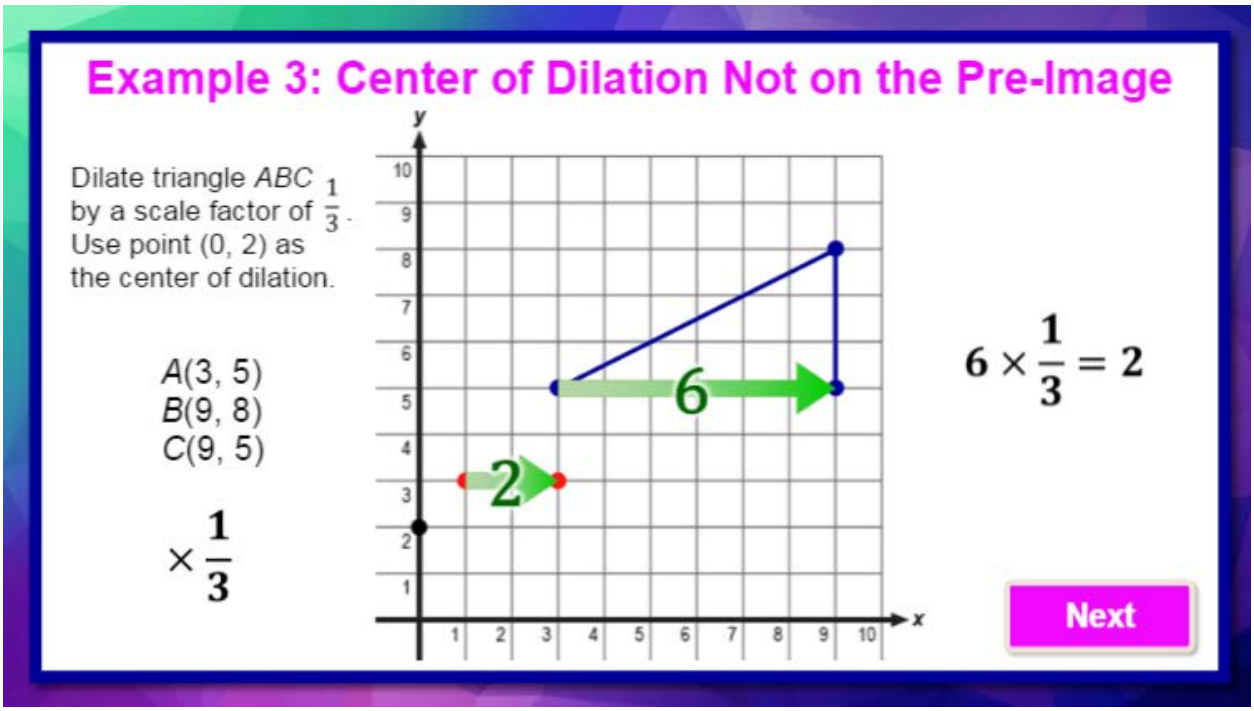


When the center of dilation is a point outside of the pre-image, start by determining the distance from the center of dilation to one of the vertices. For example, to find the distance from the center of dilation to point *A*, you have to move up the *y*-axis by 3 units and move right on the *x*-axis by 3 units.

The distance from the center of dilation to point *A*' will be $\frac{1}{3}$ of those measures, or 1 unit. Start at the center of dilation and move up the *y*-axis by 1 unit, and then move right on the *x*-axis by 1 unit. The coordinates of point *A*' are (1, 3).

Click ***NEXT*** to continue.

Example 3 (continued)

