Parabolas and Solar Cookers

Objective

The students will be able to determine the quadratic equation associated with the result of a revolution of a parabolic curve using the Conic and Graph Functions of the CFX-9850G+ graphing calculator.

Engage

Discuss with students what the revolution of a parabolic curve is and how it is used to for items used in everyday life. Give real-life examples of how it is used as a television dish, a microscope, car headlights, and a solar heater/cooker.

Explore

1. Model for students how to create a scaled model of a solar cooker.
2. Model how to measure the width and height of the model and use these measurements to create coordinate points on a graph.
3. Model how to draw a representation of the curve of the cooker on graph paper.
4. Demonstrate how to enter points into the **STAT Menu** and find the equation for the curve.
5. Model how to use the **CONICS Menu** to find the focus for the equation.
6. Demonstrate how to verify the results algebraically.

Explain

Students will create a model of a solar cooker, find the equation for each curve using a graphing calculator and compare this result with the equation found algebraically. Students will then graph the points showing a side view of the cooker, locate the focus and find the length of the latus rectum.

Evaluate

The student will complete an activity sheet along with providing a brief written discussion of the findings in the activity.

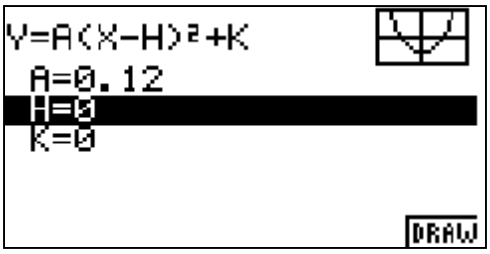
Extensions

1. Have the students build a full size model of a solar cooker and try it out.
2. Have students research the uses of the solar cooker to include areas in which it is most popular and the reasons why.

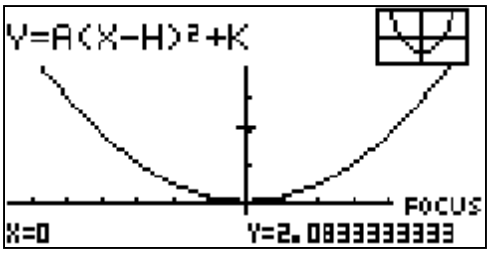
Calculator Notes:

Using the CONICS MENU

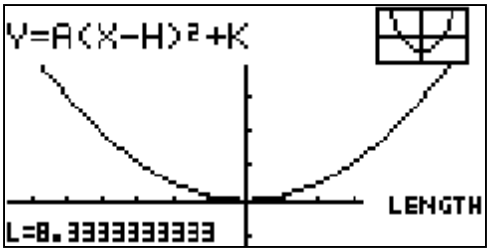
1. Turn on the calculator and highlight the **CONICS Menu** on the main screen and press **EXE**. Select **Y = A(X - H)^2 + K** by pressing the **Down Arrow** key twice and press **EXE**. Using the equation found with the calculator, enter the value of **A** into the calculator and press **EXE**. (The example will use a = .12) The screen will look like the one on the right.



3. Press **F6** to draw the graph. Now press **SHIFT F5** and **F1**. The screen will show the graph and give the coordinates for the focus at the bottom as seen on the right.

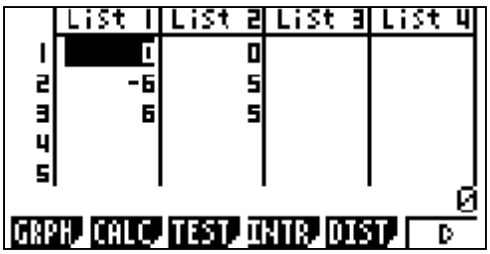


4. Now press **SHIFT F5** and **F5**. The screen will show the graph and give the length of the latus rectum at the bottom as seen on the right.

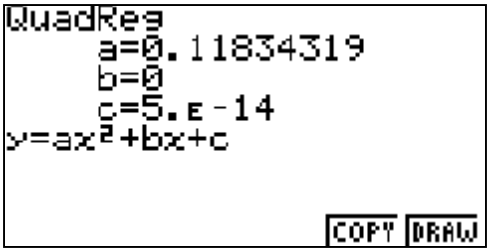


Using the STATISTICS Menu

1. Turn on the calculator and highlight the **STAT Menu**. Press **EXE** . Enter the x coordinate for the vertex and the two x-intercepts into **List 1**. Enter the y coordinate for the vertex and zero for the y values of the two x-intercepts into **List 2**. The screen will look like the one on the right.



