Around the Vertex in 80 Days

About the Lesson

In this activity, students will use the Transformational Graphing Application to move a quadratic function in the coordinate plane to specific points and observe how the vertex form of the equation changes.

Vocabulary

- vertex
- vertex form of a quadratic function
- transformation

Teacher Preparation and Notes

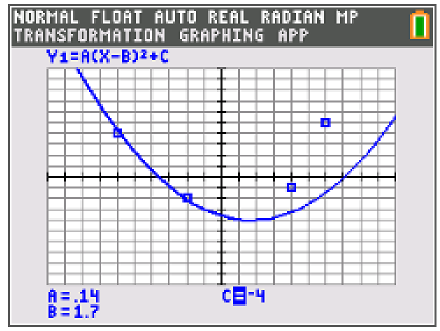
- Check to see that the Transformational Graphing Application is already loaded on all the student graphing calculators. If not, go to http://education.ti.com to get the needed application.

Activity Materials

- Compatible TI Technologies:

  TI-84 Plus*
  TI-84 Plus Silver Edition*
  TI-84 Plus C Silver Edition
  TI-84 Plus CE

*** *with the latest operating system (2.55MP) featuring MathPrint™ functionality.*



Tech Tips:

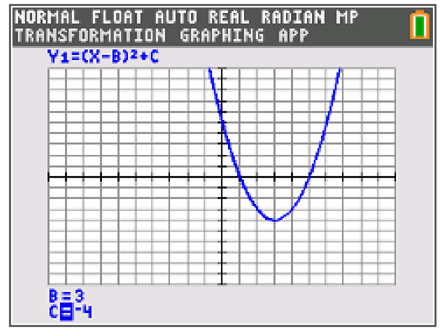
- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

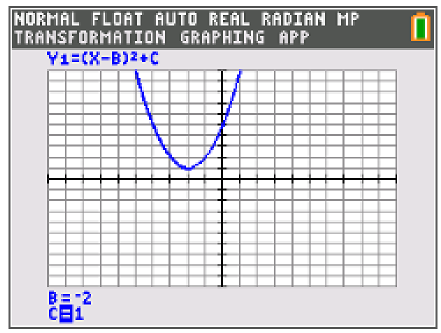
Lesson Files:

- Around_the_Vertex_in_80_Days_Student.pdf
- Around_the_Vertex_in_80_Days_Student.doc

Problem 1 – Exploring Vertex Form

In this problem, students will adjust the values of variables *B* and *C* to move the parabola into each quadrant and record four different equations. To change the values, they can press a number followed by enter or use the left and right arrow keys. Students will determine the pattern of the signs of *B* and *C* in each quadrant and answer questions about what they observe.





Possible Discussion Questions:

- What happens to the equation when the vertex is on the *x*- or *y*-axis?

  Answer: When the vertex is on the *x*-axis, the *C* value is 0. When the vertex is on the *y*-axis, the *B* value is 0.

- When is the *B* value positive? negative?

  Answer: The *B* value is positive when the vertex is to the left of the *y*-axis and negative when the vertex is to the right of the *y*-axis.

- When is the *C* value positive? negative?

  Answer: The *C* value is positive when the vertex is above the *x*-axis and negative when the vertex is below the *x*-axis.

- What happens to the signs of *B* and *C* if the parabola opens downward?

  Answer: The *B* and *C* values are unaffected when the parabola opens downward.

Use the vertex form of the equations to answer the questions below.

1. In which quadrants is the value of *B* positive?

Answer: Quadrants I & II

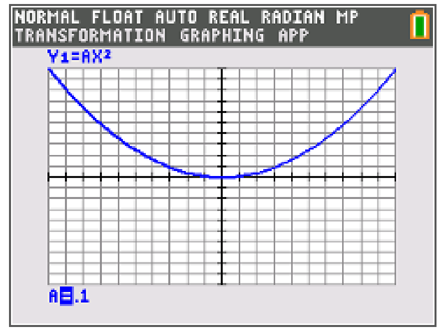
2. In which quadrants is the value of *C* positive?

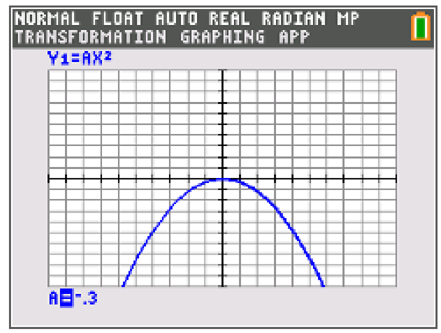
Answer: Quadrants I & IV

Problem 2 – Happy and Sad Parabolas

In this problem, students will make a parabola wider and narrower and observe the changes in the equation. They will also make the parabola "sad" (or open down) with negative *A*-values. Students will record four equations for parabolas that open up and four for parabolas that open down. Students will determine patterns in the equations.

While in the **Transfrm** App, students may manually enter the values of *A*, *B*, and *C* or change their step size by pressing window and choosing the SETTINGS menu at the top of the screen.





Teacher Tip: Ask:

How does making the parabola wider or narrower change the equation?

What happens if we make *A* = 0?

Which parabola is "wider," *A* = 2 or *A* = –3?

3. How does the equation change when the parabola is wider or narrower?

Answer: The coefficient of the squared term changes.

4. For what values of A is the parabola "happy" (opens up) or "sad" (opens down)?

Answer: "Happy" parabolas have values of A such that $A > 0$. "Sad" parabolas have values of A such that $A < 0$.

5. Is $f(x) = 3.5(x - 2)^2 + 5$ a "happy" or "sad" parabola? How do you know?

Answer: It is a "happy" parabola because the coefficient of the squared term is positive.

6. Determine whether the following parabolas open up or down.

$a(x) = 2.5x^2 - 5$

$b(x) = 6 + 3(x - 3)^2$

$c(x) = -(x - 2)^2 - 5$

$d(x) = 7(x + 1)^2 - 1$

Answers: $a(x)$ opens up

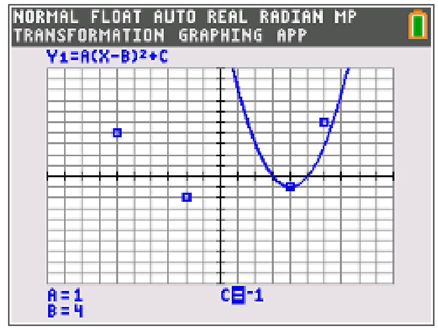
$b(x)$ opens up

$c(x)$ opens down

$d(x)$ opens up

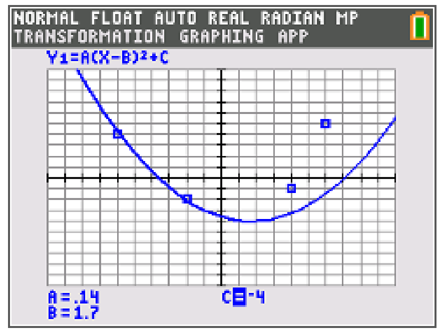
Extension – Parabola Hunt

In the extension, student must write equations for parabolas that open up and down at four given points representing the vertices of the parabolas. Students can use sliders to check their equations given the constraints of integer values for *A*, *B*, and *C*.



Have students compare their equations with a partner. Discuss whose parabola is wider/narrower.

Is it possible to find a parabola that goes through more than one of the labeled points?



Bonus Question

Find the equation of a parabola that passes through any two of the labeled points on the graph.

Sample Answer: The parabola that passes through (–2, –2) and (4, –1) is $y = 0.025(x-2)^2 - 2$.