TI-Nspire Activity: ***Transformations-Vertical and Horizontal Shifts***

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Activity Overview

Through exploration, students will discover the rules of vertical and horizontal shifts on functions. In this activity, students will be using the function: $f(x) = (x-c)^2 + d$ *and explore what affect the variables c, and d have on the following parent functions:*

$$f(x) = x^2$$
$$f(x) = |x|$$
$$f(x) = x^3$$
$$f(x) = \sqrt{x}$$

Concepts

Tennessee

Algebra 2: SPI 3103.3.10 Identify and/or graph a variety of functions and their transformations.

Advanced Algebra and Trigonometry: graph a variety of functions using transformations

PreCalculus: graph transformations and combinations of transformations for all basic functions

Teacher Preparation

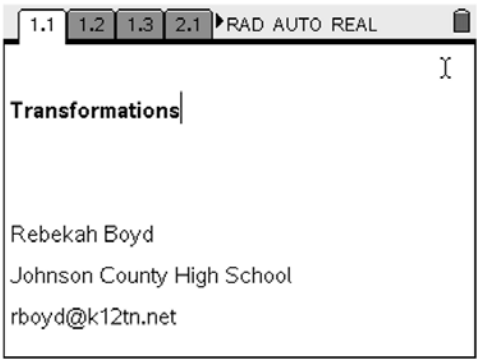
This activity is designed as an introduction to transformations in Algebra 2, but it can also be used a reteach activity for Advanced Algebra and Trigonometry and PreCalculus. Each student needs a copy of the handout and the .tns file loaded onto their handheld.

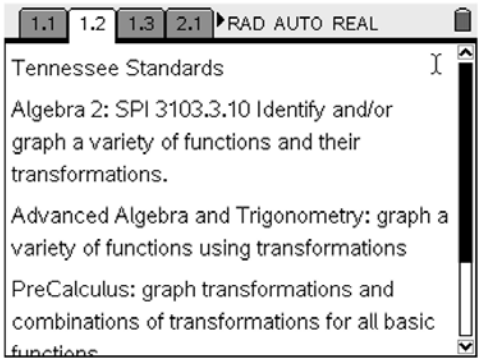
The Classroom.

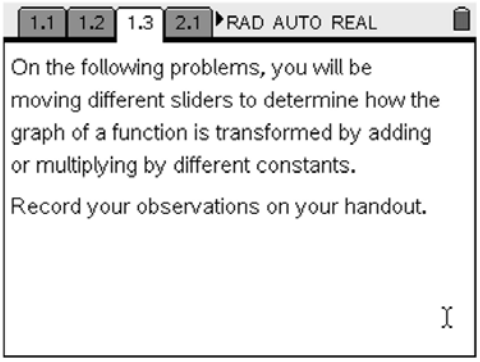
This activity can be completed individually or with students working with a partner, or as a teacher-led, whole class discussion.

-You will be using the transformations-vertical-horizontal-shift.tns file for the TI-Nspire.
-You will also need copies of the student sheet Transformations-Vertical-Horizontal shift-student.doc for each student.

Part 1: To go from page 1.1 to page 1.2: press ctrl right arrow.







Part 2: Vertical Shifts

In this section, students will begin with d and explore how adding or subtracting a value to the parent function affects the function.

There are 2 ways to manipulate the slider: either a) double click on the value that d is equal to or b) move the cursor over the slider and grab the moving bar.