2. Press **F1** and **F6** to be sure that the calculator is set up for a scatter plot. Press **EXE**. Press **F1** to get the graph. Now press **F3** to get the equation of of the parabola. The screen should look like the one on the right. Since the value of c is so small, use 0 for c when writing the equation.



Parabolas and Solar Cookers

Objectives: The student will be able to:

1. Build a scale model of a solar cooker,
2. Find the equation for the curve of the solar cooker, and
3. Determine the coordinates of the focus and the length of the latus rectum.

Introduction:

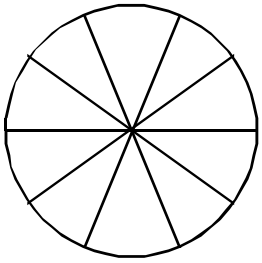
Many areas in the world in which electricity and gas are not readily available for cooking and heating use solar cookers which are in the shape of a parabola that has been rotated about an axis. Due to the property that light waves that are perpendicular to the cooker will reflect off of the parabola shaped curve to a single point which is the focus. In this activity, you will create a model of a parabolic cooker, determine the equation for the curve and find the focus. This activity will lead to another activity in which you will actually build the cooker and try it out.

Materials:

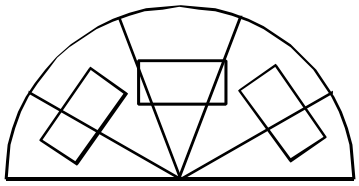
Circle Pattern to make Circles (The Elison die cut machine and the circle template for the flash card wheel was used here. The circle pattern is also included.)
Card Stock to cut Circles out of
Sheet of ¼" Graph Paper
Markers; Scissors; Rulers
Casio fx9750-GPlus Graphing Calculator

Instructions:

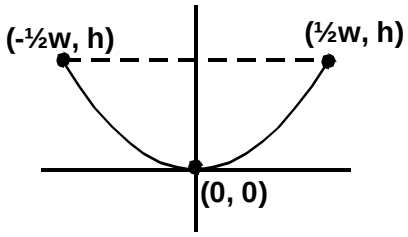
1. Using the given pattern, cut out the circle or use a die cut machine to create the circular disk. The circle should look like the one on the right.



2. Cut along each radius to about χ" of the center. Be sure not to cut all the way to the center.
3. Curl up each sector of the circle to start the formation of the parabolic curve.



4. Tape the sectors by alternating sectors on top and bottom and overlapping them approximately ¼".
5. Measure the height and width of the model in ¼ inches and record the number of quarters on the activity sheet.
6. Make an estimate of where you feel the focus will be and what the length of the latus rectum would be.
7. Draw an set of axes on the graph paper.
8. Use the coordinates that you found when measuring the model to fill in the values of (h, -½w) and (h, ½w).
9. Use the **STAT Menu** and the **CONICS Menu** to find the equation of the curve, the focus, and the latus rectum. Verify the results algebraically.
10. Plot the focus and verify the latus rectum using the graph.



Parabolas and Solar Cookers
Activity Sheet

Estimate of the Focus and Latus Rectum:

Focus will be at (____, ____) Latus Rectum will be _____.

Finding the Equation for the Curve of the Solar Cooker:

Vertex: (____, ____)
Measurements: Height in quarter inches _____
Width in quarter inches _____

Points Used to find the Curve: (____, ____) (____, ____) (____, ____)
Equation of the Curve From the Calculator: _____
Focus: (____, ____)
Length of Latus Rectum: _____

Verification Algebraically:

Using, $(y-k)=\frac{1}{4a}(x-h)^2$, verify the equation from the calculator.

Find the focus algebraically. Focus: (____, ____)
Find the length of the latus rectum algebraically. Latus Rectum: _____

Making a Diagram of the Cooker:

1. Plot the vertex and the two points found from your measurements.
2. Draw the curve and plot the focus that you found using the calculator.
3. Measure the latus rectum on the graph paper. How does this compare with the length you found using the calculator? _____

Making an Actual Solar Cooker:

1. The scale used to make the model was 1:5. If the pattern is 4" in diameter, find the actual diameter of the pattern for the real cooker? _____
2. Using the measurements you found, find the actual measurements for the completed solar cooker.
   Width: _____ Height: _____
   Focus: _____ Latus Rectum: _____