TI-Nspire Activity: *Curve Shifters*
By: Janet Andreasen

Activity Overview
In this activity, students will examine shifting curves horizontally and vertically and stretching and shrinking curves using sliders. Preservice teachers will examine technology issues in teaching and learning mathematics.

Concepts
Graphic representations; horizontal and vertical shifts; reflection, dilation

Teacher Preparation
This activity is designed for an Algebra I or Algebra II classroom or pre-service methods course.

- *Each handheld needs the file curveshifters.tns*
- *Student handout for each student/group*

The Classroom.
This activity is best completed in small groups, although individual completion is also appropriate.

- *Student worksheet will guide students through activity and provides a place for students to record their answers.*

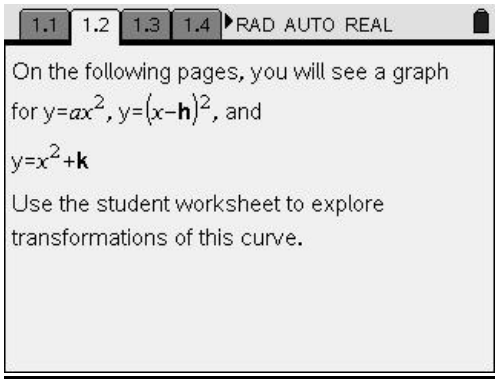
TI-Nspire Applications
Graphs & Geometry, Notes

Getting Started

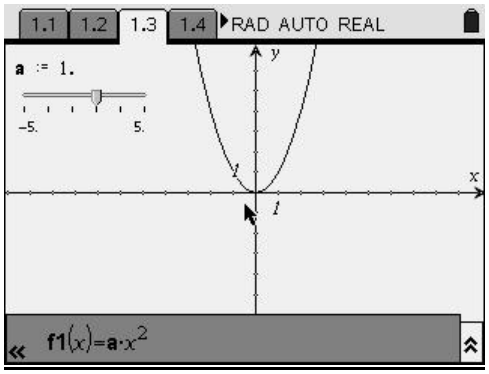
- *Open the file curveshifters.tns*
- *Follow directions on student worksheet*
- *Allow students to work through all four parts of the worksheet; circulate around the room to assist students as necessary.*

Part I

On page 1.3, the function $f(x) = a\,x^2$ is shown. A slider for the variable *a* is showing in the top left corner.

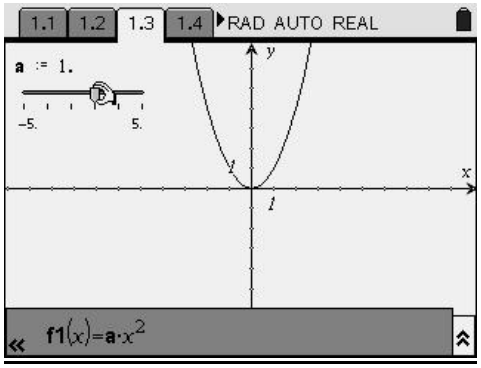


Press the tab button twice to obtain a cursor in the graph section.



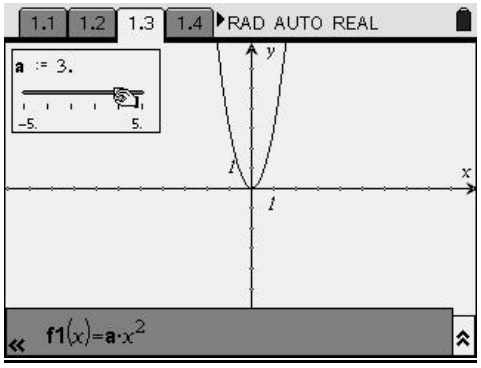
Change the value of *a* using the slider. To do this, point the cursor at the tick mark on the slider. Hold down the center button of the navigation pad to select the slider. Move the slider to the right and to the left.

Be patient – the graph may take a minute to catch up.



1. What observations can you make about what happens to the curve as the value of *a* changes?

   Answer: The value of a changes the width of the curve.



2. What if the value of *a* is positive?

   Answer: The curve opens upward.

3. What if the value of *a* is negative?

   Answer: The curve opens downward.

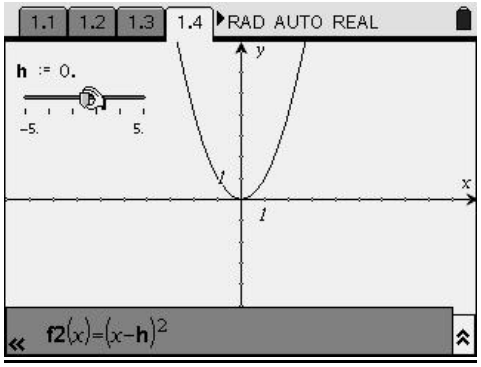
4. What would the graph of $f(x) = -4\,x^2$ look like? Sketch it here.

Answer: The curve would open downward and be skinnier than the x^2 curve.

5. What would the graph of $f(x) = 2.4\ x^2$ look like? Sketch it here.

   Answer: The curve would open upward and be skinnier than the x^2 curve.

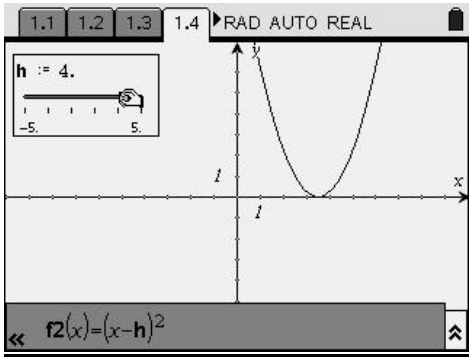
Part II:
On page 1.4, the graph of $f(x) = (x - h)^2$ is shown. Once again, there is a slider for the variable *h* in the top left corner.



