Geometry H — Name: Key
4.8 – Perform Congruence Transformations Notes — Date: __________ Period: ______

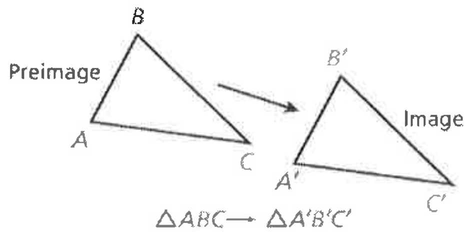
LEARNING TARGETS

- I can identify congruence transformations.
- I can find the image of reflections in the coordinate plane.

A congruence transformation, also known as an **isometry**, is a transformation that changes the position of a figure without changing its size or shape. There are three types of congruence transformations –

1. Translation (slide)
2. Reflection (flip)
3. Rotation (turn).

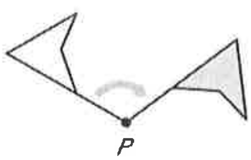
In a transformation, the original figure is called the **preimage,** and the resulting figure is called the **image.** Arrow notation (→) is used to describe a transformation, and prime notation (') is used to label the image.



Example 1: Identify transformations

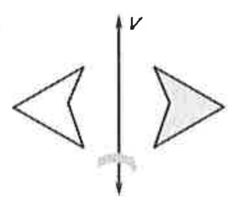
Name the type of transformation demonstrated in each picture below.

a.



b.

c.



a. Rotation about a point

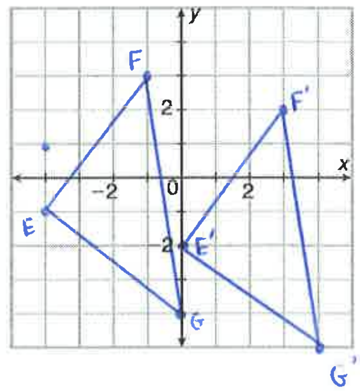
b. Translation in a straight path

c. Reflection in a vertical line

A **translation** is a transformation in which all of the points of a figure are moved the same distance and in the same direction. On the coordinate plane, translations can be described by a rule such as $(x,y) \rightarrow (x+a, y+b)$, where a represents the horizontal change and b represents the vertical change.

Example 2: Translate a figure in the coordinate plane.

ΔEFG has vertices E(-4, -1), F(-1, 3) and G(0, -4). Find the coordinates of $\Delta E'F'G'$ after a translation (x,y)→(x + 4, y – 1)



Solution:

E (-4, -1) → E' (-4 + 4, -1 – 1) → **E' (0, -2)**

F (-1, 3) → F' (-1 + 4, 3 – 1) → **F' (3, 2)**

G (0, -4) → G' (0 + 4, -4 – 1) → **G' (4, -5)**

***** NOW TRY PROBLEM 1 ON THE NEXT PAGE! *****

Example 3: Write the coordinate notation for a translation

Maddie and Noah are tossing a flying disc. Maddie stands at (2, 5) and throws the disc to Noah at (11, 0). Write the coordinate notation for the translation from Maddie to Noah.

Solution:

(2, 5) → (11, 0)

To get from x-value 2 to x-value 11, add 9: (x + 9)

To get from y-value 5 to y-value 0, subtract 5: (y – 5)

So the rule is : (x, y) → (x + 9 , y – 5) *****NOW TRY PROBLEMS 2 & 3 ON THE NEXT PAGE!*****

Example 4: Use coordinate notation to find a point

A point on an image and the translation are given. Find the corresponding point on the original figure.

Point on image: (3, -2); translation (x, y) → (x – 5, y + 2)

Solution:

Since the point given is already translated, we want to do the **opposite** of what the rule tells us to find the original point:

x-value of 3: The rule is (x – 5), so we will do the opposite and add 5 to the x-value of 3 to get 8.

y-value of -2: The rule is (y + 2), so we will do the opposite and subtract 2 from the y-value of -2 to get -4.

So the original point is (8, -4) ***** NOW TRY PROBLEM 4 ON THE NEXT PAGE! *****

TRY THESE - TRANSLATIONS:

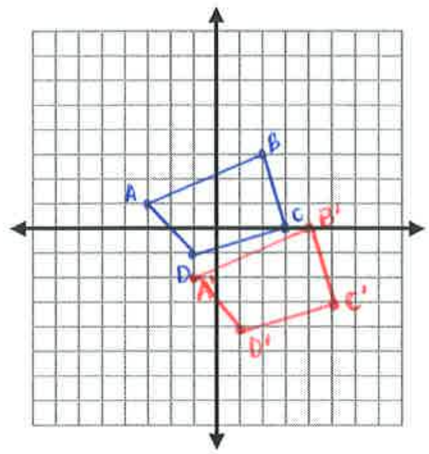
1. Quadrilateral ABCD has coordinates A(-3,1), B(2, 3), C(3, 0) and D(-1, -1). Draw ABCD and its image under the translation (x, y)→(x+2, y-3). State the image coordinates.

A(-3,1) → (-3+2, 1-3) → A' (-1,-2)

B(2,3) → (2+2, 3-3) → B' (4,0)

C(3,0) → (3+2, 0-3) → C' (5,-3)

D(-1,-1) → (-1+2, -1-3) → D' (1,-4)



2. Use coordinate notation to describe the translation.
   4 units to the left and 2 units down

   (x,y) → (x-4, y-2)

3. Complete the statement using the description of the translation. In the description, points (0, 3) and (2, 5) are points of a hexagon.