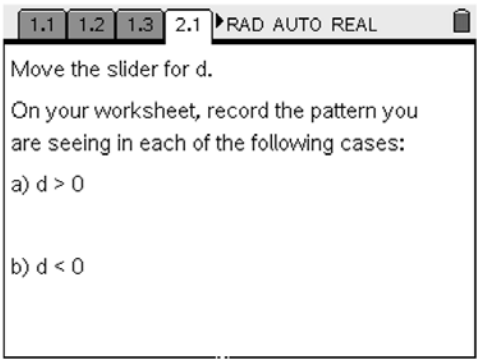
First move the slider up and explore what occurs when

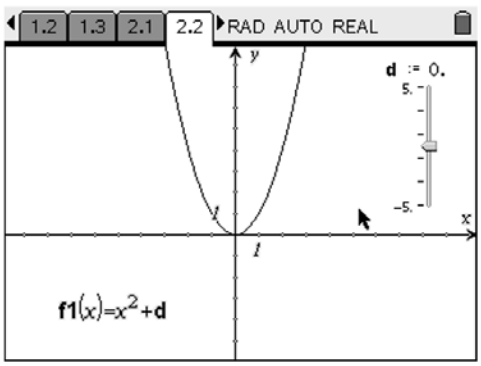
d > 0. Have students record the results on the student worksheet.

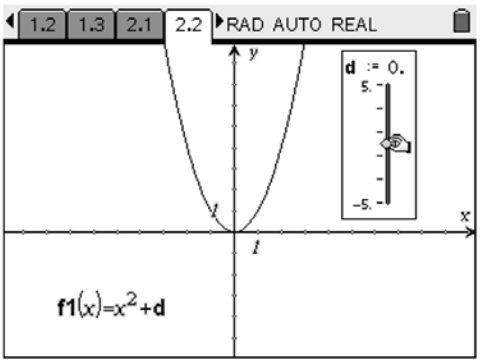
Answer:
When d > 0: the parent function is moved up the y-axis.

Next move the slider down and explore what occurs when d < 0. Have students record the results on the student worksheet.

Answer:
When d < 0: the parent function is moved down the y-axis.

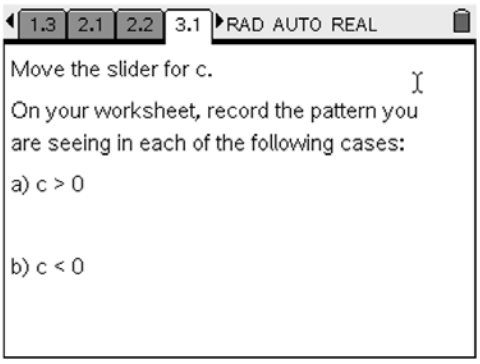






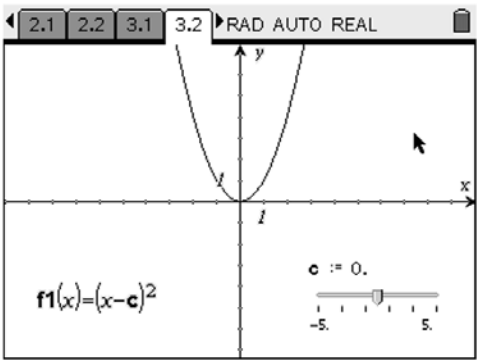
Part 3: Horizontal Shifts

$$f(x) = (x - c)^2$$



In this section, students will explore the affects of adding or subtracting a value to the x before squaring, taking the square root, etc. The base equation prior to inserting in values for the variables has a subtraction sign between the x and the c. Thus when we want c to be positive, the function will say (x – c) and when c is to be negative, the function will say (x + c).

There are 2 ways to manipulate the slider: either a) double click on the value that c is equal to or b) move the cursor over the slider and grab the moving bar.



First move the slider to the right and explore what occurs when c > 0. Have students record the results on the student worksheet.

Answer:
When c > 0: the parent function is moved to the right on the x-axis.

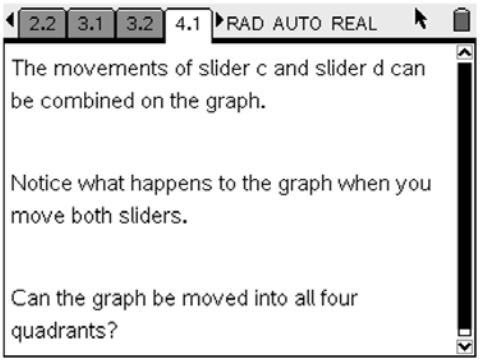
Next move the slider down and explore what occurs when c < 0. Have students record the results on the student worksheet.