Press the tab button twice to obtain a cursor in the graph section. Change the value of *h* using the slider. Be patient – the graph may take a minute to catch up.

1. What observations can you make about what happens to the curve as the value of *h* changes?

   Answer: The value of h shifts the curve to the right and left.



2. What if the value of *h* is positive?

   Answer: The curve shifts to the right.

3. What if the value of *h* is negative?

   Answer: The curve shifts to the left.

4. What would the graph of $f(x) = (x + 4)^2$ look like? Sketch it here.

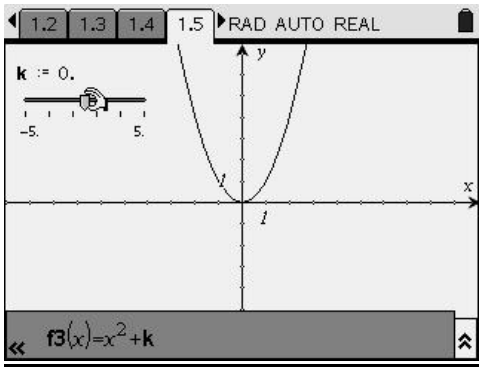
   Answer: Shifted to the left 4 (since it is x + 4, that is x – (-4), so h is negative.

5. What would the graph of $f(x) = (x - 12)^2$ look like? Sketch it here.

   Answer: Shifted to the right 12.

Part III:
On page 1.5, the graph of $f(x) = x^2 + k$ is shown. Once again, there is a slider for the variable *k* in the top left corner.

Press the tab button twice to obtain a cursor in the graph section. Change the value of *k* using the slider. Be patient – the graph may take a minute to catch up.

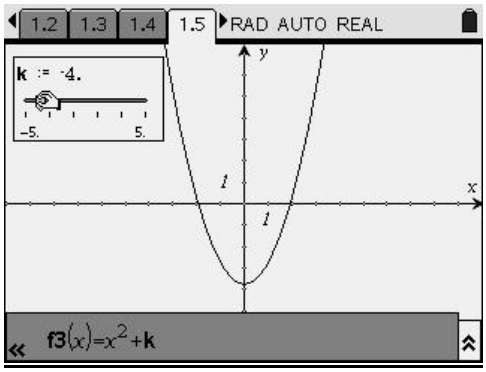


1. What observations can you make about what happens to the curve as the value of *k* changes?

   Answer: The curve shifts upward and downward.

2. What if the value of *k* is positive?

   Answer: The curve shifts upward.



3. What if the value of *k* is negative?

   Answer: The curve shifts downward.

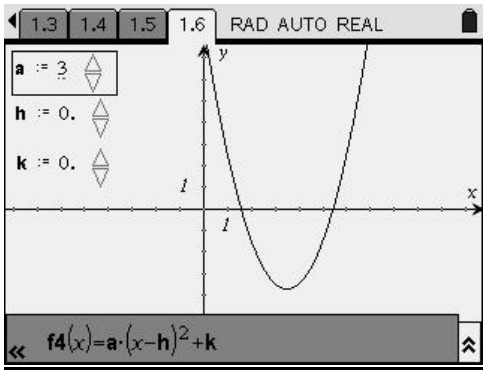
4. What would the graph of $f(x) = x^2 - 27$ look like? Sketch it here.

   Answer: Shifted downward 27 units.

5. What would the graph of $f(x) = x^2 + 17$ look like? Sketch it here.

   Answer: Shifted upward 17 units.

Part IV:
On page 1.6, the graph of $f(x) = a(x - h)^2 + k$ is shown. There are now sliders for *a, h,* and *k* which have up and down arrows.



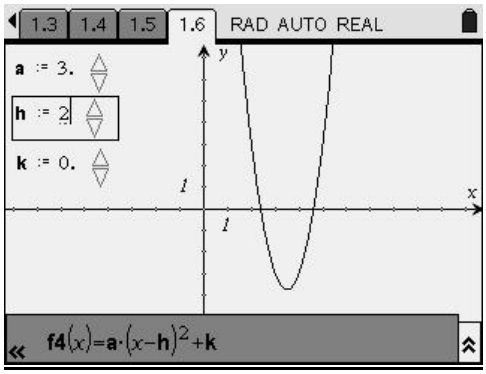
1. Predict what the graph of $f(x) = 3(x - 2)^2 + 4$ would look like. Sketch it here.

   Answer: Opening upward, shifted right 2, up 4, and skinnier than the x^2 curve.

2. Why did you predict the curve in problem 1?

   Answer: a is 3, h is 2, k is 4

3. Tab twice to have a cursor in the graph window. Move the cursor up to the sliders in the top left. Change the values of *a, h,* and *k* to those given in problem 1. To do this, click on the number. Use the key pad to change the values.



4. How well did you predict what the curve would look like?

5. What might you expect the function $f(x) = -5(x + 4)^3 - 7$ to look like compared to $f(x) = x^3$?

   Answer: Open downward, shifted left 5, down 7 and skinnier than x^3.

Pedagogical Considerations – This is particularly relevant for preservice teachers to consider.

Question 1: What were the mathematical goals of this task?

Question 2: Why are those goals important?

Question 3: What prerequisite knowledge must students have in order to do this activity?

Question 4: What prerequisite mathematics content knowledge, technological knowledge and pedagogical knowledge must the teacher have in order to facilitate this activity effectively?

Question 5: How might you accomplish the same goal in a non-dynamic environment?

Question 6: What are advantages and disadvantages of using the dynamic environment?

Question 7: NCTM's Technology Principle indicates that “Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.” How does this relate to the mathematics activity?

Question 8: How does the Technology Principle and this activity relate to with NCTM's Principle on Learning?