Bell Ringer:

Write TEST for Tuesday!

On Wednesday, write the objective statement located on page 103, then answer the following question:

Write down what you think of when you hear the word "transform".
1. Why could a single translation map one of the long rectangular benches onto the other long rectangular bench, but not map one short rectangular bench and flagpole onto the other short rectangular bench and flagpole?

2. Describe a rigid motion or composition of rigid motions that maps the rectangular bench at (0, 10) and the adjacent flagpole onto the other short rectangular bench and flagpole.

3. Regina wants to know if it is possible for a composition of rigid motions to map one of the short rectangular benches onto a long rectangular bench. Write a short explanation that you could send to Regina in an email.

4. One of Regina’s assistants glances at the plan and comments that the hexagonal shape has the greatest number of lines of symmetry of all the shapes in the plan. Is the assistant correct? Explain.

5. A landscape architect recommends installing a triangular statue with vertices at (10, −10), (10, −8), and (7, −10). 
   a. Is the triangle congruent to triangle T? Justify your answer.
   b. Propose a series of rigid motions that justifies your answer to part a.

6. Another landscape architect recommends installing a triangular statue with vertices at (−5, 10), (−5, 8), and (−7, 8). 
   a. Is the triangle congruent to triangle T? Justify your answer.
   b. Propose a series of rigid motions that justifies your answer to part a.
UNIT 2 GETTING READY PRACTICE

1. Simplify.
   a. \( \sqrt{64} \)
   b. \( \sqrt{98} \)

2. Solve the following equations.
   a. \( x^2 - 8x + 15 = 0 \)
      \[ (x - 5)(x - 3) = 0 \]
      \[ x = 5, 3 \]
   b. \( x^2 = 27 \)
      \[ x = \pm 3\sqrt{3} \]

3. If \( f(x) = 2x - 5 \), find
   a. \( f(4) \)
   b. \( f(-3) \)

4. Write the equation of the line shown below.

5. Find the slope of a line that passes through \((-2, 5)\) and \((1, 7)\).
   \[ m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 5}{1 + 2} = \frac{2}{3} \]

6. Write the equation of a line that contains the points \((4, 2)\) and \((-7, -6)\).
   \[ y - 8 = 2(x - 3) \]
   \[ y = 2x + 6 \]

7. Find the midpoint and length of a line segment that has endpoints \((1, 1)\) and \((4, 3)\).
   \[ M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) = \left(\frac{1 + 4}{2}, \frac{1 + 3}{2}\right) = \left(\frac{5}{2}, 2\right) \]
   \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(4 - 1)^2 + (3 - 1)^2} = \sqrt{9 + 4} = \sqrt{13} \]

8. a. Find the solution of the system of equations:
   \[ \begin{align*}
   x + 3y &= 4 \\
   5x - 2y &= 3
   \end{align*} \]
   b. Explain the method you used to find the solution.
   \[ \begin{align*}
   5(4 - 3y) - 2y &= 3 \\
   20 - 15y - 2y &= 3 \\
   20 - 17y &= 3 \\
   20 - 17y &= 3 \\
   -20 &= -20
   \end{align*} \]
Mr. Scott directs the Marching Cougars, the band at Chavez High School. He uses the coordinate plane to represent the football field. For the band’s first show, he arranges the band in a rectangle that is 6 marchers wide and 9 marchers deep.

The band begins by marching down the grid in this formation. Then the marchers move apart from each other vertically, while keeping the same distance between marchers within the same row.

The diagrams on the next page show the initial shape of the marchers, and the two transformations that they undergo. To describe and classify the transformations, compare the pre-image of a transformation to its image.

1. Use your own words to describe Transformation 1.
Lesson 9-1
Transformations

2. Compare Transformation 1 and Transformation 2. How do the two transformations compare?

3. Model with mathematics. Transformation 1 is an example of a rigid motion. A rigid motion keeps the same distance between the points that are transformed (in this situation, the marchers of the band); the shape and size of the pre-image and image are the same.
   a. How does Transformation 1 affect the distance between any two marchers in the band?
   b. How does Transformation 2 affect the distance between the marchers? Is Transformation 2 a rigid motion?

4. Review Transformation 1. Each point in the pre-image is mapped to a point in the image. For this reason, the transformation can be expressed as a function.
   a. Complete the table to show the positions of the four corners of the rectangle when Figure A is mapped onto Figure B.

