Math by Design
Lesson Plan: Transformations – Rotations

National Standard: **Geometry**: Apply transformations…/describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling
MD Standard 2: Knowledge of Geometry
MD Topic E: Transformations
MD Indicator 1: Analyze a transformation on a coordinate plane
MD Objective a: Identify, describe, and plot the results of multiple transformations on a coordinate plane
Materials and/or Set Up: Cutouts of several geometric figures, rulers, *Interactive Resource 1*
Relevant Vocabulary: Coordinate plane, coordinates, transformation, rotation, image, clockwise, counterclockwise, angle, angle measure, right angle, straight angle
Note to Teacher: This lesson is designed to be used in conjunction with the online interactive activity at http://mathbydesign.thinkport.org.
Suggested Activities: ▪ Lead a discussion about the meaning of the word "rotation" and what it means to rotate something. Ask a student to demonstrate what it means to rotate. Hand a geometric figure to another student and ask him or her to rotate the figure. ▪ If your students are interested in skateboarding or snowboarding, you may ask them to explain the meaning of a "180" or a "360" or a "540" or even a "720". *(These terms are used to describe the number of degrees of rotation of the person as he or she performs tricks on a skate- or snowboard.)* ▪ Use a cutout model of a figure attached to a segment (perhaps a toothpick or a straw) to demonstrate a rotation on a coordinate plane. Rotate the segment through 90 degrees to show the movement of the figure. Be sure that the students see the relationship of the original figure to its rotation by drawing the appropriate right angles to represent the beginning and ending positions of the endpoints of the segment. ▪ Repeat this process using a 90 degree angle in the opposite direction. Be sure that students understand the meaning of rotating counterclockwise versus rotating clockwise. ▪ Demonstrate or ask a student to demonstrate a rotation of 180 degrees. Draw the opposite rays that indicate the 180 degree of rotation. ▪ Lead a discussion about the relationship between the original coordinates and the ending coordinates. ▪ Use *Interactive Resource 1* to provide practice with rotations. Use both 90 and 180 degree rotations.

- If the students have already learned other types of transformations, use the figures from *Interactive Resource 1* to provide practice in applying several transformations.

Differentiation Suggestions:

- Use the interactive graph available at this website to assist students in identifying the relationships between the beginning coordinates and the coordinates after a rotation.
  http://www.shodor.org/interactivate/activities/Transmographer/

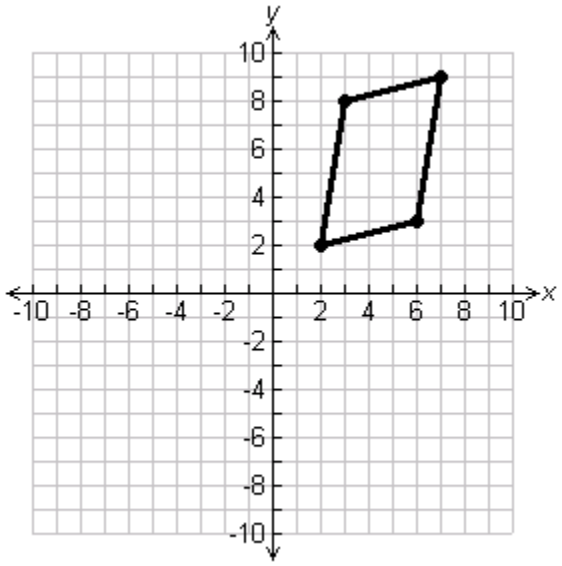
Assessment:

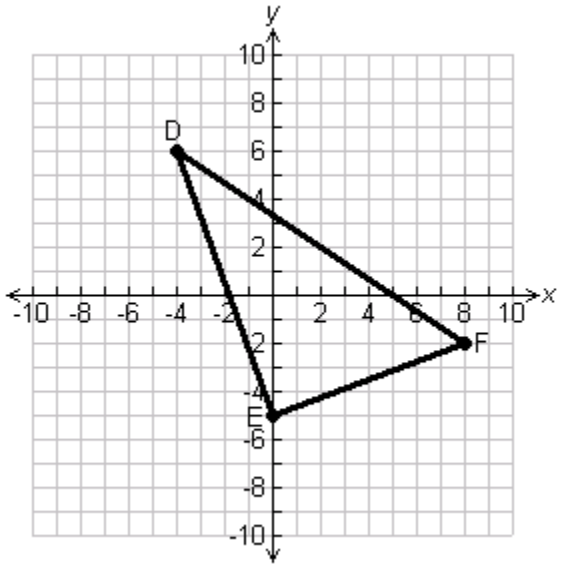
- On a coordinate plane, a point P located at coordinates (a, b) is rotated 180 degrees about the origin. What are the coordinates of the rotated point?
  Answer: (-a, -b)

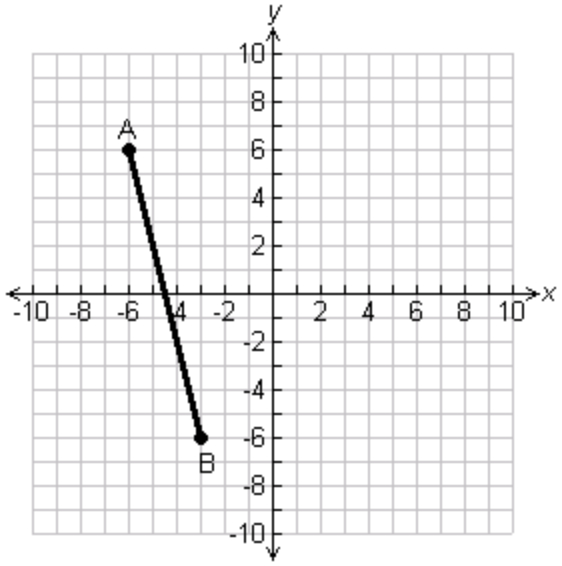
Follow Up:

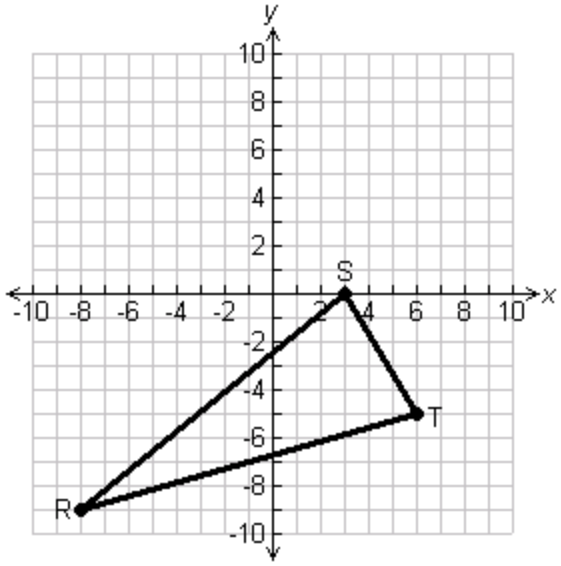
- Ask students to bring pictures that show examples of rotations being used in designs such as wall paper, floor tiles, art work, etc.
- Work with the art teacher to design a project involving geometric transformations.
- Ask students to identify geometric figures that have been rotated in this pattern:
  http://etc.usf.edu/clipart/37200/37289/pattern_11_37289.htm
- Find other patterns at:
  http://etc.usf.edu/clipart/galleries/math/geometric_blocks.php

