# Transformations

**Four Types of Transformations**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translation</td>
<td>A shift left, right, up, or down. Size stays the same. Shape stays the same.</td>
</tr>
<tr>
<td>Reflection</td>
<td>When an image is flipped over a line of symmetry. Size stays the same. Shape stays the same.</td>
</tr>
<tr>
<td>Dilation</td>
<td>A change in size. Coordinates are multiplied by the scale factor. Sides are proportional. Shape stays the same.</td>
</tr>
<tr>
<td>Rotation</td>
<td>To turn a figure. Size stays the same. Shape stays the same. The orientation of the figure changes.</td>
</tr>
</tbody>
</table>

## Translations

- **Translation**
  - Translate two units horizontally.
  ![Translation Diagram](image1)
  - Translate negative five units vertically.
  ![Translation Diagram](image2)

A shift horizontally changes the **x-axis** of the coordinate. A shift vertically changes the **y-axis** of the coordinate.
**Reflections**

Reflect triangle ABC over the $y$ axis.
Find the vertices of $A''B''C''$.

Reflect triangle ABC over the $x$-axis.
Find the vertices of $A'B'C'$.

Reflecting over the $y$-axis changes the coordinates of the point to its **opposite side**.
Reflecting over the $x$-axis changes the coordinates of the point to its **opposites**.

**Rotations**

90° counterclockwise

90° clockwise

180° rotation
Dilations

In order to perform a dilation, multiply the x and y values of each coordinate by the scale factor.

Find the coordinates of triangle ABC after a size transformation with a scale factor of 2. Graph A'B'C'.

\[ \frac{10}{6} \times 2 \]

Find the coordinates DEFG after a size transformation with a scale factor of \( \frac{1}{2} \). Graph D'E'F'G'.
**You Try It!**

**TIME** has the following coordinates:  \( T(-2, 3) \)  \( I(4, 3) \)  \( M(4, -1) \)  \( E(-2, -1) \)

1. Draw \( TIME \). Then, dilate the figure. Use the scale factor 4.

2. What are the coordinates of \( T'I'M'E' \)?

3. Using a different color, translate the pre-image \( TIME \) four units to the left. Label the image \( T''I''M''E'' \).

4. What is the difference between the dilation of \( TIME \) and the translation of \( TIME \)?

**OUT** has the following coordinates:  \( O(0,0) \)  \( U(4, 12) \)  \( T(8, -4) \)

1. Draw \( OUT \). Then, draw \( O'U'T' \) after a **dilation with a scale factor of** \( \frac{1}{4} \). What are the coordinates of \( O'U'T' \)?

2. Using a different color, reflect the pre-image \( OUT \) over the y-axis. Label it \( O''U''T'' \).

3. What is the difference between the dilation of \( OUT \) and the reflection of \( OUT \)?
If rectangle ABCD is dilated by a scale factor of three, which best represents the coordinates of the new figure?

Option 1: A'(-6, 9), B'(3, 9), C'(3,3) D'(-6, 3)
Option 2: A'(6, -9), B'(-3, -9), C'(-3, -3) D'(6, -3)
Option 3: A'(-2, 3), B'(1, 3), C'(1,1) D'(-2, 1)
Option 4: A'(-3, 6), B'(0, 6), C'(0,0) D'(-3, 0)

Next to each picture below, identify what type of transformation occurred. (Translation, Reflection, or Dilation)

Directions for #6 - 9:

Consider the triangle on the right. Without graphing, determine the coordinates for the vertices of the image after each of the given transformations.

1) Translation ten units vertically.

2) Translation negative four units horizontally.

3) Reflection across the x-axis.

4) Reflection across the y-axis.
Translations of Shapes

Graph the image of the figure using the transformation given.

1) translation: 1 unit left

2) translation: 1 unit right and 2 units down

3) translation: 3 units right

4) translation: 1 unit right and 2 units down

5) translation: 5 units up
   \[U(-3, -4), M(-1, -1), L(-2, -5)\]

6) translation: 3 units up
   \[R(-4, -3), D(-4, 0), L(0, 0), F(0, -3)\]
Find the coordinates of the vertices of each figure after the given transformation.

7) translation: 2 units left and 1 unit down
   \( Q(0, -1), \ D(-2, 2), \ V(2, 4), \ J(3, 0) \)

8) translation: 2 units down
   \( D(-4, 1), \ A(-2, 5), \ S(-1, 4), \ N(-1, 2) \)

9) translation: 4 units left and 4 units up
   \( J(-1, -2), \ A(-1, 0), \ N(3, -3) \)

10) translation: 3 units right and 4 units up
    \( Z(-4, -3), \ J(-2, -2), \ V(-2, -4) \)

Write a rule to describe each transformation.

11) 

12) 

13) 

14)
Reflections of Shapes

Graph the image of the figure using the transformation given.

1) reflection across the x-axis

2) reflection across $y = 3$

3) reflection across $y = 1$

4) reflection across the x-axis

5) reflection across the x-axis
   $T(2, 2), C(2, 5), Z(5, 4), F(5, 0)$

6) reflection across $y = -2$
   $H(-1, -5), M(-1, -4), B(1, -2), C(3, -3)$
Find the coordinates of the vertices of each figure after the given transformation.

7) reflection across the x-axis
   \(K(1, -1), N(4, 0), Q(4, -4)\)

8) reflection across \(y = -1\)
   \(R(-3, -3), M(-4, 0), V(-2, -1), E(0, -4)\)

9) reflection across \(x = 3\)
   \(F(2, 2), W(2, 5), K(3, 2)\)

10) reflection across \(x = -1\)
    \(V(-3, -1), Z(-3, 2), G(-1, 3), M(1, 1)\)

Write a rule to describe each transformation.

11)

12)

13)

14)
Rotations of Shapes

Graph the image of the figure using the transformation given.

1) rotation 180° about the origin

2) rotation 90° counterclockwise about the origin

3) rotation 90° clockwise about the origin

4) rotation 180° about the origin

5) rotation 90° clockwise about the origin
   \( U(1, -2), W(0, 2), K(3, 2), G(3, -3) \)

6) rotation 180° about the origin
   \( V(2, 0), S(1, 3), G(5, 0) \)
Find the coordinates of the vertices of each figure after the given transformation.

7) rotation $180^\circ$ about the origin
   $Z(-1, -5), K(-1, 0), C(1, 1), N(3, -2)$

8) rotation $180^\circ$ about the origin
   $L(1, 3), Z(5, 5), F(4, 2)$

9) rotation $90^\circ$ clockwise about the origin
   $S(1, -4), W(1, 0), J(3, -4)$

10) rotation $180^\circ$ about the origin
    $V(-5, -3), A(-3, 1), G(0, -3)$

Write a rule to describe each transformation.