5.0 Translations

Overview: In this activity, students explore translations on a coordinate plane in order to develop algebraic generalizations for translations.

Objective: **Mathematics TEKS**

(6.7) Locate and name points on a coordinate plane using ordered pairs of non negative rational numbers

(6.8.B) Select and use appropriate units, tools, or formulas to measure and to solve problems involving length…

(7.7.A) Locate and name points on a coordinate plane using ordered pairs of integers

(7.7.B) Graph translations on a coordinate plane

(8.6.B) Graph dilations, reflections, and translations on a coordinate plane

(6.11.D, 7.13.D, 8.14.D) Select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems

(6.12.A, 7.14.A, 8.15.A) Communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models

(6.13.A, 7.15.A, 8.16.A) Make conjectures from patterns or sets of examples and nonexamples

Mathematics TAKS Grades 6-8

Objective 3: The student will demonstrate an understanding of geometry and spatial reasoning. (6.7, 7.7.A, 7.7B, 8.6.B)

Objective 4: The student will demonstrate an understanding of the concepts and uses of measurement. (6.8B)

Objective 6: The student will demonstrate an understanding of the mathematical processes and tools used in problem solving. (6.11.D, 7.13.D, 8.14.D, 6.12.A, 7.14.A, 8.15.A, 6.13.A, 7.15.A, 8.16.A)

Terms: translation, isometry, original image, new image, congruence

Materials: patty paper, straightedge, ruler, protractor, graphing calculator

Procedures:
1. *Have students work in pairs to complete problems 1 & 2.*
2. *Debrief as a whole group.*
3. *Have students work in pairs to complete problem 3.*
4. *Debrief as a whole group.*
5. *Have students work in pairs to complete problems 4 & 5.*
6. *Debrief as a whole group.*

Student Activity: Translations

1. **Translate the given figure 3 units to the right.**

    a) **Complete the table to compare the coordinates of the points in the new image to the corresponding points in the original image.**
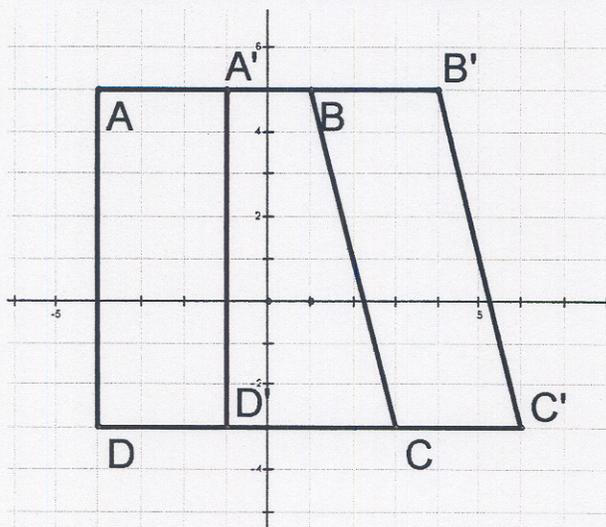
Original image	New image
A (-4, 5)	A' (-1, 5)
B (1, 5)	B' (4, 5)
C (3, -3)	C' (6, -3)
D (-4, -3)	D' (-1, -3)
(x, y)	$(x+3, y)$

    b. **Write a generalization in (x, y) form for points on the new image, compared to corresponding points on the original image.**
        $(x+3, y)$

    c. **Explore the characteristics of the original image and new image. How do they compare?**

        • **Lengths of corresponding sides**
           They are congruent.

        • **Corresponding angle measurements**
           They are congruent.

        • **Perimeter**
           They are congruent.

        • **Area**
           They are congruent.

    d. **Write a generalization in (x, y) form if the transformation was a translation 4 units to the left.**
        $(x-4, y)$
        If shifting to the right increases the value of our x-coordinate, shifting to the left would decrease the value of our x-coordinate. The y-coordinates are unaffected as no vertical shifting is taking place. Connect this to addition on a number line.

