Transformations of Absolute Value Functions

TI Calculator Activity

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Lab: Transformations of Absolute Value Functions

Alignment with *2007 Mississippi Mathematics Framework Revised*

Algebra II
Strand: Geometry
Objective: 3c. Sketch and describe transformations of quadratic and absolute value functions. (DOK 2)

Suggestions for Grouping
For this activity the students should be placed in groups of two or three.

Materials

- TI-84 Plus graphing calculators
- graph paper
- notebook paper
- pencils

National Council of Teachers of Mathematics Five Process Standards

Problem Solving	This non-routine problem-solving task requires students to think critically and use schema to develop new ideas and make conjectures.
Communications	The student groups communicate in both verbal and written form throughout the task. Students will share their findings with the class during the debrief.
Connections	Students make connections to other mathematical topics such as: coordinate geometry, geometric transformations, and families of lines.
Representations	Students represent absolute value functions using equations, sketches, and calculator-generated graphs.
Reasoning and Proof	Students reason out and justify their predictions and observations during the lab exploration and debrief.

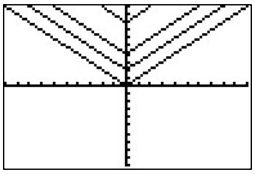
Additional Information

It is important to note that the rays of the graph of the absolute function are displayed without arrows when graphed with a graphing calculator. Please take special care to ensure that students are aware of how to accurately sketch the graph of absolute value functions.

Lab : Transformations of Absolute Value Functions

Graph the following absolute value functions using your graphing calculator. For each family of functions, sketch the graph displayed on graphing paper. Then answer the questions given.

1. Parent graph: $y = |x|$



$y = |x| + 2$

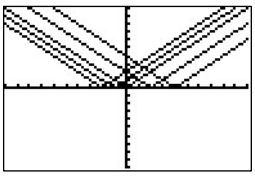
$y = |x| + 4$

$y = |x| + 8$

a. What do all functions in this family have in common? In what ways are they different from one another? **Answers may vary. Each function has two rays with opposite slopes. The functions are parallel to each other. All of the functions open upward. The functions touch the *y*-axis at different places. The parent function is translated vertically.**

b. Write the equation of two more functions that belong to this family. Explain. **Answers may vary.**

2. Parent graph: $y = |x|$



$y = |x + 1|$

$y = |x + 2|$

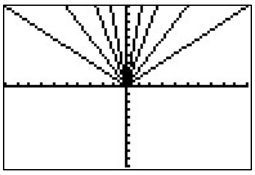
$y = |x - 2|$

$y = |x - 4|$

a. What do all functions in this family have in common? In what ways are they different from one another? **Answers may vary. Each function has two rays with opposite slopes. The rays to the left of the vertices are parallel to each other, and the rays to the right of the vertices are parallel to each other. All of the functions open upward. The functions touch the *y*-axis at different places. The parent function is translated horizontally.**

b. Write the equation of another function that belongs to this family. Explain. **Answers may vary.**

3. Parent graph: $y = |x|$



$y = 2|x|$

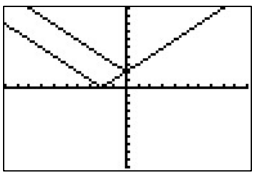
$y = 4|x|$

$y = 8|x|$

a. What do all functions in this family have in common? In what ways are they different from one another? **All of the functions have a vertex at the origin. All of the functions open upward. The rays of the functions have different slopes. The parent function is wider than the other functions provided for this family.**

b. Write the equation of two more functions that belong to this family. Explain. **Answers may vary.**

4. Graph the following functions:



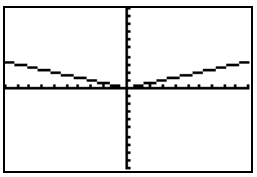
$y = |x| + 2$

$y = |x + 2|$

a. What do these functions have in common? In what ways are they different from one another? **Answers may vary. Both of these functions open upward. The rays of the functions have the same slope. Both functions have a vertex two units away from the origin. The first function has been translated two units up from the parent graph in items 1. and 2. The second function has been translated two units to the left from the parent graph in items 1. and 2.**

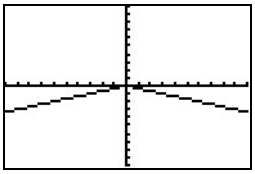
b. Predict what the graph of $y = |x - 3| + 2$ will look like? Explain your reasoning. **Answers may vary. This graph will have both a horizontal shift and vertical shift from the parent graph. The function will be translated three units to the right and two units up from the position of the parent graph, but will have rays with the same slopes as the parent graph and will open upward.**

5. Maria graphed an absolute value function that looked like this:



a. Write an equation that could represent the function Maria graphed. Explain. **Answers may vary. The equation that represents this function is $y = \frac{1}{3}|x|$. This pattern can be generalized from the pattern noticed in item 3. That is, as the coefficient of *x* increases, the graph of the absolute value function gets narrower. To find the appropriate equation for this graph, you should consider a coefficient of *x* that is less than that of the parent graph. So your coefficient must be between 0 and 1.**

b. Predict what the reflection over the x-axis of Maria's graph would look like. Sketch your prediction. **Answers may vary. Students may realize while working item 5a. that a negative coefficient of *x* will provide a function that reflects across the *x*-axis. The equation that represents this function is $y = -\frac{1}{3}|x|$.**



Suggested Debrief Questions

- What patterns did you notice?
- What predictions can you make for these patterns?
- How were all of the absolute value functions alike? Why do you think they all shared these common characteristics?

References:

Dougherty, B. J., Matsumoto, A. N., & Zenigami, F. (2003). *Explorations in algebra: Hands on lab activities*. Honolulu, HI: University of Hawaii, Curriculum Research & Development Group.

Mississippi Department of Education. (2007). *2007 Mississippi mathematics framework revised.* Jackson, Mississippi: Mississippi Department of Education.

National Council of Teachers of Mathematics (2000). *Principles and standards for school mathematics*. Reston, VA: NCTM.