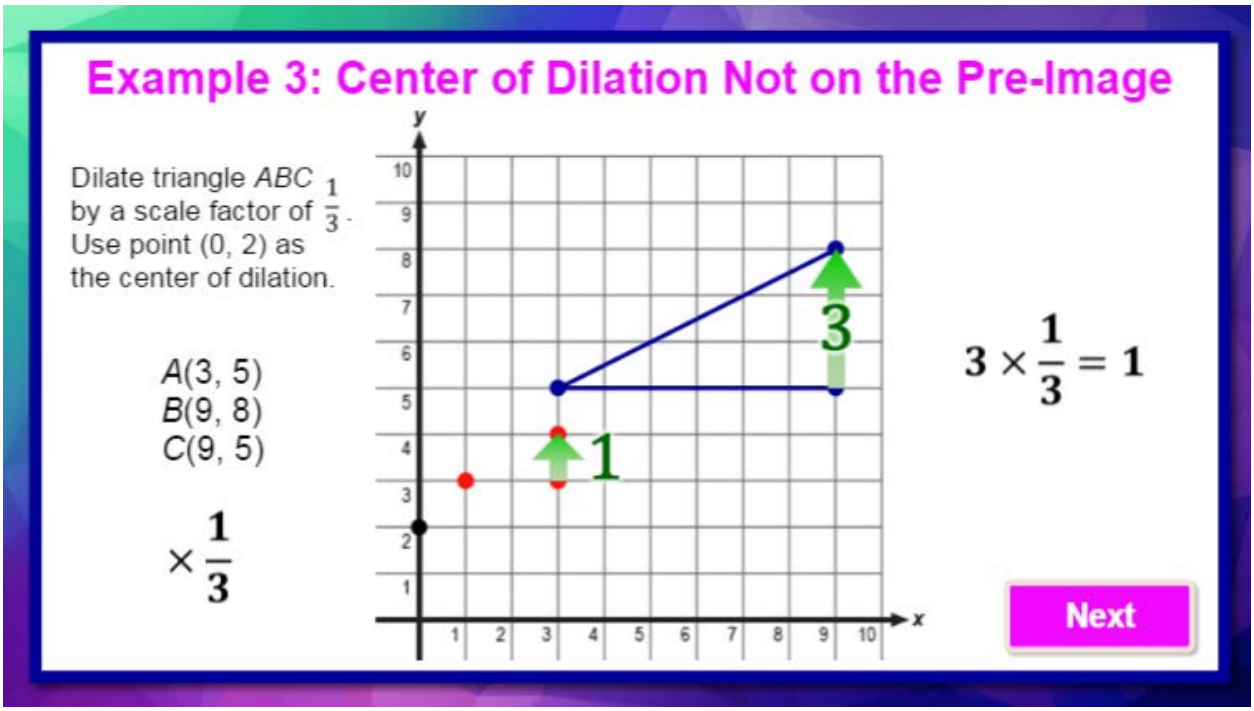


Now determine the distances from the other two vertices, such as point C, to the center of dilation. One approach is to use the rise-over-run method and reduce the distances by the scale factor $\frac{1}{3}$, just as you did to find point A'.

Since you already know the coordinates of point A', another method is to simply measure the distance of line segment AC and reduce AC by the scale factor $\frac{1}{3}$. If the length of AC is 6 units, then the length of line segment $A'C'$ will be 2 units. The coordinates of point C' are (3, 3).

Click ***NEXT*** to continue.

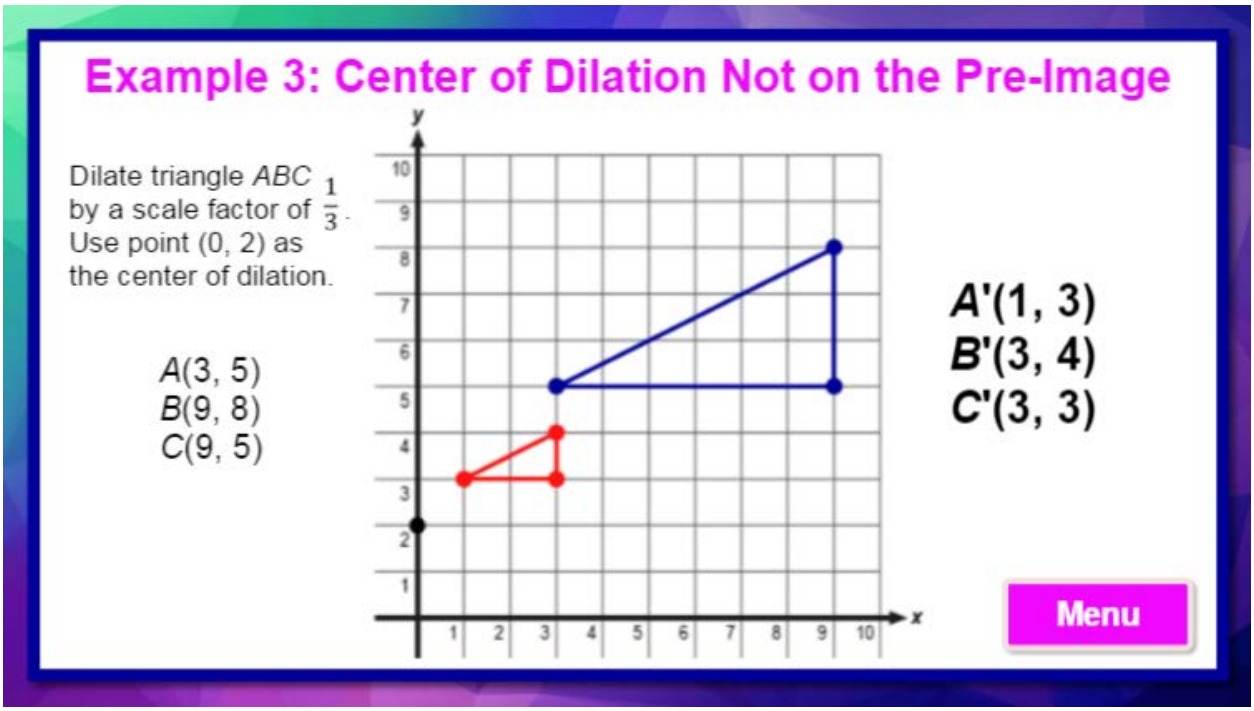
Example 3 (continued)