2. Translate the given figure down 2 units.

a. Complete the table to compare the coordinates of the points in the new image to the corresponding points in the original image.
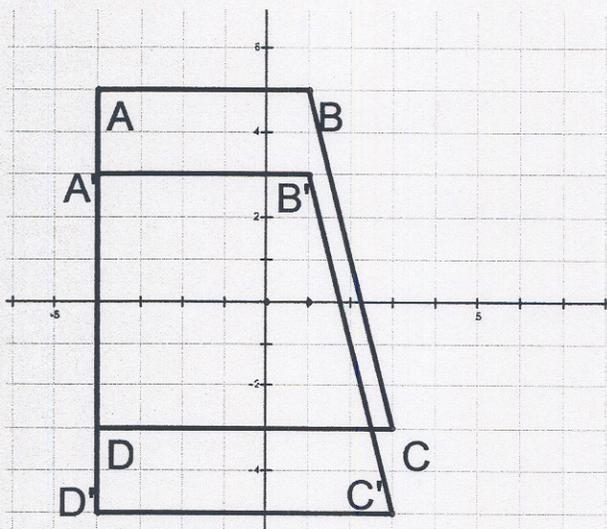
Original image	New image
A (-4, 5)	A' (-4, 3)
B (1, 5)	B' (1, 3)
C (3, -3)	C' (3, -5)
D (-4, -3)	D' (-4, -5)
(x, y)	$(x, y - 2)$

b. Write a generalization in (x, y) form for points on the new image, compared to corresponding points on the original image.
$(x, y-2)$

c. Explore the characteristics of the original image and new image. How do they compare?

- **Length of corresponding sides**
  They are congruent.

- **Corresponding angle measurements**
  They are congruent.

- **Perimeter**
 They are congruent.

- **Area**
  They are congruent.

d. Write a generalization in (x, y) form if the transformation was a translation up 5 units.
$(x, y +5)$
If shifting down decreases the value of our y-coordinates, shifting up would increase the value of our coordinates. The x-coordinates are unaffected as no horizontal shifting is taking place.

3. **For each set of figures,**
    a. **describe the transformation from figure A to figure B,**
    b. **record ordered pairs of corresponding points in the table, and**
    c. **write a generalization in (x, y) form for points on figure B compared to figure A.**
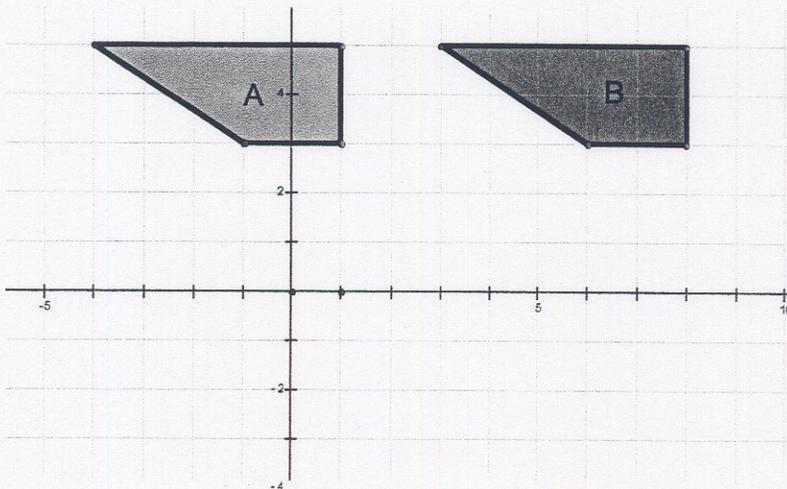
(i.)   *Answers will vary, but the rule will not.*
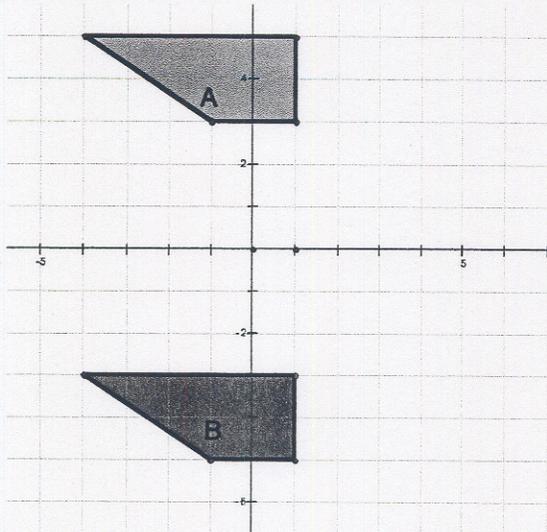
Original image	New image
(-4, 5)	(-4, -3)
(1, 5)	(1, -3)
(1, 3)	(1, -5)
(-1, 3)	(-1, -5)
(x, y)	$(x, y-8)$