<table>
<thead>
<tr>
<th>Figure A (pre-image)</th>
<th>Figure B (image)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1, 10)</td>
<td>(1, -4)</td>
</tr>
<tr>
<td>(1, 2)</td>
<td>(6, 4)</td>
</tr>
<tr>
<td>(6, 10)</td>
<td>(10, -4)</td>
</tr>
<tr>
<td>(6, 2)</td>
<td></td>
</tr>
</tbody>
</table>

   b. For any given point, how does the transformation change the x-coordinate and y-coordinate?
   c. You can use the notation (1, 10) → (1, -4) to show how a point is transformed. When you use this notation to show how a general point (x, y) is transformed, you are expressing the transformation as a function. Express Transformation 1 as a function.

   \[(x, y) \rightarrow (x, y - 6)\]
Lesson 9-1
Transformations

5. Review Transformation 2.
   a. Complete the table to show the positions of the four corners of the rectangle when Figure B is mapped onto Figure C.

<table>
<thead>
<tr>
<th>Figure B (pre-image)</th>
<th>Figure C (image)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1, 4)</td>
<td>(1, 8)</td>
</tr>
<tr>
<td>(1, -4)</td>
<td>(1, -8)</td>
</tr>
<tr>
<td>(0, 4)</td>
<td>(0, 8)</td>
</tr>
<tr>
<td>(0, -4)</td>
<td>(0, -8)</td>
</tr>
</tbody>
</table>

   b. For any given point, how does the transformation change the x-coordinate and y-coordinate?

   c. Can Transformation 2 also be expressed as a function? Explain why or why not. Write the function for each.

6. Draw each image on the graph to show how the pre-image is transformed by the function. Then classify the transformation as rigid or non-rigid.
   a. $(x, y) \rightarrow (2x, y)$

   b. $(x, y) \rightarrow (x, 2y)$

7. Write the numeral "4" in the middle of each pre-image in Item 6. Describe how the numeral should appear in each image.

Activity 9 • Translations, Reflections, and Rotations 105
Chunk: Draw a line after #10b

Lesson 9-1
Transformations

Check Your Understanding

Use the text and diagram to answer items 8 and 9.
The rectangle undergoes the transformation described by the function $\text{(}x, y\text{)} \rightarrow \text{(}x - 2, y + 1\text{)}$.

8. Complete the table to show the coordinates of the image and pre-image for the four corners of the rectangle.

<table>
<thead>
<tr>
<th>Pre-Image</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1, 3)</td>
<td>(-1, 4)</td>
</tr>
<tr>
<td>(4, 7)</td>
<td>(-1, 8)</td>
</tr>
<tr>
<td>(10, 3)</td>
<td>(8, 8)</td>
</tr>
<tr>
<td>(10, 2)</td>
<td>(8, 4)</td>
</tr>
</tbody>
</table>

9. Graph the transformation of the figure. Is the transformation a rigid motion or non-rigid motion? Explain how you know.

10. A rectangle is transformed as shown.

$(x, y) \rightarrow (x, y-4)$
Lesson 9-1
Transformations

a. Which function describes the transformation?

b. Classify the transformation as rigid or non-rigid. Explain why you classified the transformation that way.

LESSON 9-1 PRACTICE
For items 11 and 12, consider the following: A rectangle undergoes the transformation described by the function \((x, y) \rightarrow \left(\frac{x}{2}, \frac{y}{2}\right)\).

11. Graph the transformation of the figure. Is the transformation a rigid motion? Explain.

12. Reason abstractly. Draw a plus sign (+) in the middle of the image. Describe how the transformation would change the plus sign.

13. Attend to precision. Use the graph of the rectangle to help you classify each of the following transformations.
   a. Draw the image of the rectangle under the transformation described by the function \((x, y) \rightarrow (x \cdot \frac{1}{2}, y)\). Classify the transformation as rigid or non-rigid.
   b. Draw the image of the rectangle under the transformation described by the function \((x, y) \rightarrow (x, y + 2)\). Classify the transformation as rigid or non-rigid.
<table>
<thead>
<tr>
<th>Vocabulary Term</th>
<th>Definition / Naming</th>
<th>Sketch / Symbol / Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformation</td>
<td>A transformation is a change in the position, size, or shape of a figure.</td>
<td></td>
</tr>
<tr>
<td>Pre-image</td>
<td>The pre-image of the transformation is the original figure.</td>
<td></td>
</tr>
<tr>
<td>Image</td>
<td>The image is the figure after the transformation.</td>
<td></td>
</tr>
<tr>
<td>Rigid Motion</td>
<td>A rigid motion is a transformation that preserves size and shape.</td>
<td></td>
</tr>
</tbody>
</table>
HOMEWORK:
Lesson 9-1 Worksheet