   If (0,3) translates to (1, 2), then (2, 5) translates to ___(3,4)___.

   Rule: (x,y) → (x+1, y-1)   (2+1, 5-1)

4. A point on an image and the translation are given. Find the corresponding point on the original figure.

   Point on image: (6, -9); translation (x, y) → (x – 7, y – 4)

   x-coord: 6+7 = 13

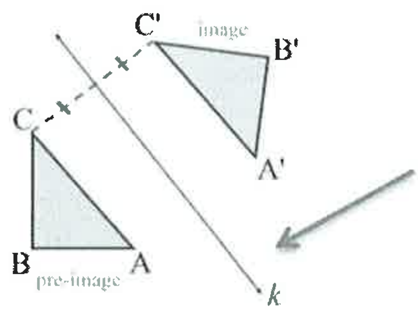
   y-coord: -9+4 = -5   ⇒ $\boxed{(13,-5)}$

Answers:

1. A'(-1, -2); B'(~~-1,~~-2); C'(5, -3); D'(1, -4)   2. (x, y) → (x – 4, y – 2)   3. (3, 4)   4. (13, -5)

(4,0)

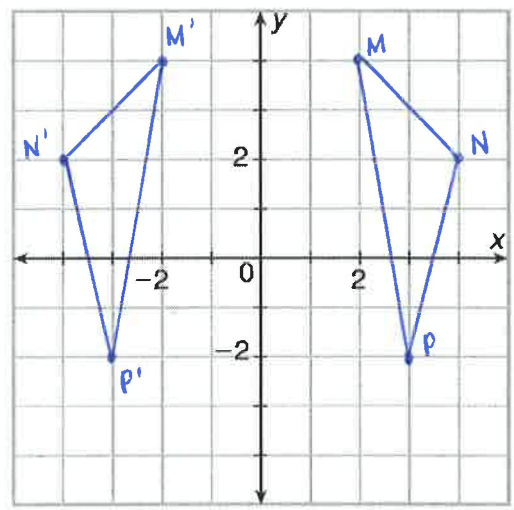
A **reflection** uses a *line of reflection* to create a mirror image of the original figure.



Line k is the

INVESTIGATION – REFLECTIONS IN THE COORDINATE PLANE

- **REFLECTION IN Y-AXIS**
  1. On the coordinate plane, draw ΔMNP, with vertices M(2, 4), N(4, 2), and P(3, -2).
  2. Place patty paper over the grid and trace ΔMNP and the axes. Label your traced triangle $\Delta M'N'P'$
  3. Reflect ΔMNP in the y-axis by flipping the patty paper, making sure you line up the axes.
  4. Record your coordinates for $\Delta M'N'P'$ in the table below. Can you write a rule to show the transformation from $\Delta MNP \rightarrow \Delta M'N'P'$?



Preimage coordinates (ΔMNP)	**Image Reflected in y-axis ($\Delta M'N'P'$)**
M (2, 4)	M' (-2, 4)
N (4, 2)	N' (-4, 2)
P (3, -2)	P' (-3, -2)
(x, y)	(-x, y)

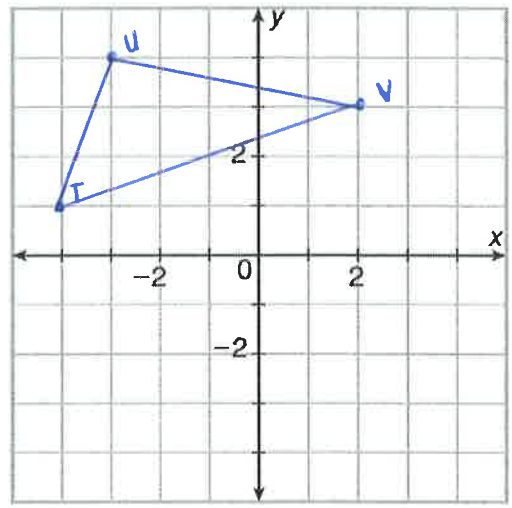
✓ What happened to the x-coordinates under the reflection in the y-axis? They switched signs

✓ What happed to the y-coordinates under the reflection in the y-axis? They stayed the same

✓ What rule describes the reflection across the y-axis? $(x,y) \rightarrow (-x,y)$

- **REFLECTION IN X-AXIS**

5. On the coordinate plane, draw ΔTUV, with vertices T(-4,1), U(-3, 4), and V(2, 3).



6. Place patty paper over the grid and trace ΔTUV and the axes. Label your traced triangle $\Delta T'U'V'$

7. Reflect ΔTUV in the x-axis by flipping the patty paper, making sure you line up the axes.

8. Record your coordinates for $\Delta T'U'V'$ in the table below. Can you write a rule to show the transformation from $\Delta TUV \rightarrow \Delta T'U'V'$?

Preimage coordinates (ΔTUV)	Image Reflected in y-axis ($\Delta T'U'V'$)
T (-4, 1)	T' (-4 , -1)
U (-3, 4)	U' (-3 , -4)
V (2, 3)	V' (2 , -3)
(x, y)	(x , -y)

✓ What happened to the x-coordinates under the reflection in the x-axis? They stayed the same

✓ What happed to the y-coordinates under the reflection in the x-axis? They switched signs

✓ What rule describes the reflection across the y-axis? $(x,y) \rightarrow (x,-y)$