Now find the coordinates of point B'. Measure the distance of line segment CB and reduce CB by the scale factor $\frac{1}{3}$. The length of CB is 3 units. Thus, the length of line segment $C'B'$ will be 1 unit. The coordinates of point B' are (3, 4).

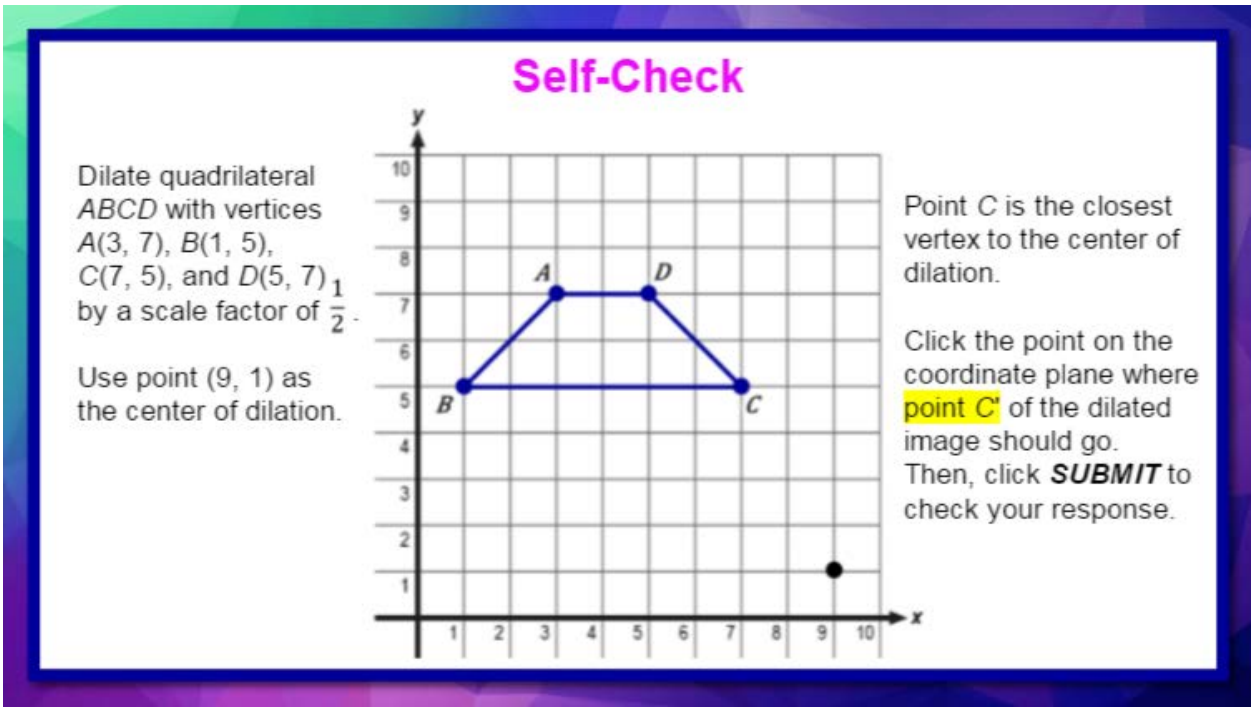
Click ***NEXT*** to continue.

