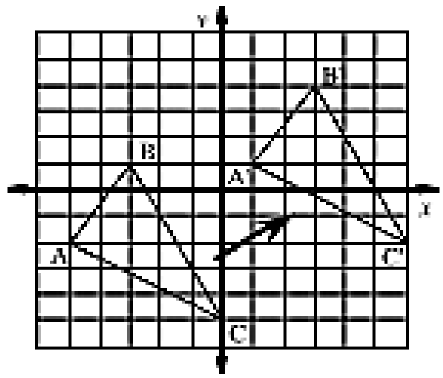
Name____ Date___________________________

Day 1 – Translations, Reflections, and Rotations

There are many different ways to move a figure on the coordinate plane. Some movements keep the figure the same size and some may make the figure bigger or smaller. These "movements" are called transformations. **Transformations** are the mapping or movement of all the points in a figure on the coordinate plane.



When a figure is the original figure, it is called the **pre-image**. The prefix "pre" means _______________. In the above picture, we would label the points as A, B, and C.

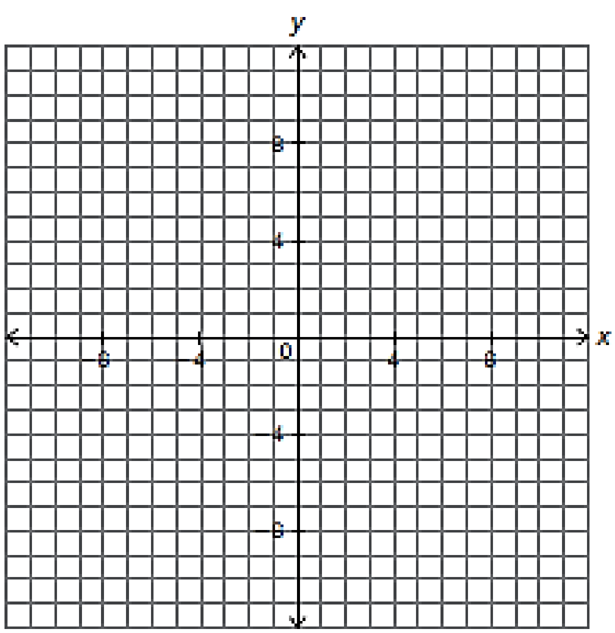
When a figure has been transformed, it is called the **image**. We would label the new points as A', B', and C'. We would say that points A, B, and C have been mapped to the new points A', B', and C'

Exploring Translations

A. Graph triangle ABC by plotting points A(8, 10), B(1, 2), and C(8, 2).

B. Translate triangle ABC 10 units to the left to form triangle A'B'C' and write new coordinates.

C. Translate triangle ABC 12 units down to form triangle A''B''C'' and write new coordinates.



Coordinates of Triangle ABC	Coordinates of Triangle A'B'C'	Coordinates of Triangle A''B''C''
A (8, 10)		
B (1, 2)		
C(8, 2))		

Observation: Did the figures change size or shape after each transformation?

You observed that your four triangles maintained the same shape and size. When a figure keeps the same size and shape, it is called a **rigid transformation.**

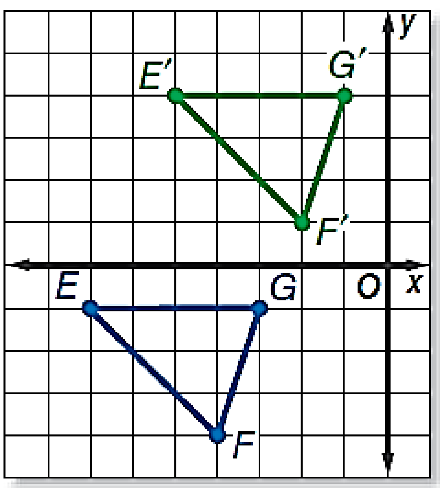
With your experiment, you were performing a translation. A **translation** is a slide that maps all points of a figure the same distance in the same direction. A translation can slide a figure horizontally, vertically, or both.

