

GEOM Menu and Reflections

Lesson Plan Level: Geometry; Algebra II

Graphing Calculate: FX-9860G Plus; FX-9860 G Slim

Objective: The student will be able to:

1. Use the GEOM Menu of a graphing calculator to find the new coordinates of a polygon that is reflected the x-axis, y-axis, and the line $y = x$ and
2. Verify the results algebraically.

Engage

Review the terminology related to coordinate axes. Discuss the graph of the line $y = x$. Discuss with students the meaning of a translation and demonstrate a simple reflection without coordinates. Discuss how reflections are used in graphic arts and design.

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Explore

Demonstrate using the GEOM Menu of the graphing calculator to construct polygons, and perform reflections.

Explain:

Students will be able to explain the changes in the coordinates of a polygon for each of the given reflections.

Evaluate:

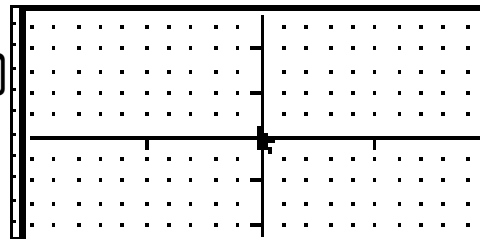
The student will be able to demonstrate their results using the calculator and an over head or LCD projector.

Extensions:

The students will be able to create a simple graphic design using reflections of lines and polygons using a geometry program.

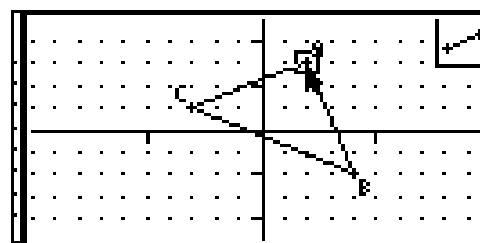
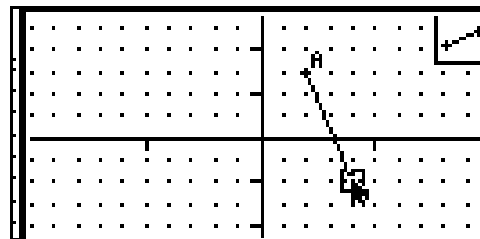
Calculator Notes: Using the GEOM Menu:

Press **MENU** and use the arrow keys to highlight the GEOM Menu and press **EXE**. Now press **SHIFT** **MENU** **F1** **▼** **F1** **EXE** to set up the axes and show the grid, then press **SHIFT** **F3** **(←)** **1** **0** **EXE** **EXE** **1** **0** **EXE** to set up a 10 by 10 grid on the screen as shown at the right.

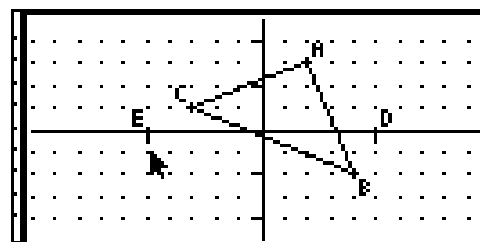


To draw a triangle with vertices at (2, 3), (4, -2) and (-3, 1), do the following:

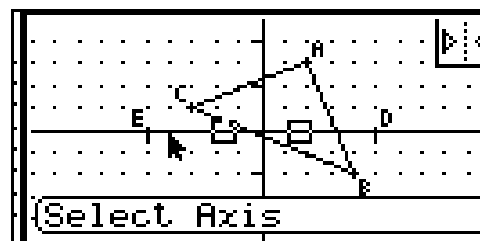
- Use the arrow keys to move the cursor to (2, 3) and press **F3** **2** **tan**. Use the arrow keys to move the cursor to (4, -2) and press **tan** twice. The screen should look like the one at the right.
- Use the arrow keys to move the cursor to (-3, 1) and press **tan** twice.
- Use the arrow keys once more to move the cursor to (2, 3) and press **tan**. The screen should display a triangle as shown at the right.



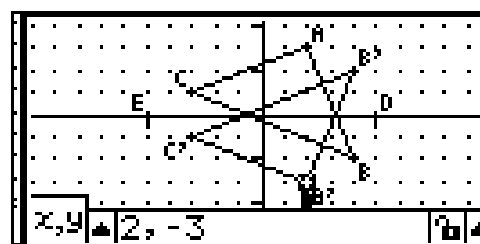
To draw the line of reflection for the x-axis, move the cursor to (5, 0), press **tan**, move the cursor to (-5, 0), and press **tan** **EXIT**. The two endpoints for the line segment will be labeled as shown at the right with points D and E.



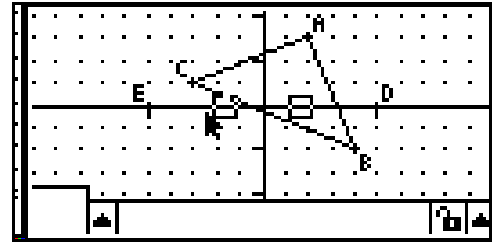
To reflect the triangle across the x-axis, press **F5** **1** and move the cursor to the x-axis until two open boxes appear on the line segment as shown at the right.