Example 3 (continued)



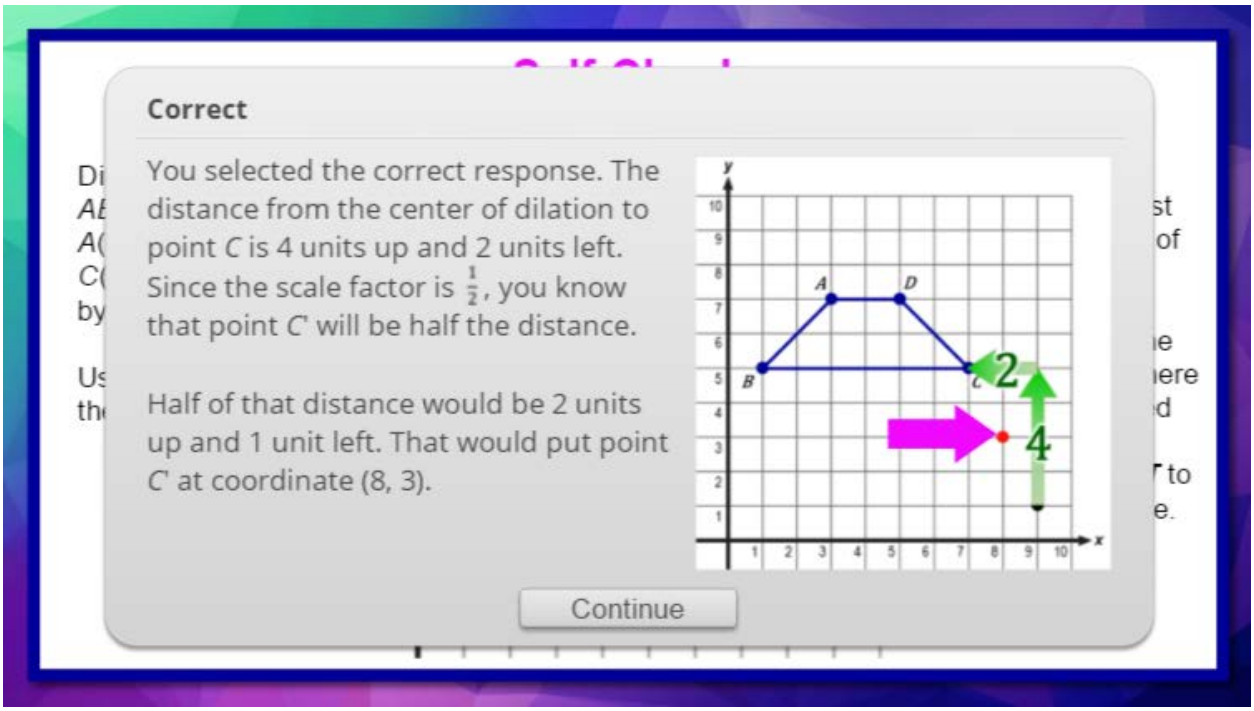
The vertices of triangle $A'B'C'$ are $A'(1, 3)$, $B'(3, 4)$, and $C'(3, 3)$.