Description of transformation: vertical shift 8 units down

(ii.)   *Answers will vary, but the rule will not.*

Original image	New image
(-4, 5)	(3, 5)
(1, 5)	(8, 5)
(1, 3)	(8, 3)
(-1, 3)	(6, 3)
(x, y)	$(x+7, y)$

Description of transformation: horizontal shift 7 units to the right
(iii.)   *Answers will vary, but the rule will not.*
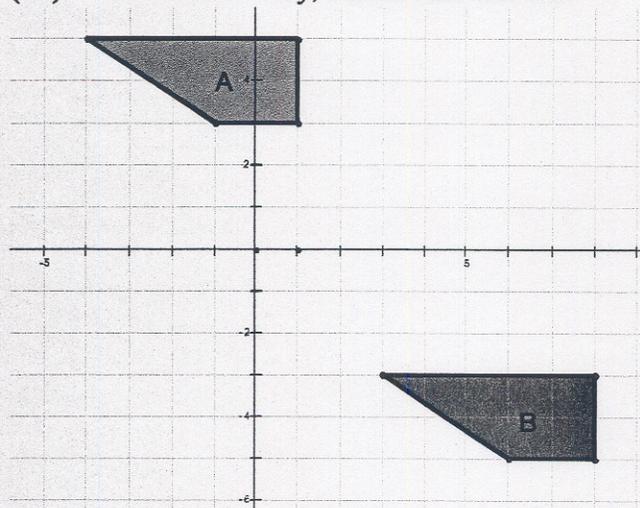
Original image	New image
(-4, 5)	(3, -3)
(1, 5)	(8, -3)
(1, 3)	(8, -5)
(-1, 3)	(6, -5)
(x, y)	(x+7, y-8)

Description of transformation:
vertical shift 8 units down and horizontal shift of 7 units to the right OR horizontal shift 7 units to the right and a vertical shift of 8 units down

4. **Using a graphing utility,**
   a. **Given the ordered pairs of points on the original image in lists 1 and 2, create the corresponding ordered pairs of the new image in lists 3 and 4 if the figure is translated 6 units to the right.**

List 1	List 2	List 3	List 4
3	5	9	5
-1	7	5	7
-4	-5	2	-5
0	-7	6	-7
2	-2	8	-2

   • **Create a scatter plot of the original image and new image.**
     You will need to re-enter the first point as the last point and select the connected plotting.

   • **In which Quadrant is the new image?**
     Quadrants I and IV

b. **Given the ordered pairs of points on the original image in lists 1 and 2, create the corresponding ordered pairs of the new image in lists 3 and 4 so that the new image will appear in Quadrant III.**
This will require a horizontal shift at least 3 units to the left and a vertical shift at least 7 units down

List 1	List 2	List 3	List 4
3	5		
-1	7	*answers will*	
-4	-5	*vary*	
0	-7		
2	-2		

- **Create a scatter plot of the original image and new image.**
  You will need to re-enter the first point as the last point and select the connected plotting.

c. **Given the ordered pairs of points on the original image in lists 1 and 2, create the corresponding ordered pairs of the new image in lists 3 and 4 so that the new image will appear in Quadrant IV.**
This will require a horizontal shift at least 4 units to the right and a vertical shift at least 7 units down.

List 1	List 2	List 3	List 4
3	5		
-1	7	*answers will*	
-4	-5	*vary*	
0	-7		
2	-2		

- **Create a scatter plot of the original image and new image.**
  You will need to re-enter the first point as the last point and select the connected plotting.