Press **tan** **F2** **3** to see the reflection. To find the coordinates of the new points, press **VARS** **EXIT** **tan** and move the cursor until a single open box appears on the desired point. The coordinates for A' are shown at the right. Press **tan** to deselect a point and find the coordinates of another point.



To draw a different reflection, press **F2** **1** to undo the current reflection. Move the cursor so that it selects \overline{ED} . Again, you will see two open boxes appear on the line segment as shown at the right. Now press **tan** **F2** **5**. The segment will be deleted.



To draw a line of reflection using the y-axis, follow the same procedure, but use the points (0, 4) and (0, -4). To reflect across the line $y = x$, use the points (-2, -2) and (2, 2). To draw a new figure, press **F2** **6** **F1**. This will clear the calculator in order to draw a new figure.

Student Activity Sheet - GEOM Menu and Reflections

Name: _____

Date: _____

Objective: Given the coordinates of a polygon, the student will:

1. Use a graphing calculator to draw the polygon and find the new coordinates of the vertices for the polygon for each reflection, and
2. Verify this algebraically.

Introduction:

One of the many uses of reflecting points is in the use of graphic design and building construction. These uses can be seen in fabric patterns, architecture, and animation. There are also uses for translating radio waves for cell phones and satellites.

Materials:

- a. Casio FX-9860G+ Graphing Calculator
- b. Student Answer Sheet

Formulas:

$$\text{a. } \begin{bmatrix} x_1' & y_1' \\ x_2' & y_2' \\ x_3' & y_3' \end{bmatrix} = \begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \\ x_3 & y_3 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \quad \text{- reflection across the x-axis}$$

$$\text{b. } \begin{bmatrix} x_1' & y_1' \\ x_2' & y_2' \\ x_3' & y_3' \end{bmatrix} = \begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \\ x_3 & y_3 \end{bmatrix} \cdot \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \quad \text{- reflection across the y-axis}$$

$$\text{c. } \begin{bmatrix} x_1' & y_1' \\ x_2' & y_2' \\ x_3' & y_3' \end{bmatrix} = \begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \\ x_3 & y_3 \end{bmatrix} \cdot \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \quad \text{- reflection across the line } y = x$$

Procedure:

1. Use the calculator to find the new coordinates for Triangle ABC and fill in the table.
2. Use the calculator to find the new coordinates for Parallelogram ABCD and fill in the table.
3. Verify your answers algebraically on a separate sheet of paper.
4. Answer the questions concerning your findings.

Table 1:

Triangle ABC		Triangle A'B'C'			
			x-axis	y-axis	y = x
Point A	(3, 2)	Point A'			
Point B	(-2, -2)	Point B'			
Point C	(4, -3)	Point C'			

Table 2:

Parallelogram ABCD		Parallelogram A'B'C'D'			
			x-axis	y-axis	y = x
Point A	(4, 2)	Point A'			
Point B	(2, -2)	Point B'			
Point C	(-5, -2)	Point C'			
Point D	(-3, 2)	Point D'			

Questions:

1. What change takes place when a figure is reflected across the x-axis? _____

2. What change takes place when a figure is reflected across the y-axis? _____

3. What change takes place when a figure is reflected across the line $y = x$? _____

4. Did you get the same results using algebra? _____
5. If a triangle whose vertices are (-12, 10), (6, -8) and (-3, 4) is reflected across the x-axis, what would be the coordinates of the new triangle? _____
6. If a rectangle whose vertices are (-5, 4), (-5, -2), (3, -2) and (3, 4) is reflected across the y-axis, what would be the coordinates of the new rectangle? _____
7. In your own words, describe how to find the new coordinates for a reflection across the line $y = x$. _____

Solutions:

Table 1:

Triangle ABC		Triangle A'B'C'			
			x-axis	y-axis	y = x
Point A	(3, 2)	Point A'	(3, -2)	(-3, 2)	(2, 3)
Point B	(-2, -2)	Point B'	(-2, 2)	(2, -2)	(-2, -2)
Point C	(4, -3)	Point C'	(4, 3)	(-4, -3)	(-3, 4)

Table 2:

Parallelogram ABCD		Parallelogram A'B'C'D'			
			x-axis	y-axis	y = x
Point A	(4, 2)	Point A'	(4, -2)	(-4, 2)	(2, 4)
Point B	(2, -2)	Point B'	(2, 2)	(-2, -2)	(-2, 2)
Point C	(-5, -2)	Point C'	(-5, 2)	(5, -2)	(-2, -5)
Point D	(-3, 2)	Point D'	(-3, -2)	(3, 2)	(2, -3)

Questions:

1. The sign of the y-coordinate changes to the opposite.
2. The sign of the x-coordinate changes to the opposite.
3. The coordinates are reversed.
4. Yes
5. (-12, -10) (6, 8) (-3, -4)
6. (5, 4) (5, -2) (-3, -2) (-3, 4)
7. Answers will vary.