Self-Check



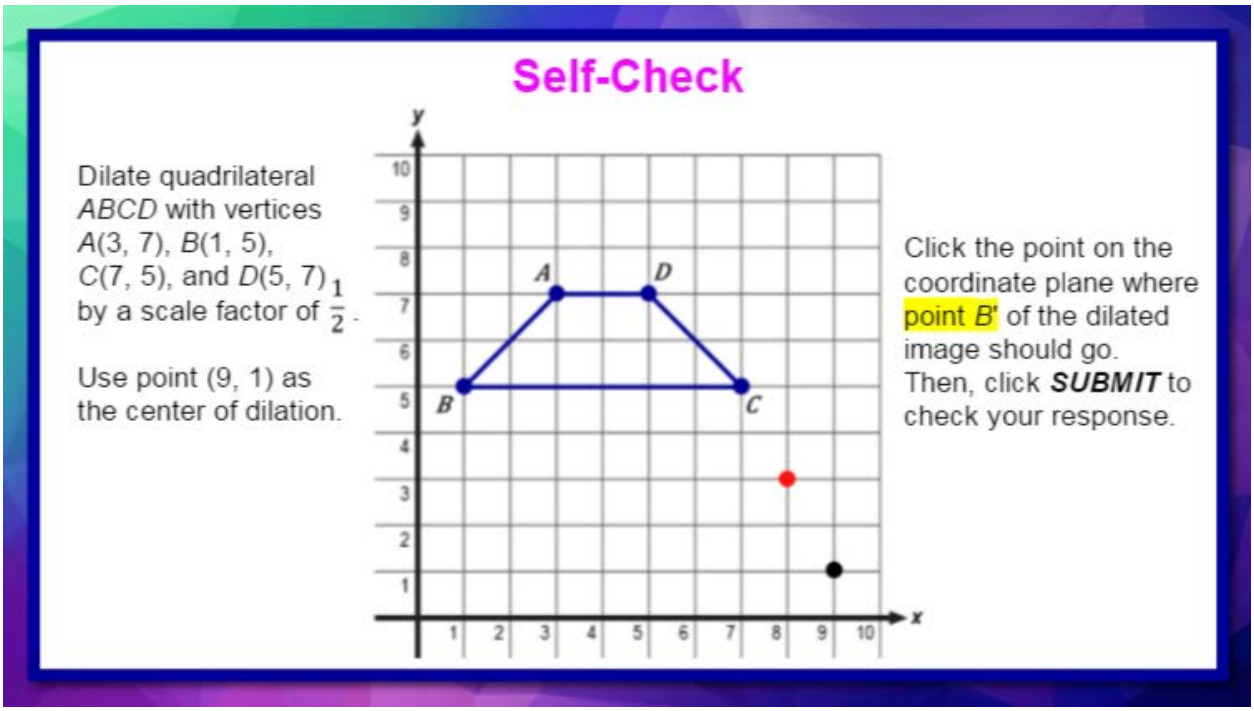
Solve the problem in the image above to check your understanding of the content.

Self-Check: Answer



For your reference, the images above show the correct solution to the self-check problem.

Self-Check



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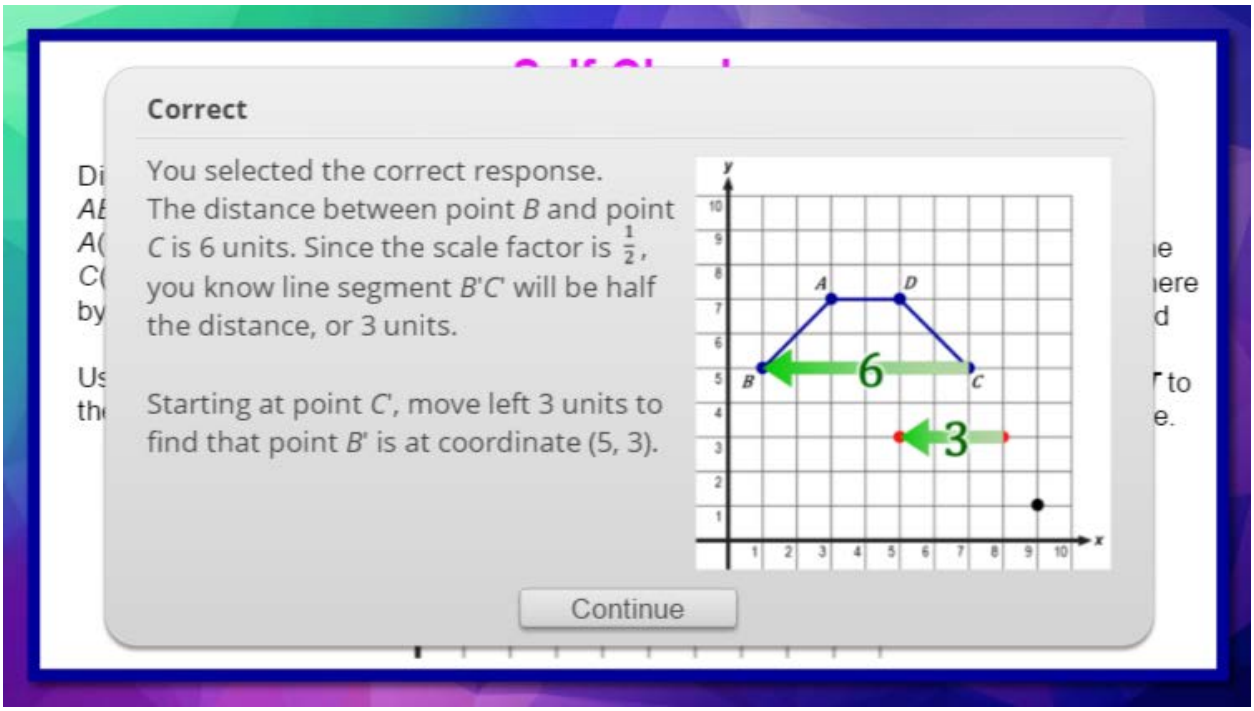
Self-Check: Answer



