Warm Up
Identify the ordered pairs associated with each of the five labeled points on the star.

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(x,y)
A(0,11)
B(9,3)
C(5,-9)
D(-5,-9)
E(-9,3)
You know that translations are transformations that "slide" each point of a figure the same distance and the same direction. Each point moves in a line. You can describe translations more precisely by using coordinates.

1. Place patty paper on the coordinate plane, trace Figure W, and copy the labels for the vertices on the patty paper.

   a. Translate the figure down 6 units. Then, identify the coordinates of the translated figure.

   ↓ 6 units vertically

   b. Draw the translated figure on the coordinate plane with a different color, and label it as Figure W'. Then identify the pre-image and the image.

   The pre-image is Figure W and the image is Figure W'.

   c. Did translating Figure W vertically change the size or shape of the figure? Justify your answer. No, the translation did not change the size or shape.

   d. Complete the table with the coordinates of Figure W'.

   e. Compare the coordinates of Figure W' with the coordinates of Figure W. How are the values of the coordinates the same? How are they different? Explain your reasoning.

   The x-coordinates are the same in the pre-image and image. The y-coordinates of the image are 6 less than the pre-image. (x, y - 6)
Now, let’s investigate translating Figure $W$ horizontally.

2. Place patty paper on the coordinate plane, trace Figure $W$, and write and copy the labels for the vertices.

a. Translate the figure left 5 units, 

-5 units horizontally

b. Draw the translated figure on the coordinate plane with a different color, and label it as Figure $W''$. Then identify the pre-image and the image.

The pre-image is Figure $W$ and the image is Figure $W''$.

c. Did translating Figure $W$ horizontally change the size or shape of the figure? Justify your answer.

No, the translation did not change the size or shape. congruent

d. Complete the table with the coordinates of Figure $W''$.

<table>
<thead>
<tr>
<th>Coordinates of $W$</th>
<th>Coordinates of $W''$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (2, 5)</td>
<td>A'' (-3, 5)</td>
</tr>
<tr>
<td>B (2, 1)</td>
<td>B'' (-3, 1)</td>
</tr>
<tr>
<td>C (4, 1)</td>
<td>C'' (-1, 1)</td>
</tr>
<tr>
<td>D (6, 3)</td>
<td>D'' (1, 3)</td>
</tr>
<tr>
<td>E (6, 4)</td>
<td>E'' (1, 4)</td>
</tr>
<tr>
<td>F (4, 5)</td>
<td>F'' (-1, 5)</td>
</tr>
</tbody>
</table>

e. Compare the coordinates of Figure $W''$ with the coordinates of Figure $W$. How are the values of the coordinates the same? How are they different? Explain your reasoning.

The $y$-coordinates are the same in the pre-image and image. The $x$-coordinates of the image are 5 less than the pre-image. $(x-5, y)$

3. Make a conjecture about how a vertical or horizontal translation affects the coordinates of any point $(x, y)$.

A horizontal translation affects the $x$-coordinates and a vertical translation affects the $y$-coordinates.
ACTIVITY 3.2 Translating Any Points on the Coordinate Plane

Consider the point \((x, y)\) located anywhere in the first quadrant on the coordinate plane.

1. Consider each translation of the point \((x, y)\) according to the descriptions in the table shown. Record the coordinates of the translated points in terms of \(x\) and \(y\).

<table>
<thead>
<tr>
<th>Translation</th>
<th>Coordinates of Translated Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 units to the left</td>
<td>((x - 3, y))</td>
</tr>
<tr>
<td>3 units down</td>
<td>((x, y - 3))</td>
</tr>
<tr>
<td>3 units to the right</td>
<td>((x + 3, y))</td>
</tr>
<tr>
<td>3 units up</td>
<td>((x, y + 3))</td>
</tr>
</tbody>
</table>

\((x + 2, y - 5)\) \(\rightarrow\) 2 \(\downarrow 5\)
Describe a translation in terms of $x$ and $y$ that would move any point $(x, y)$ in Quadrant I into each quadrant.

a. Quadrant II  

b. Quadrant III  

c. Quadrant IV

*HW starts here* Let’s consider Triangle ABC shown on the coordinate plane.

Use the table to record the coordinates of the vertices of each translated triangle.

a. Translate Triangle ABC 5 units to the right to form Triangle $A'B'C'$. List the coordinates of points $A'$, $B'$, and $C'$. Then graph Triangle $A'B'C'$.

b. Translate Triangle ABC 8 units down to form Triangle $A''B''C''$. List the coordinates of points $A''$, $B''$, and $C''$. Then graph Triangle $A''B''C''$.

*use the table on the next page*
<table>
<thead>
<tr>
<th>Original Triangle</th>
<th>Triangle Translated 5 Units to the Right</th>
<th>Triangle Translated 8 Units Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔABC</td>
<td>ΔA' B' C'</td>
<td>ΔA'' B'' C''</td>
</tr>
<tr>
<td>A (−3, 4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B (−6, 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (−4, 9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Let’s consider translations of a different triangle without graphing.

4. The vertices of Triangle DEF are D (−7, 10), E (−5, 5), and F (−8, 1).
   a. If Triangle DEF is translated to the right 12 units, what are the coordinates of the vertices of the image? Name the triangle.
   b. How did you determine the coordinates of the image without graphing the triangle?
   c. If Triangle DEF is translated up 9 units, what are the coordinates of the vertices of the image? Name the triangle.
   d. How did you determine the coordinates of the image without graphing the triangle?