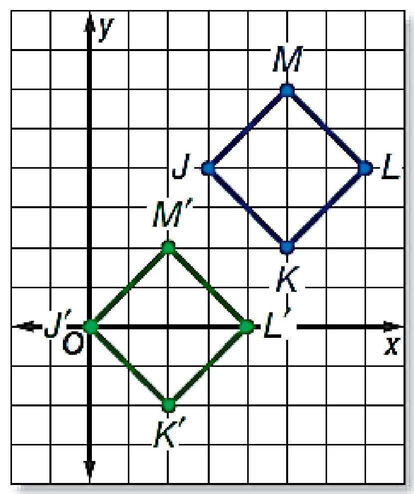
Rule for Translations: (x, y) → (x + a, y + b)

a → left or right translations (horizontally)
b → up or down translations (vertically)

Practice with Translations

Name the rule for the given figures:





Practice

1. Translate the image by (x – 8, y + 2)

$A(-2,4) \rightarrow A'$________

$B(0,-8) \rightarrow B'$________

$C(-3,5) \rightarrow C'$________

2. Translate the image by (2x + 2, y – 3)

$D(1,2) \rightarrow D'$________

$E(-3,-5) \rightarrow E'$________

$F(4,-1) \rightarrow F'$________

3. Find the pre-image (x + 12, y – 17)

G________ $\rightarrow G'(5,-29)$

H________ $\rightarrow H'(20,-19)$

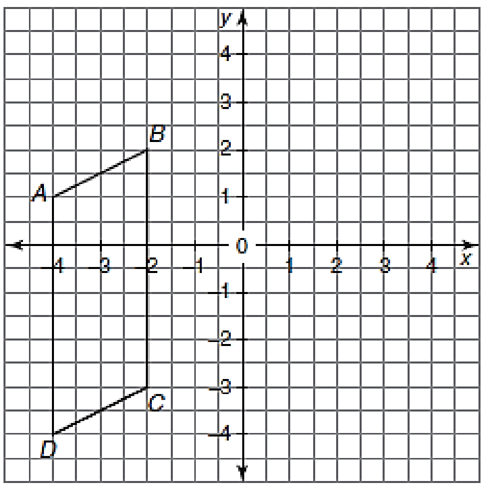
I________ $\rightarrow$ I' (21, -4)

Reflections and Rotations

Figures that are mirror images of each other are called reflections. A **reflection** is a transformation that "flips" a figure over a reflection line. A **reflection line** is a line that acts as a mirror so that corresponding points are the same distance from the mirror. Reflections maintain shape and size; they are our second type of rigid transformation.

Reflection over y-axis

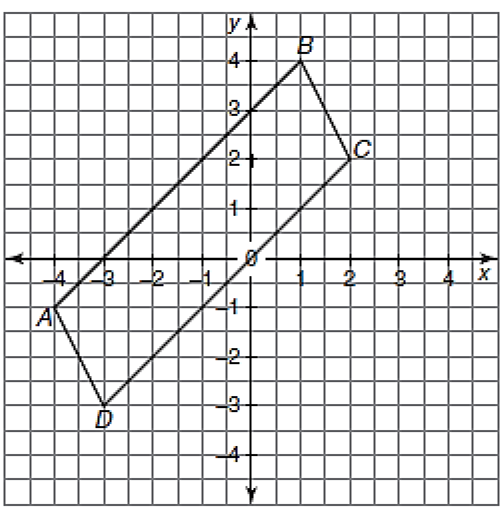
Reflect parallelogram ABCD over the y-axis using reflection lines. Record the points in the table.



	Pre-Image	Image
A		
B		
C		
D		
Rule	(x, y)	

Reflection over x-axis

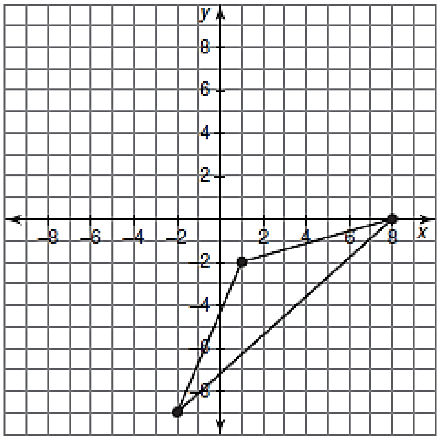
Reflect parallelogram ABCD over the x-axis using reflection lines. Record the points in the table



	Pre-Image	Image
A		
B		
C		
D		
Rule	(x, y)	

