

Reflections and Rotations

ID: 8286

Time required

45 minutes

Activity Overview

Students will reflect figures over the x - and y -axes. By studying what happens to the coordinates of the pre-image and image points, they will 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.
- Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.
- **To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter “8286” in the keyword search box.**

Associated Materials

- ReflectionsRotations_Student.doc
- ReflectionsRotations.tns
- ReflectionsRotations_Soln.tns

Suggested Related Activities

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

- Handy Reflections (TI-84 Plus family) — 6798
- “Fishing for Points”—Transformations Using Lists (TI-84 Plus or TI-73 Explorer) — 8823

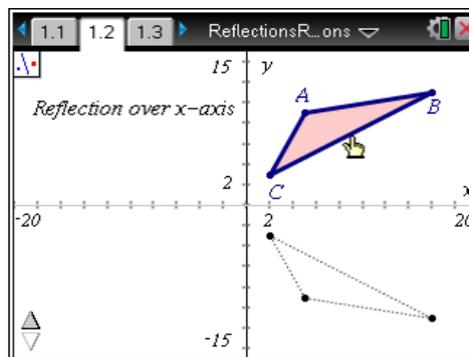
Reflections in the coordinate plane can be over any line. In this activity, though, any reflections are over the x - or y -axis. Similarly, a figure can be rotated clockwise or counterclockwise about any point in the coordinate plane, but this activity focuses solely on counterclockwise rotations about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

You may wish to have students explore “less restrictive” reflections and rotations using the constructions found on pages 3.1, 3.2, and 3.3 of the student TI-Nspire document.

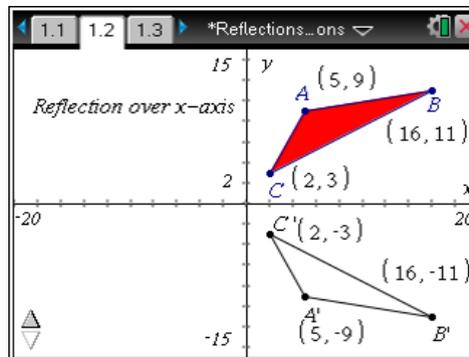
Problem 1 – Reflections

On page 1.2, $\triangle ABC$ is shown. Have students reflect this triangle across the x -axis. To reflect a figure, select the **Reflection** tool from the Transformation menu. Click on the line of reflection, followed by the figure to be reflected.

Students can press the up arrow to verify that they reflected the triangle correctly. Pressing the down arrow will hide the reflection.



The coordinates of both sets of points can be displayed by choosing **MENU > Actions > Coordinates and Equations** and clicking on each point. Have students record the coordinates on their worksheet and then sketch the triangles, labeling the image points with primes. (Labeling the points on screen may be accomplished by using the **Text** tool, also available from the Actions menu.)



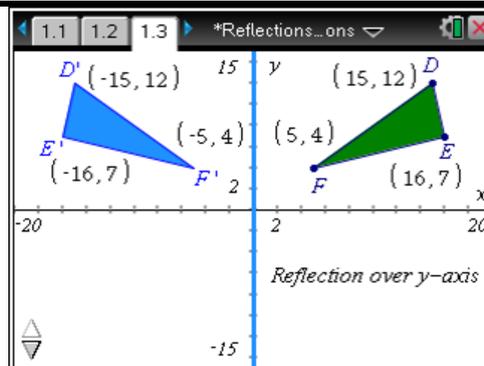
Have students change $\triangle ABC$, dragging it by one of its vertices or a side. Ask students what they notice about any changes in the coordinates. (The x -values of pre-image and image points are equal; the y -values are opposites.)

TI-Nspire Navigator Opportunity: Screen Capture

See Note 1 at the end of this lesson.

Students will now reflect $\triangle DEF$ across the y -axis on page 1.3. Again, students can press the up arrow to verify they reflected the triangle correctly.

Once more, have students display and record the coordinates of the pre-image and image points, as well as label the image points with primes. 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.)



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.

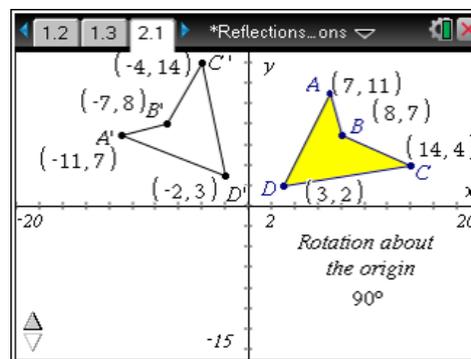
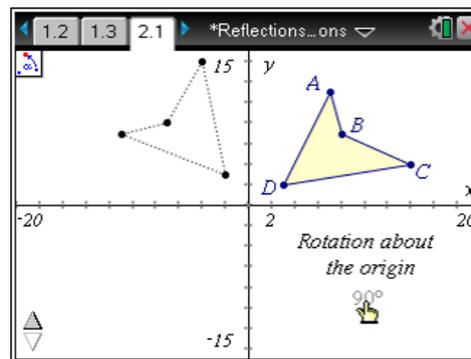
Make sure that they read the negative sign as “the opposite of” instead of “negative.” The expression $-x$ could be a positive coordinate if the x -coordinate of the pre-image is a negative number, e.g. $(-4, -5) \rightarrow (4, -5)$.