5. **Describe the transformation from (x, y) given the following generalizations.**
   a. $(x + 5, y)$
   horizontal shift 55 units to the right

   b. $(x, y + 5)$
   vertical shift 5 units up

   c. $(x - 3, y)$
   horizontal shift 3 units to the left

   d. $(x, y - 3)$
   vertical shift 3 units down

e. **(*x*–3, *y*+5)**
    combination of a horizontal shift 3 units to the left and a vertical shift 5 units up

Student Activity: Translations

1. Translate the given figure 3 units to the right.

   a. Complete the table to compare the coordinates of the points
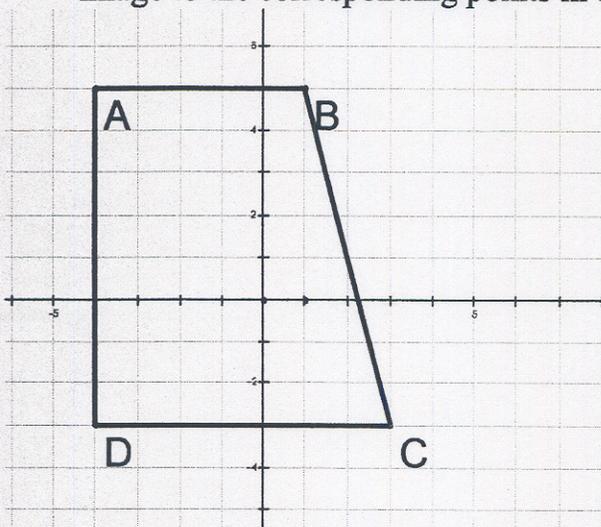   in the new image to the corresponding points in the original image.
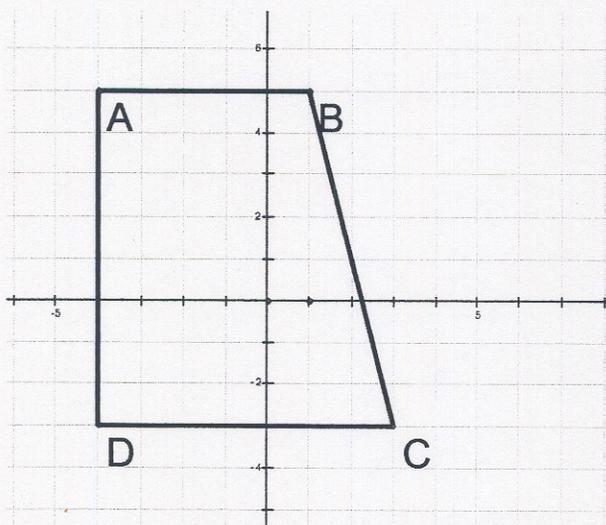
Original image	New image
A (-4, 5)	A' (_____ , _____)
B (1, 5)	B' (_____ , _____)
C (3, -3)	C' (_____ , _____)
D (-4, -3)	D' (_____ , _____)
(x, y)	(_____ , _____)

   a. Write a generalization in (x, y) form for points on the new image, compared
      to corresponding points on the original image.

   b. Explore the characteristics of the original image and new image. How do
      they compare?
      • Length corresponding of sides

      • Corresponding angle measurements

      • Perimeter

      • Area

   c. Write a generalization in (x, y) form if the transformation was a translation 4
      units to the left.

2. Translate the given figure down 2 units.

    a. Complete the table to compare the coordinates of the points in the new image to the corresponding points in the original image.

Original image	New image
A (-4, 5)	A' (,)
B (1, 5)	B' (,)
C (3, -3)	C' (,)
D (-4, -3)	D' (,)
(x, y)	(,)

    b. Write a generalization in (x, y) form for points on the new image, compared to corresponding points on the original image.


    c. Explore the characteristics of the original image and new image. How do they compare?
        • Length of corresponding sides

        • Corresponding angle measurements

        • Perimeter

        • Area

   d. Write a generalization in (x, y) form if the transformation was a translation up 5 units.

3. For each set of figures:
    a. Describe the transformation from figure A to figure B,
    b. Record ordered pairs of corresponding points in the table, and
    c. Write a generalization in (x, y) form for points on figure B compared to figure A.

(i.)