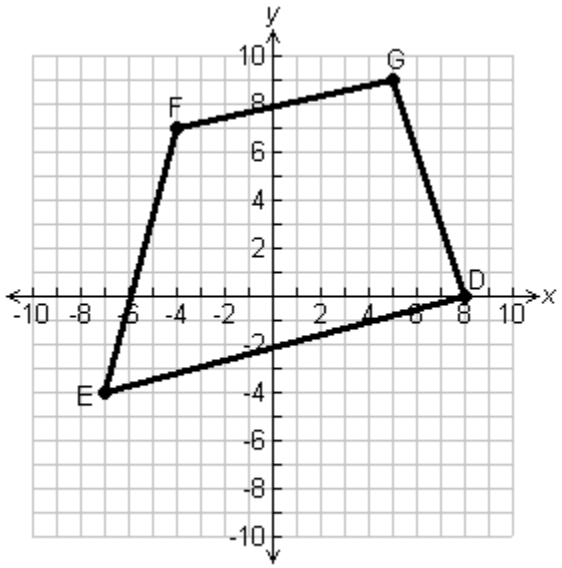
Interactive Resource 1

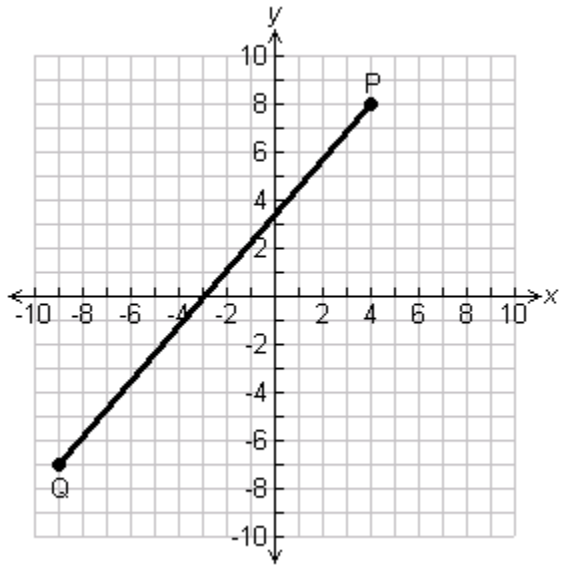


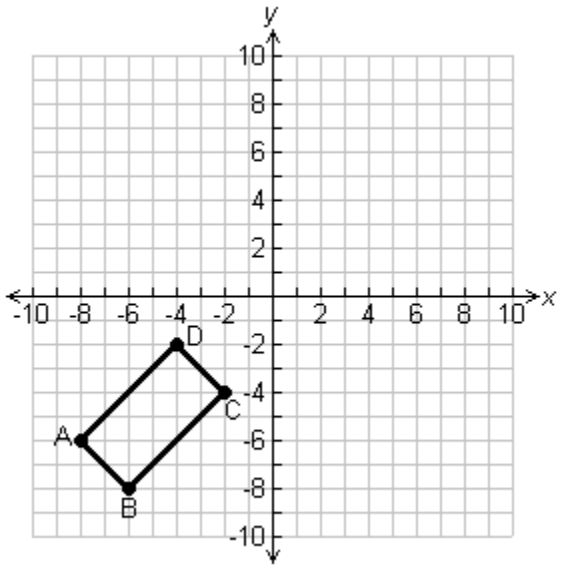


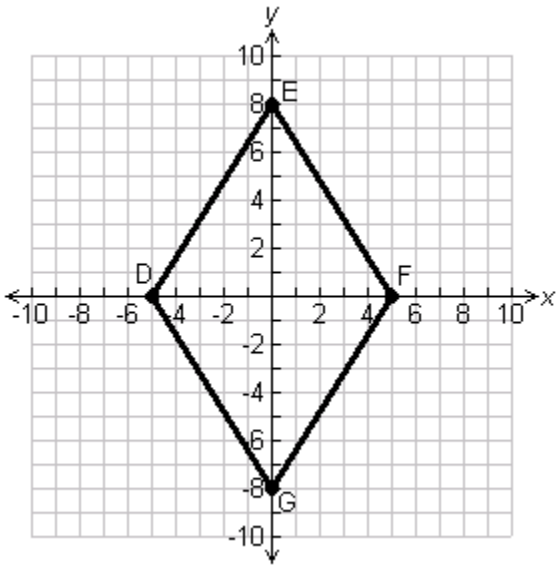












Interactive Resource 1 Answers for rotations 90 degrees counterclockwise; first answer includes two right angles for demonstration purposes.