Problem 2 – Rotations

Next, students will explore rotations. On page 2.1, quadrilateral $ABCD$ is drawn in Quadrant 1. Have students rotate the triangle 90° counterclockwise about the origin.

To rotate the figure, choose the **Rotation** tool from the Transformation menu. Then select the center of rotation (the origin), the figure to be rotated ($ABCD$), and the angle of rotation (90° as displayed in the text box). Students can press the up arrow to verify that they rotated the quadrilateral correctly. Pressing the down arrow will hide the quadrilateral.

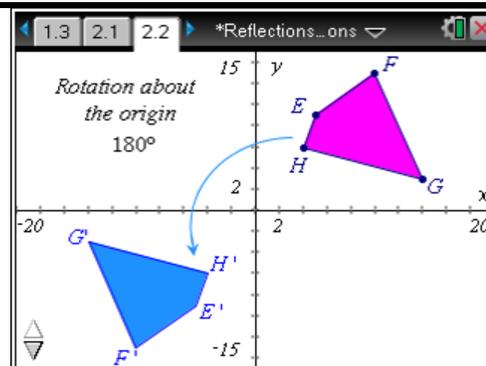
Students should find and record the coordinates of both figures, and then sketch the pre-image and image on their worksheets, labeling the image points with primes. As before, students should spend some time dragging the pre-image around the coordinate plane. Ask how the coordinates are related. (The x - and y -values are exchanged, and the sign of the original y -coordinate is its opposite.)



TI-Nspire Navigator Opportunity: *Screen Capture*

See Note 2 at the end of this lesson.

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.



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: $(x, y) \rightarrow (y, -x)$

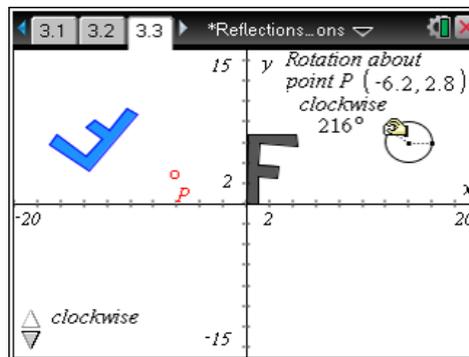
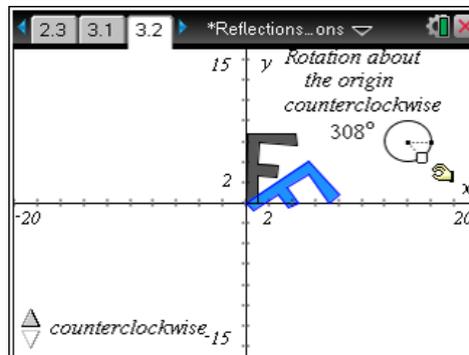
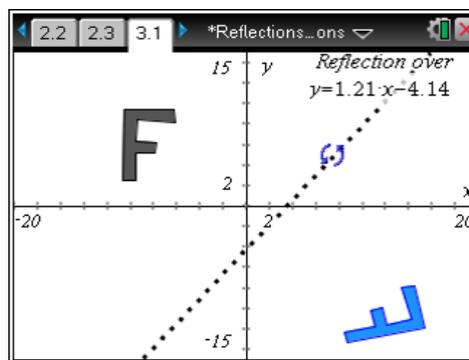
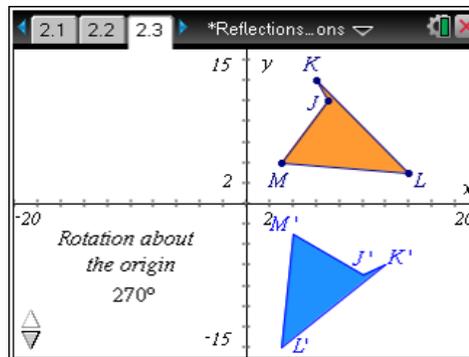
Problem 3 – More reflections and rotations

If time allows, encourage students explore reflections over lines other than the axes using the diagram on page 3.1. The line may be dynamically changed by dragging and/or rotating—and the image will update accordingly. Students can also grab and drag the pre-image.

Additionally, students can explore counterclockwise and clockwise rotations about the origin by different angle measures. On page 3.2, students can drag the topmost point on the circle around the circle to specify the angle of rotation. If students click the up arrow, they can rotate the figure clockwise. If students click the down arrow, they can rotate the figure counterclockwise.

Page 3.3 takes the diagram from page 3.2 one step further by allowing students to also change the center of rotation, either by dragging the point directly, or by altering its coordinates displayed on the screen.

To alter the coordinates onscreen, double-click on the coordinate you want to change, type in the new value and press .



TI-Nspire Navigator Opportunities**Note 1****Problem 1, *Screen Capture***

This would be a good place to do a screen capture to verify students are correctly reflecting the triangle.

Note 2**Problem 1, *Screen Capture***

This would be a good place to do a screen capture to verify students are correctly rotating the quadrilateral.