Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Unit 8 – Exploring Transformations**

Monica

Geometry Period:\_\_\_\_\_

Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**PART 1 DIRECTIONS:** Over the next few days you will be using Geometer’s Sketchpad to explore properties of transformations. Specifically we will be examining reflections, rotations, and dilations. Be sure to follow the directions ***carefully*** and answer all of the questions.

**Step 1:** Go to the class web site at tywlsgeometry.weebly.com. Under “Unit 8 – Similarity,” click on the file named “Starting Triangle – Transformations”. You will be using this starting triangle to answer all of the questions. Complete the chart below as you finish each step.

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| **REFLECTIONS** | | | | |
| **STEP** | **Coordinates of starting triangle** | **Reflect Over Line** | **New Coordinates** |  |
| 2 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | y – axis | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 3 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | x – axis | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 4 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | y = x | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 5 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | y = -x | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 6 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | x = 2 | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 7 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | y = -1 | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |

**Step 2:** Double-click the y-axis. This marks the line as the reflection line. Select the 3 points and 3 segments of triangle ABC. We will now reflect triangle ABC over the y-axis. Under the “Transform” menu, select “Reflect”. Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**QUESTION #1:** How many horizontal units away is point A from the y-axis? How many horizontal units away is point A’ from the y-axis? Answer these questions again for points B and B’, and C and C’. What relationship do you notice between the pre-image and image? Why do you think this happened?

**Step 3:** Delete triangle A’B’C’. Double-click the x-axis. This marks the line as the reflection line. Select the 3 points and 3 segments of triangle ABC. We will now reflect triangle ABC over the x-axis. Under the “Transform” menu, select “Reflect”. Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above. ***(Think and discuss: Why do B and B’ have the same coordinates?)***

**Step 4:** Delete triangle A’B’C’. Using the line tool, graph the line y = x. Double-click the line y = x. This marks the line as the reflection line. We will now reflect triangle ABC over the line y = x. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Reflect”. Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

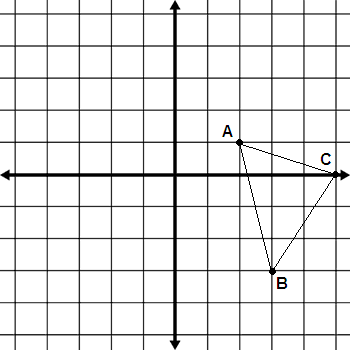
**Step 5:** Delete triangle A’B’C’ and the line y = x. Using the line tool, graph the line y = -x. Double-click the line y = -x. This marks the line as the reflection line. We will now reflect triangle ABC over the line y = -x. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Reflect”. Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**Step 6:** Delete triangle A’B’C’ and the line y =-x. Using the line tool, graph the line x = 2. Double-click the line x = 2. This marks the line as the reflection line. We will now reflect triangle ABC over the line x = 2. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Reflect”. Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**Step 7:** Delete triangle A’B’C’ and the line x = 2. Using the line tool, graph the line y = -1. Double-click the line y = -1. This marks the line as the reflection line. We will now reflect triangle ABC over the line y = -1. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Reflect”. Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**OBSERVATION #1:** Look at your pre-image coordinates and your image coordinates. Look for a pattern of how the points changed. You will have to generalize your observations in Part 2.

**QUESTION #2:** Based on what you’ve observed about reflections, reflect the triangle below over the y-axis. Label your new triangle A’B’C’ and identify the new coordinates. *(Not sure? Use GSP to help you!)*



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| **ROTATIONS** | | | | |
| **STEP** | **Coordinates of starting triangle** | **Rotate About the Origin** | **New Coordinates** |  |
| 8 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | 90° | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 9 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | 180° | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 10 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | 270° | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 11 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | 360° | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |

**Step 8:** If you haven’t done so already, delete all of your lines and triangles, except for starting triangle ABC. Double click the origin (point (0,0)). This marks the point of rotation. We will now rotate triangle ABC 90° about the origin. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Rotate.” Make sure the pop-up box is labeled with “90.0 degrees.” Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**QUESTION #3:** Which quadrant and/or axes does triangle ABC start in? In which quadrant and/or axes does triangle A’B’C’ end up in? For every 90° a figure is rotated, how many quadrants do you expect it to move and in what direction (clockwise or counterclockwise)?

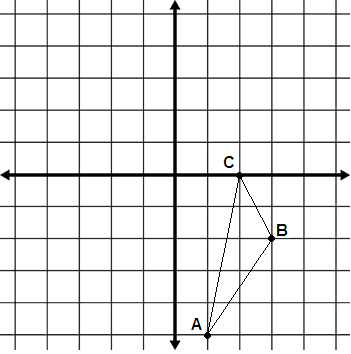
**Step 9:**  Delete triangle A’B’C’ . The origin is still marked as the point of rotation. Select the 3 points and 3 segments of triangle ABC. We will now rotate triangle ABC 180° about the origin. Under the “Transform” menu, select “Rotate.” Make sure the pop-up box is labeled with “180.0 degrees.” Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**Step 10:**  Delete triangle A’B’C’ . The origin is still marked as the point of rotation. Select the 3 points and 3 segments of triangle ABC. We will now rotate triangle ABC 270° about the origin. Under the “Transform” menu, select “Rotate.” Make sure the pop-up box is labeled with “270.0 degrees.” Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**Step 11:**  Delete triangle A’B’C’ . The origin is still marked as the point of rotation. Select the 3 points and 3 segments of triangle ABC. We will now rotate triangle ABC 360° about the origin. Under the “Transform” menu, select “Rotate.” Make sure the pop-up box is labeled with “360.0 degrees.” Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**OBSERVATION #2:** Look at your pre-image coordinates and your image coordinates. Look for a pattern of how the points changed. You will have to generalize your observations in Part 2.