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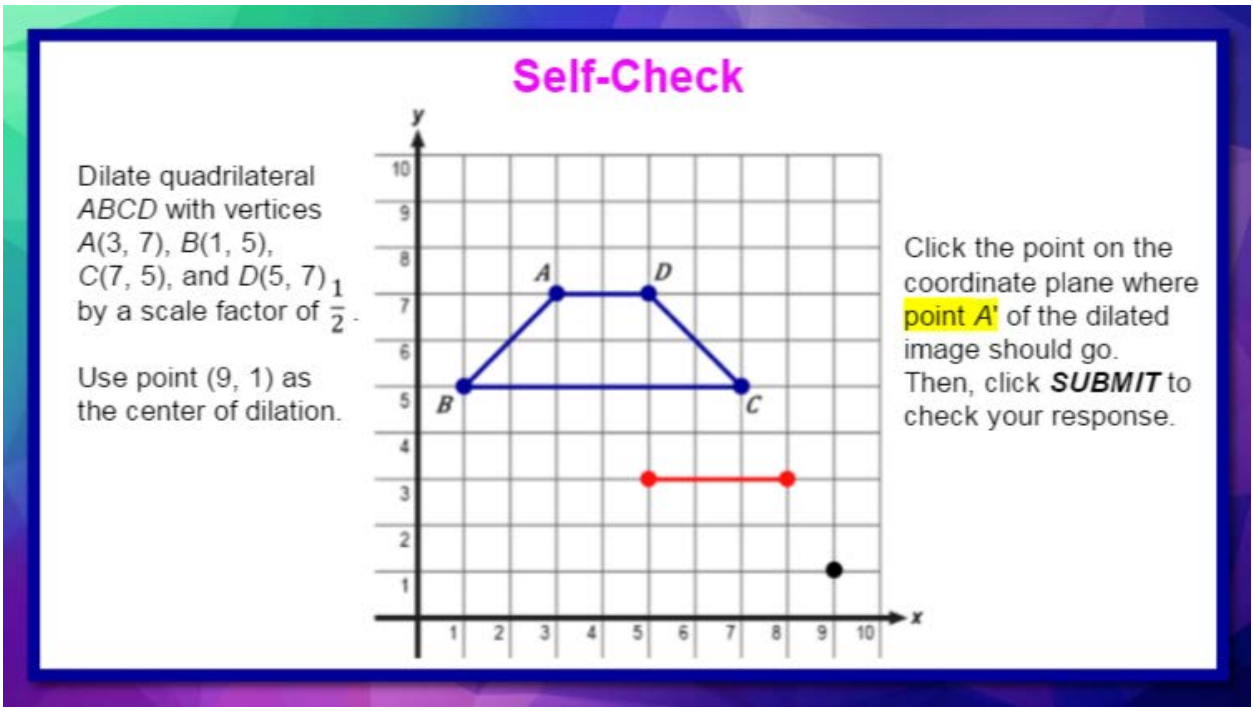
Self-Check