Reflection over y = x

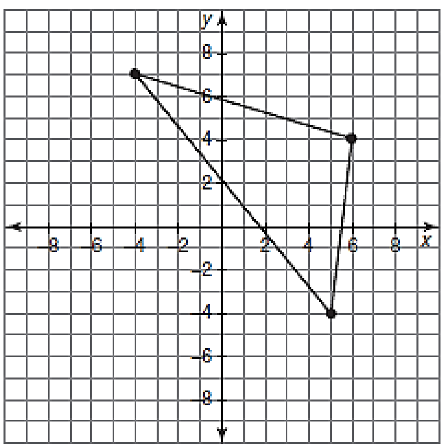
Reflect the triangle over the y = x using reflection lines. Record the points in the table



	Pre-Image	Image
A		
B		
C		
Rule	(x, y)	

Reflection over y = -x

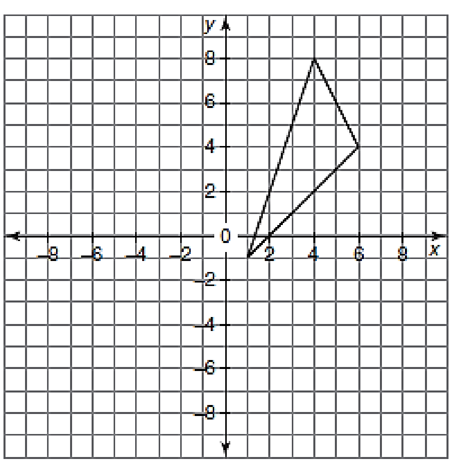
Reflect triangle ABC over the y = -x using reflection lines. Record the points in the table



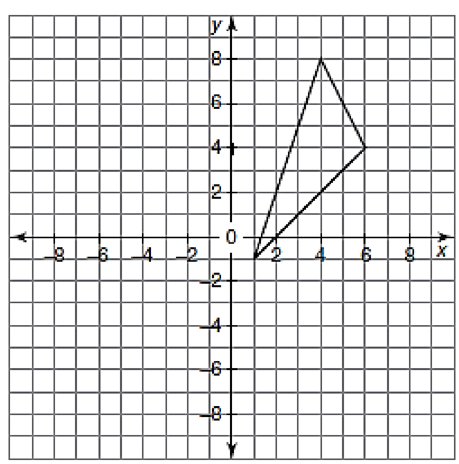
	Pre-Image	Image
A		
B		
C		
Rule	(x, y)	

Reflection over Horizontal and Vertical Lines

Reflect over x = -1



Reflect over y = 2



Practice with Reflections

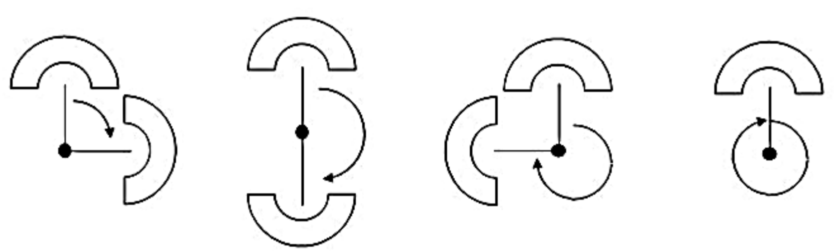
Given triangle MNP with vertices of M(1, 2), N(1, 4), and P(3, 3), reflect across the following lines of reflection:

x-axis	**y-axis**	**y = x**	**y = -x**
(x, y)→	**(x, y)→**	**(x, y)→**	**(x, y)→**
M(1, 2) →	M(1, 2) →	M(1, 2) →	M(1, 2) →
N(1, 4)→	N(1, 4)→	N(1, 4)→	N(1, 4)→
P(3, 3)→	P(3, 3)→	P(3, 3)→	P(3, 3)→

Rotations

A **rotation** is a circular movement around a central point that stays fixed and everything else moves around that point in a circle. A rotation maintains size and shape; therefore, it is our third type of rigid transformation. When we rotate our figures around a fixed point, we classify our rotation by direction and degree of rotation.

