

Transformations

ID: 13712

Time required

15 minutes

Activity Overview

Students will reflect figures over the x - and y -axis and then write rules for reflecting points over the axes. Students will then rotate figures 90° , 180° , and 270° counterclockwise about the origin, studying the coordinates of the pre-image and the image to write rules for rotations. In Problem 3, students can use the “grab and move” feature to explore other reflections and rotations.

Topic: Transformational Geometry

- Given a reflection line and a geometric figure, reflect the figure to discover that lengths, angles, areas and shapes are preserved under reflections and orientations are reversed.
- Given a center and angle of rotation, rotate a figure to discover that lengths, angles, areas, shapes and orientation are preserved under rotations.

Teacher Preparation and Notes

- Although this is a geometry activity, it can also be used in a Pre-Algebra or Algebra classroom.
- Before beginning this activity, students should be familiar with reflections and rotations outside the coordinate plane. They should already know the terms associated with transformations, such as pre-image, image, line of reflection, angle of rotation, and center of rotation.
- This activity is designed to be primarily teacher-led, with breaks for independent student practice.
- **To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter “13712” in the quick search box.**

Associated Materials

- *Transformations_Student.doc*
- *Transformations.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

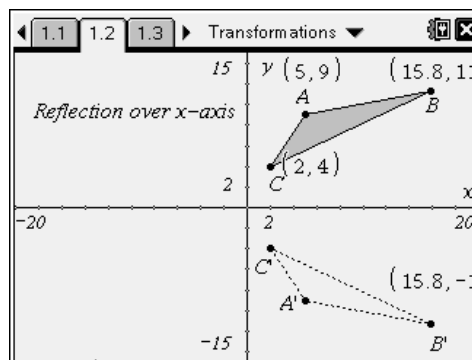
- *Reflections in the Plane (TI-84 Plus)* — 4044
- *Handy Reflections (TI-84 Plus)* — 6798
- *“Fishing for Points”—Transformations Using Lists (TI-84 Plus)* — 8823

Reflections in the coordinate plane can be over any line. In this activity, though, any reflections are over the x - or y -axis. Similarly, a figure can be rotated clockwise or counterclockwise about any point in the coordinate plane, but this activity focuses solely on counterclockwise rotations about the origin.

You may wish to have students explore “less restrictive” reflections and rotations using the constructions found on pages 3.1 and 3.2 of the student TI-Nspire document.

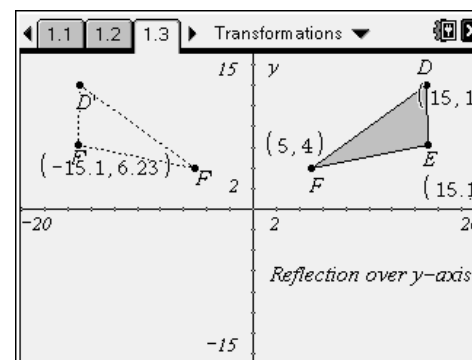
Problem 1 – Reflections

On page 1.2, $\triangle ABC$ is shown along with the reflection across the x -axis, $\triangle A'B'C'$. Each of the points is labeled with its coordinates. The coordinates to points A' and C' are hidden. Students can use the **Hide/Show** tool in the Actions menu to display the other coordinates.



Have students change $\triangle ABC$, dragging it by one of its vertices or a side. Ask students what they notice about any changes in the coordinates. (The x -values of pre-image and image points are equal; the y -values are opposites.)

On page 1.3, the triangle $\triangle DEF$ is reflected over the y -axis as $\triangle D'E'F'$.



Changing the coordinates of the pre-image points, ask students what they notice about the coordinates. (The y -values of pre-image and image points are equal; the x -values are opposites.) The coordinates to points D' and F' are hidden. Students can use the **Hide/Show** tool to display the other coordinates.

Students should complete the rules on their worksheet. Introduce the following notation if necessary (the arrow is read as “goes to”):

reflect over y -axis: $(x, y) \rightarrow (-x, y)$

reflect over x -axis: $(x, y) \rightarrow (x, -y)$

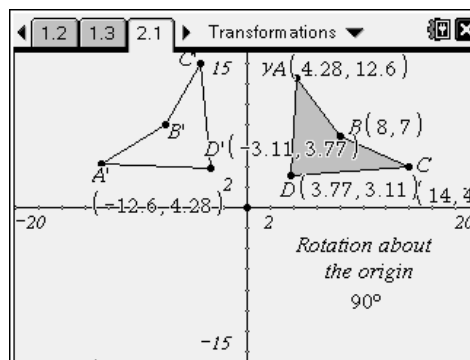
Discuss with students why these rules make sense.

Make sure that they read the negative sign as “the opposite of” instead of “negative.” The expression $-x$ could be a positive coordinate if the x -coordinate of the pre-image is a negative number, e.g. $(-4, -5) \rightarrow (4, -5)$.

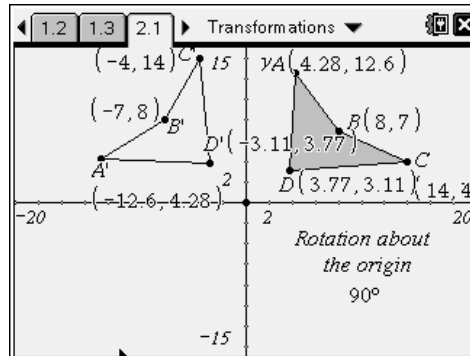
Problem 2 – Rotations

Next, students explore rotations. On page 2.1, quadrilateral $ABCD$ is drawn in Quadrant 1.

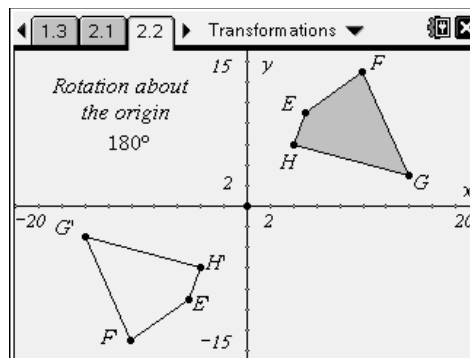
As before, students should spend some time dragging the pre-image around the coordinate plane. Ask how the coordinates are related. (The x - and y -values are exchanged, and the sign of the original y -coordinate is its opposite.)



Students should find and record the coordinates of both figures, and then sketch the pre-image and image on their worksheets, labeling the image points with primes.



On page 2.2, students should repeat the above steps to explore 180° rotations about the origin, finding that the coordinates of the image and pre-image points are opposites. Students can use the **Coordinates and Equations** tool in the Actions menu to display the coordinates of each point.



The diagram on page 2.3 asks students to similarly explore 270° rotations counterclockwise about the origin. They should conclude that the x - and y -values are exchanged, and the sign of the original x -coordinate is its opposite.)

Students should now complete the rules on their worksheets:

- rotate 90° counterclockwise: $(x, y) \rightarrow (-y, x)$
- rotate 180° counterclockwise: $(x, y) \rightarrow (-x, -y)$
- rotate 270° counterclockwise: $(x, y) \rightarrow (y, -x)$