Original image	New image
(,)	(,)
(,)	(,)
(,)	(,)
(,)	(,)
(x, y)	(,)

Description of transformation: _____

(ii.)
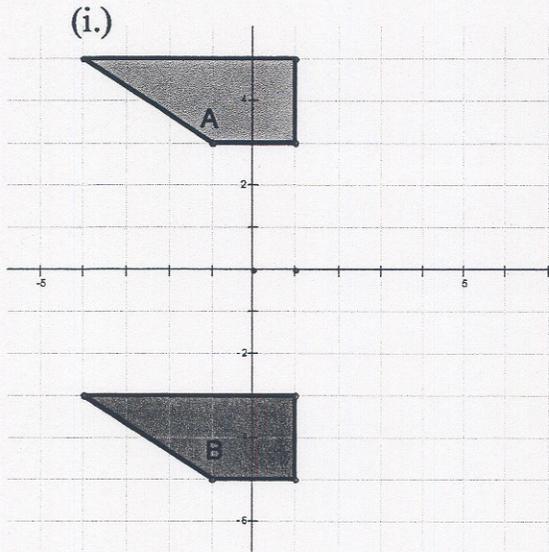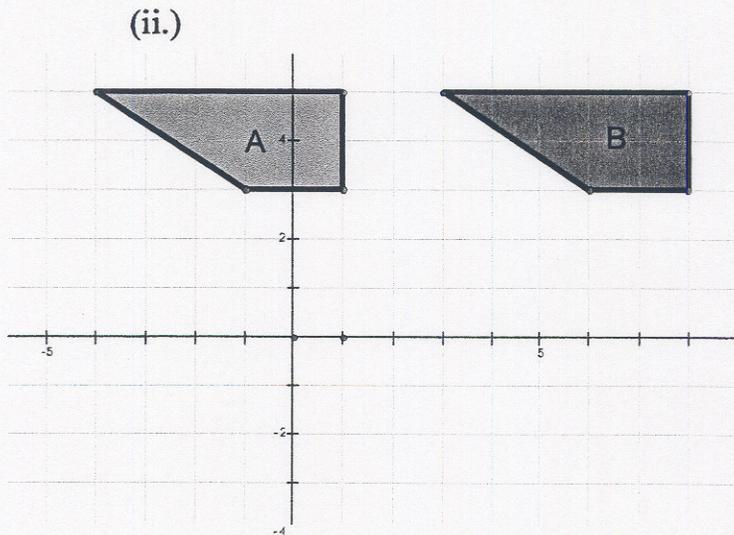
Original image	New image
(,)	(,)
(,)	(,)
(,)	(,)
(,)	(,)
(x, y)	(,)

Description of transformation: _____

(iii.)

Original image	New image
(___ , ___)	(___ , ___)
(___ , ___)	(___ , ___)
(___ , ___)	(___ , ___)
(___ , ___)	(___ , ___)
(x, y)	(___ , ___)

Description of transformation: _____

4. Use a graphing calculator to answer the following:

   a. Given the ordered pairs of points on the original image in lists 1 and 2, create the corresponding ordered pairs of the new image in lists 3 and 4 if the figure is translated 6 units to the right.

List 1	List 2	List 3	List 4
3	5		
-1	7		
-4	-5		
0	-7		
2	-2		

   • Create a scatter plot of the original image and new image.

   • In which Quadrant(s) is the new image?

b. Given the ordered pairs of points on the original image in lists 1 and 2, create the corresponding ordered pairs of the new image in lists 3 and 4 so that the new image will appear in Quadrant III.

List 1	List 2	List 3	List 4
3	5		
-1	7		
-4	-5		
0	-7		
2	-2		

- Create a scatter plot of the original image and new image.

c. Given the ordered pairs of points on the original image in lists 1 and 2, create the corresponding ordered pairs of the new image in lists 3 and 4 so that the new image will appear in Quadrant IV.

List 1	List 2	List 3	List 4
3	5		
-1	7		
-4	-5		
0	-7		
2	-2		

- Create a scatter plot of the original image and new image.

5. Describe the transformation from (x, y) given the following generalizations.

a. $(x+5, y)$

b. $(x, y + 5)$

c. $(x-3, y)$

d. $(x, y-3)$

e. $(x-3, y+5)$