

Mathematics Activity for Precalculus

Topic Area- Conic Sections

“Parabolic Reflector Construction & Statistical Analysis”



Activity developed by

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CONIC SECTIONS

Parabolic Reflector Construction & Statistical Analysis Overview

This activity explores the mathematical representation of parabolas, the construction of a parabolic reflector, and the statistical analysis to determine if there is a best reflector, which will be judged by its light gathering ability. The student will apply the mathematics learned here to develop equations for their design. They will then create their optimal design with a predetermined amount of material. Using the CBL-TI83 system to gather data and a basic understanding of inferential statistics they will analyze data they and the class have obtained.

Objectives:

1. Define Parabola with understanding of Vertex, Directrix & Focus.
2. Derive a standard equation for the parabola
3. Sketch parabolas with known equations
4. Create an equation for a parabola with defined conditions of focus, etc.
5. Apply this information to creating a parabolic reflector
6. With given materials create a parabolic reflector and optimize the light gathering power
7. Test your reflector for light gathering power with the CBL-TI83 system.
8. Collect 10 trials of data on the CBL and test for normality
9. Combine data from all groups and run Statistical tests to see if any significant differences exist among groups.
10. If possible statistically determine the best reflector



Student projects

This activity demonstrates to the students that mathematics has a valuable place in the real world. Starting with identical large U-Haul boxes each team of 4 students builds a reflector frame covered with aluminum foil. They must master the parabola equations and then determine the best way to construct the reflector. By varying focal length and diameter there are an infinite number of ways to complete the project. They must make decisions all through the process that will affect how their reflector will perform. Gathering data and testing it for statistical significance introduces them to the world of inferential statistics. This activity can be completed in one hectic week. The students find it to be an exciting experience when testing their final product and comparing it to other groups. The students will always remember this area of mathematics because it was so relevant to a fun activity.

Project Schedule

Day One

Objectives:

1. Introduce students to conic sections
2. Define the parabola
3. Develop the standard equation $(x-h)^2 = 4p(y-k)$
4. Discuss revolving plane curve to create 3d parabolic reflector
5. Practice designing various shapes in preparation for actual construction

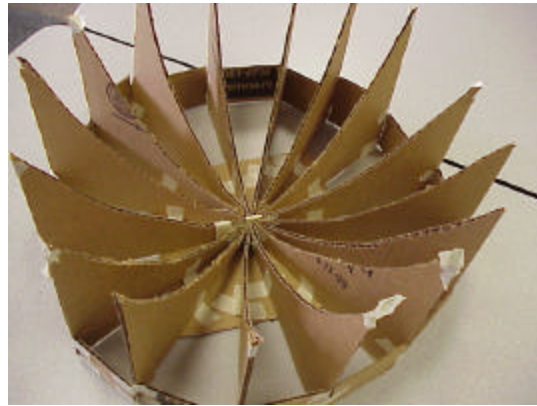
Day Two

Objectives:

1. Students plan and design their parabolic reflector with given materials
2. Students begin to construct their design



Parabolic ribs used in construction



Ribs assembled for dish shape

Day Three

(If needed Day Four)

Objectives:

1. Students finish the construction of their design
2. Test the final product with the light sensor from the CBL-TI 83 equipment. Each group will gather data at the focal point for light intensity 10 times.



Students measure light intensity

3. Statistically display data for each group. Find means and standard deviations for each group. Test for normality and graph normal distribution curves for each group. Introduce students to confidence intervals, One-way Anova, and t-tests.
4. Determine if a best reflector exists.



Finished parabolic reflectors of various shapes

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