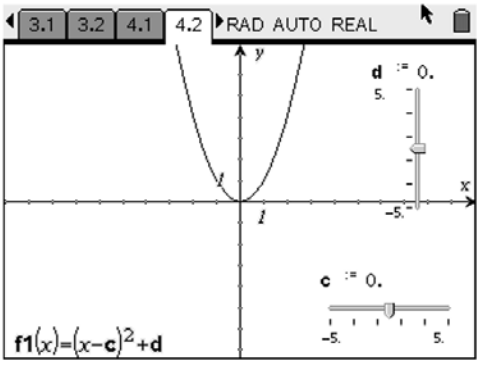
Answer:
When c < 0: the parent function is moved to the left on the x-axis.

Part 4: Vertical and Horizontal Shifts Combined

Students will be combining horizontal and vertical shifts in this section.

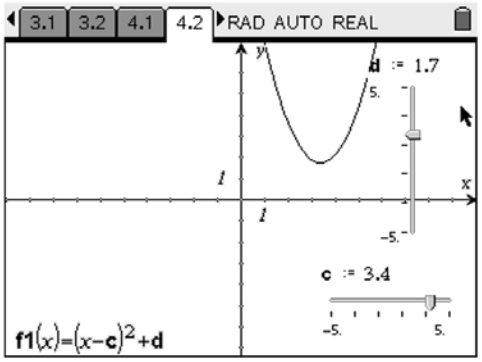
Thus far, each slider has just moved the graph on either the x-axis or the y-axis. Students will notice that by moving both sliders, the graph leaves the axis and enters the 4-quadrants.



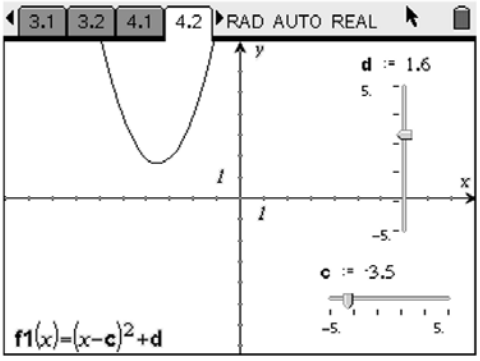


The student should notice the following:

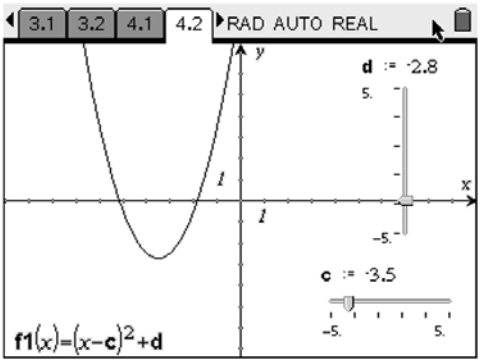
a) When d > 0 and c > 0, the base of the graph is located in the first quadrant.



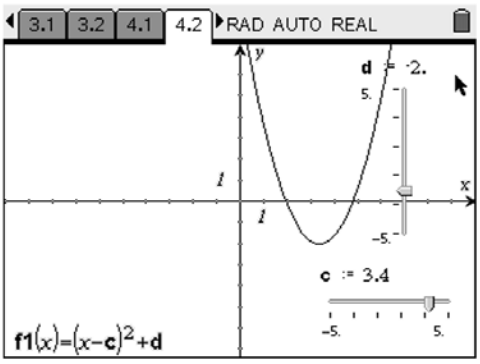
b) When d > 0 and c < 0, the base of the graph is located in the second quadrant.



c) When d < 0 and c < 0, the base of the graph is located in the third quadrant.



d) When d < 0 and c > 0, the base of the graph is located in the fourth quadrant.