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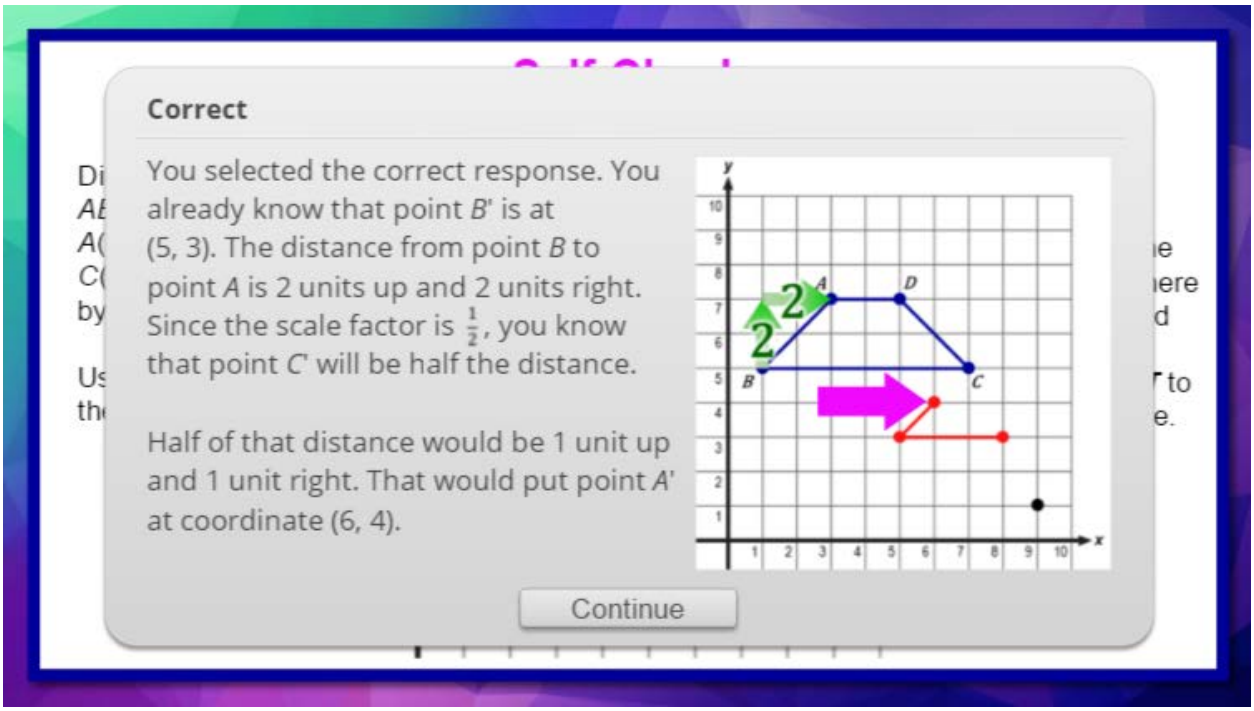
Self-Check: Answer



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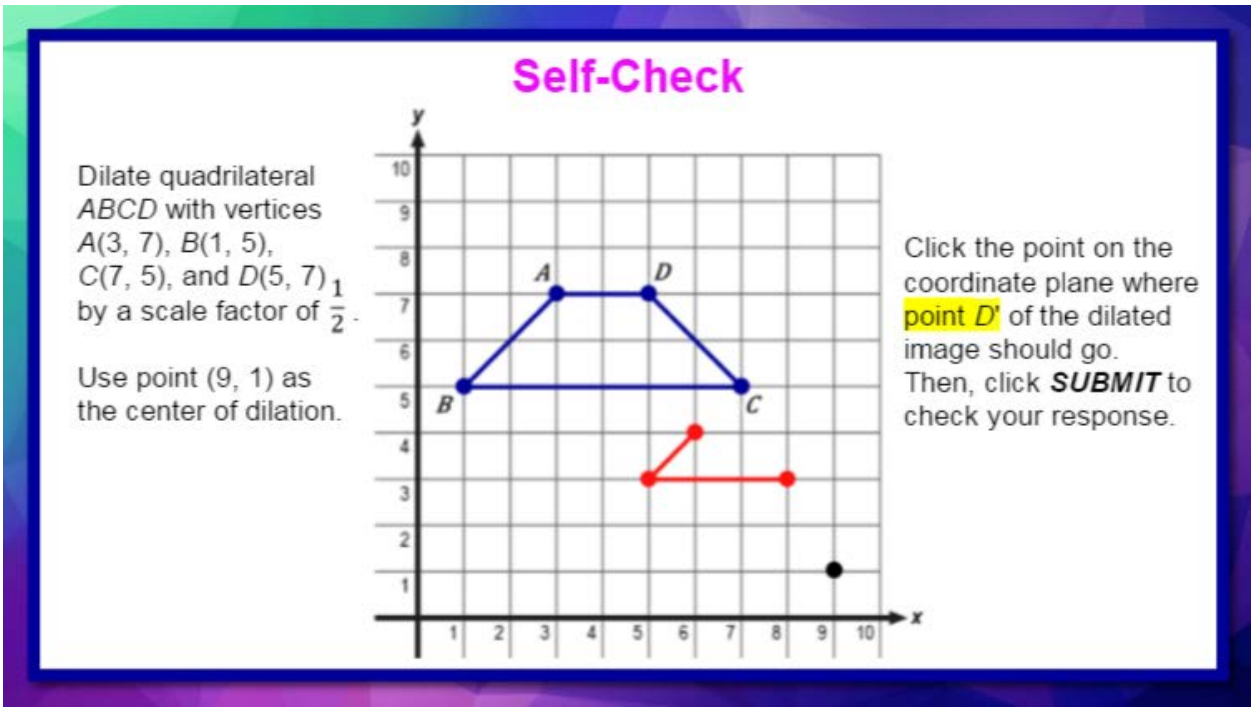
Self-Check