Degrees of Rotation



90° clockwise 180° clockwise 270° clockwise 360° clockwise

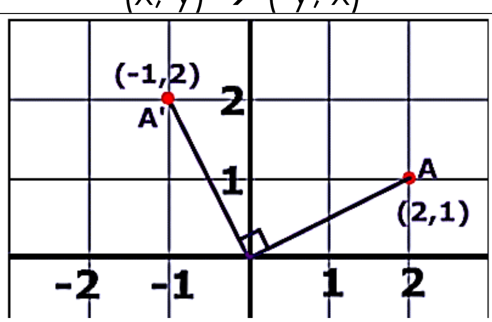
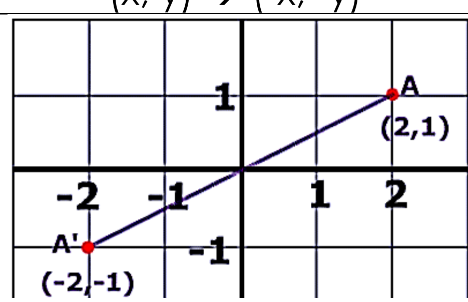
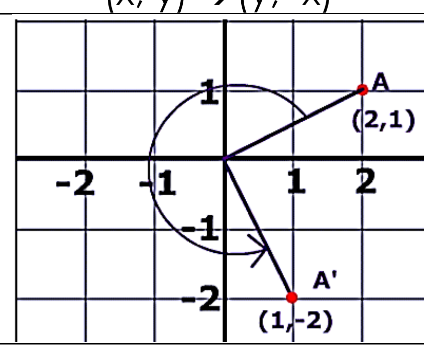
Direction of Rotation

It is important to understand that some rotations are the same depending on the degree and direction of the rotation. Most of the time, rotations are given using counterclockwise direction. Here are equivalent rotations:

90° Counterclockwise = 270° Clockwise **90° Clockwise = 270° Counterclockwise**

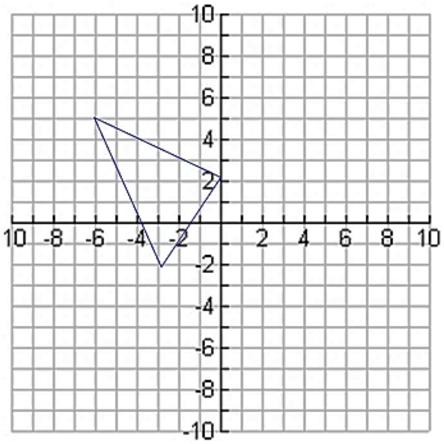
180° Counterclockwise = 180° Clockwise

Rules for Rotations

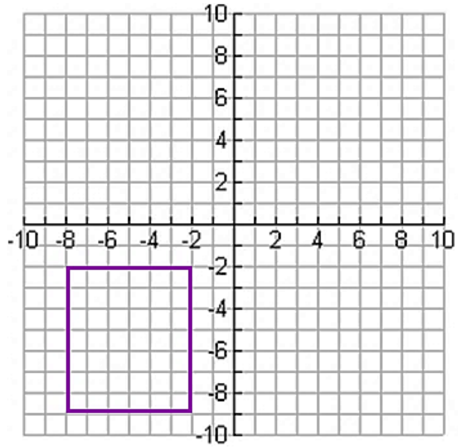
90°CCW / 270°CW	**180°CCW / 180°CW**	**90°CW/270°CCW**
(x, y) → (-y, x)	(x, y) → (-x, -y)	(x, y) →(y, -x)
		

Practice with Rotations

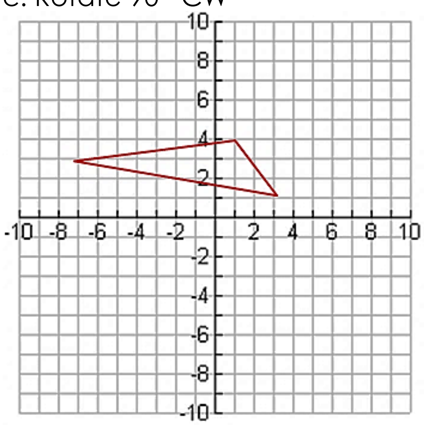
a. Rotate 90° CCW



b. Rotate 180° CCW



c. Rotate 90° CW



Lines of Symmetry

A **line of symmetry** is a line you can use to fold a figure so that both halves match up perfectly. This means the figure is symmetrical (balanced/matching) on both sides of the line.

Example: How many lines of symmetry does each shape have?