Students are to record examples of the equations found that place each graph into each quadrant on the handout.

Ex:

Quadrant 1: $(x - 3.4)^2 + 1.7$

Quadrant 2: $(x - -3.5)^2 + 1.6 = (x + 3.5)^2 + 1.6$

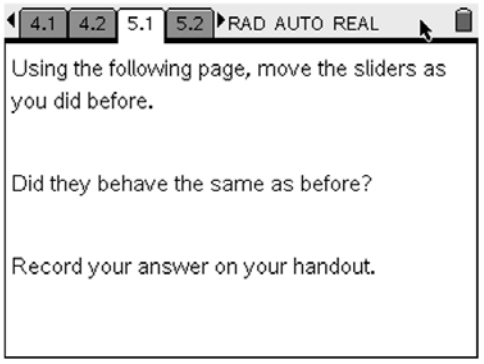
Quadrant 3: $(x - -3.5)^2 - 2.8 = (x + 3.5)^2 - 2.8$

Quadrant 4: $(x - 3.4)^2 - 2$

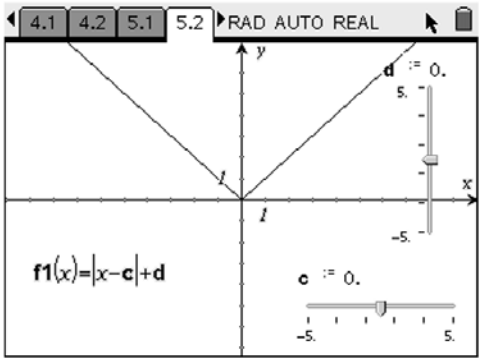
Continued exploration with additional parent functions:

Part 5: Absolute value function

In this section, students can explore that these rules apply to more parent functions other than f(x) = x^2.



In problem 5, students are exploring the parent function of absolute value. $f(x) = |x - c| + d$

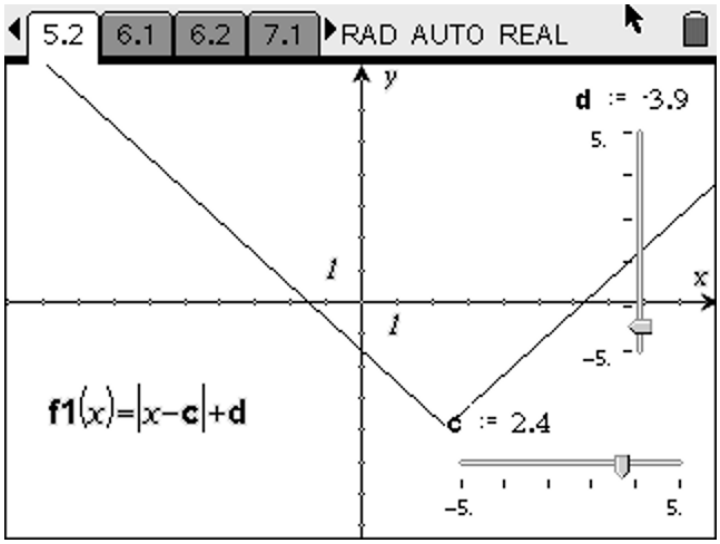


On their worksheet, students are asked to describe the movement of the function.

Answer: Behaves the same: c moves the function left and right and d moves the function up and down.