**QUESTION #5:** Based on what you’ve observed about rotations, rotate the triangle below 90° about the origin. Label your new triangle A’B’C’ and identify the new coordinates. *(Not sure? Use GSP to help you!)*



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| **DILATIONS** | | | | |
| **STEP** | **Coordinates of starting triangle** | **Dilate** | **New Coordinates** |  |
| 12 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) | 2 | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 13 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) |  | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 14 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) |  | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |
| 15 | A: (\_\_\_,\_\_\_), B: (\_\_\_,\_\_\_), C: (\_\_\_,\_\_\_) |  | A’: (\_\_\_,\_\_\_), B’: (\_\_\_,\_\_\_), C’: (\_\_\_,\_\_\_) |  |

**Step 12:** If you haven’t done so already, delete all of your triangles, except for starting triangle ABC. Double click the origin (point (0,0)). This marks the point of dilation. We will now dilate triangle ABC. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Dilate.” Make sure the pop-up box is labeled with a fixed ratio of . (This means we’re dilating by a factor of 2.) Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

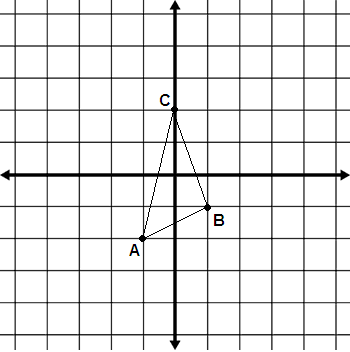
**Step 13:** Delete triangle A’B’C’. The origin is still marked as the point of dilation. We will now dilate triangle ABC. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Dilate.” Make sure the pop-up box is labeled with a fixed ratio of . (This means we’re dilating by a factor of or 0.5.) Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**Step 14:** Delete triangle A’B’C’. The origin is still marked as the point of dilation. We will now dilate triangle ABC. Select the 3 points and 3 segments of triangle ABC. Under the “Transform” menu, select “Dilate.” Make sure the pop-up box is labeled with a fixed ratio of . (This means we’re dilating by a factor of or 0.25.) Use the letter tool to name each point. (This should be done automatically as A’, B’, and C’.) Record the coordinates of the new points in the chart above.

**OBSERVATION #3:** Look at your pre-image coordinates and your image coordinates. Look for a pattern of how the points changed. You will have to generalize your observations in Part 2.

**QUESTION #6:** In which cases did our dilated triangle get bigger? In which cases did our dilated triangle get smaller? Why do you think this happened?

**QUESTION #7:** Based on what you’ve observed about dilations, dilate the triangle below by a scale factor of 2. Label your new triangle A’B’C’ and identify the new coordinates. *(Not sure? Use GSP to help you!)*



**QUESTION #8:** Based on your observations in today’s investigation, determine if each of the properties for each transformation changed. If that property did change, write “yes.” If it did not, write “no.” (You might have to go back and repeat some of the transformations, if you’re unsure.)

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| **TRANSFORMATION** | **Did the ORIENTATION change?** | **Did the LENGTH OF THE SEGMENTS change?** | **Did the ANGLE MEASURES change?** | **Did the SLOPE OF THE SEGMENTS change?** |
| **Reflection** |  |  |  |  |
| **Rotation** |  |  |  |  |
| **Dilation** |  |  |  |  |

**PART 2 DIRECTIONS:** Use what you learned in today’s investigation to answer the following questions. The first one is done for you.

1. If a point  is reflected over the y – axis, the new coordinates will be .

2. If a point  is reflected over the x –axis, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

3. If a point  is reflected over the line y = x, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

4. If a point  is reflected over the line y = -x, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

5. If a point  is rotated about the origin 90°, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

6. If a point  is rotated about the origin 180°, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

7. If a point  is rotated about the origin 270°, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

8. If a point  is rotated about the origin 360°, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_\_.

9. If a point  is dilated about the origin by a scale factor of *k*, the new coordinates will be \_\_\_\_\_\_\_\_\_\_\_.

**PART 3 DIRECTIONS:** Use your rules from part 2 to help you answer the questions below.

1. If the point (2,5) is rotated 90° about the origin, the image point will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. If the point (-4, 0) is reflected over the y-axis, the image point will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. If the point (-2, 3) is dilated by a scale factor of 3, the image point will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. If the point (-4, 5) is reflected over the line y = x, the image point will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_.