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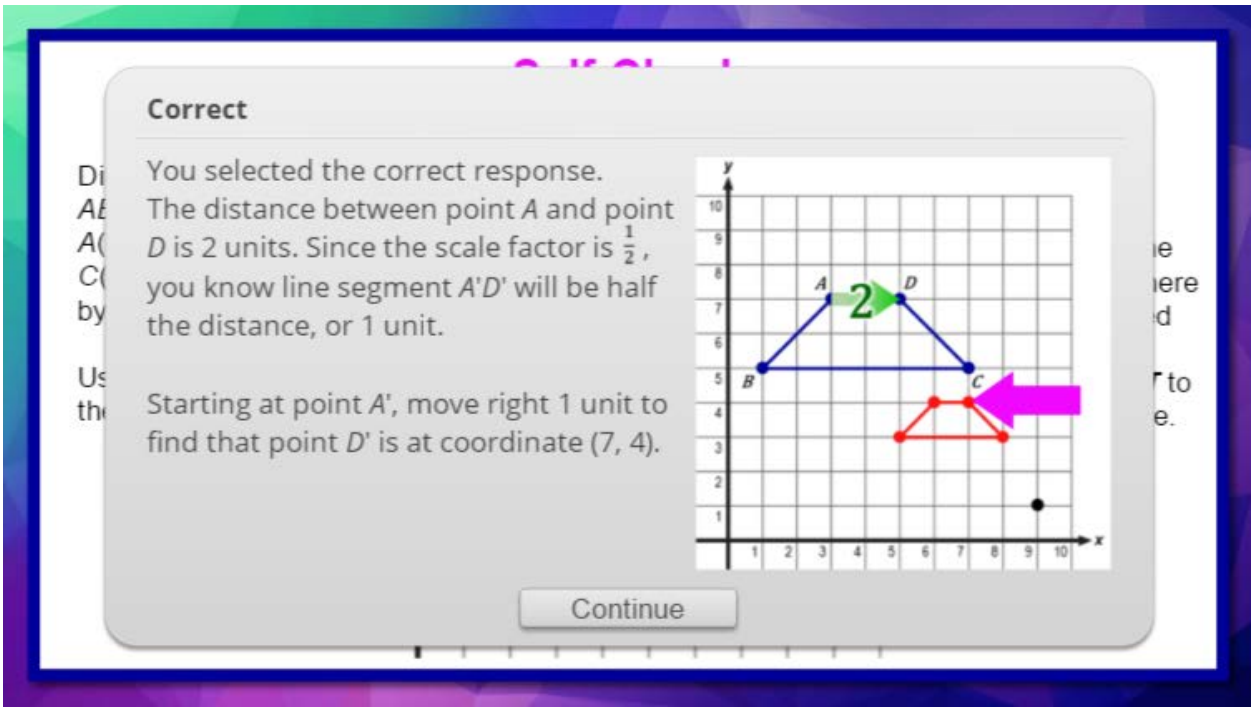
Self-Check: Answer



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