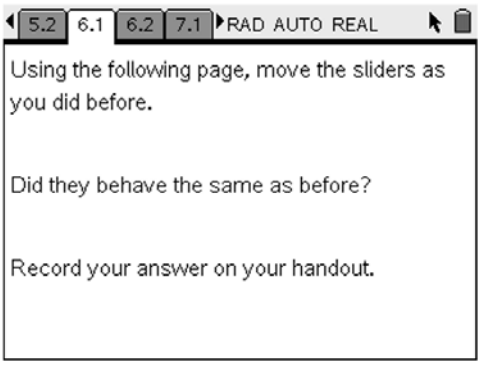
They are then asked to sketch the graph of:

$f(x) = |x - 2.4| - 3.9$

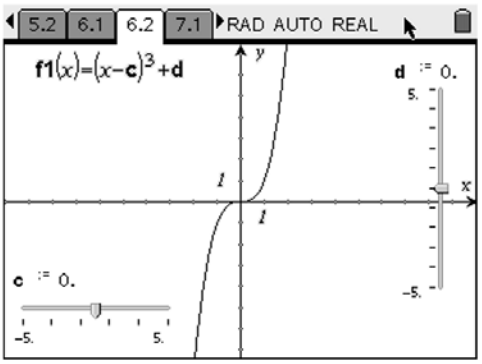


In problem 6, students are exploring the cubic function.

$$f(x) = (x-c)^3 + d$$



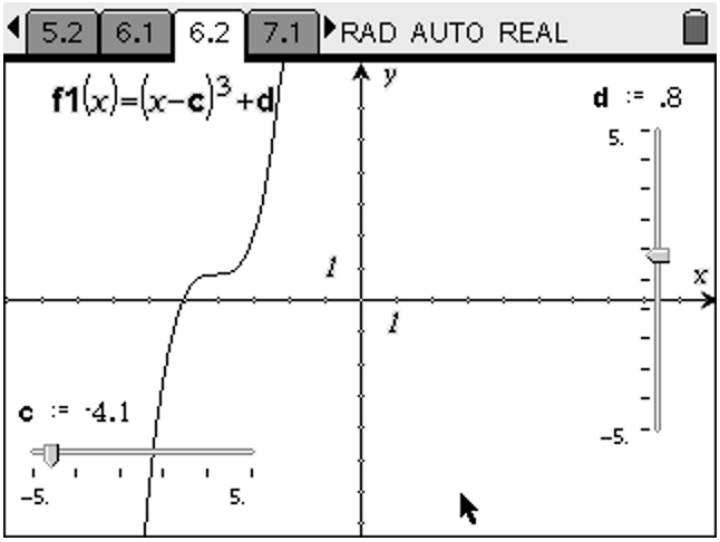
On their worksheet, students are asked to describe the movement of the function.



Answer: Behaves the same: c moves the function left and right and d moves the function up and down.

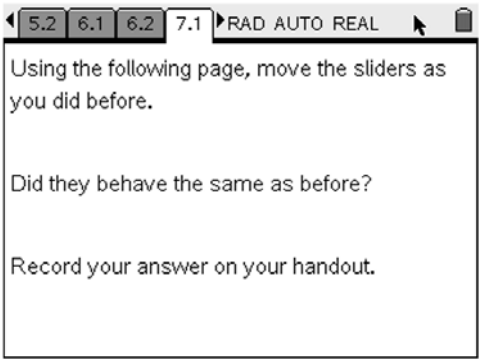
They are then asked to sketch the graph of:

$$f(x) = (x+4.1)^3 + .8$$



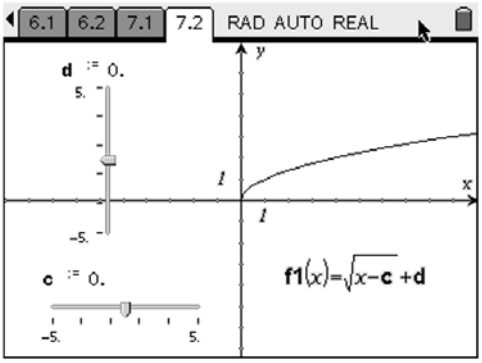
In problem 7, students are exploring the square root function.

$$f(x) = \sqrt{x-c} + d$$



On their worksheet, students are asked to describe the movement of the function.

Answer: Behaves the same: c moves the function left and right and d moves the function up and down.



They are then asked to sketch the graph of:

$$f(x) = \sqrt{x-1.5} - 2$$