CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
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Project Number
J1211

Project Title
Shape to the Max

Abstract

Objectives/Goals
The objective of this experiment is to find out which shape of a fixed perimeter encloses the largest area.

Methods/Materials
Since I only know how to compute the areas for simple shapes I needed a method to compute areas for more general shapes. If shapes are cut out of the same material that has the same thickness then there is a simple way to convert mass to area. My basic procedure for the experiment is to cut out different shapes of the same perimeter and weigh them to determine their area. As there are an infinite number of shapes I chose 23 for my experiment. Five of my shapes were rectangles, eight of my shapes were triangles, four of my shapes were ovals, three of my shapes were regular polygons (5, 6 and 8 sided), and three of my shapes were irregular shapes. I used poster board to cut out my shapes, a ruler and protractor, an accurate scale (.01 g) and a digital thermometer/barometer.

Results
During the experiment I noticed many patterns. First I noticed the square has the largest area of the rectangles with a fixed perimeter and the equilateral triangle has the largest area for triangles with a fixed perimeter. After measuring the area of the regular polygons of a fixed perimeter I found out that my hypothesis that the square enclosed the maximal area was wrong. As the number of sides of the regular polygons of a fixed perimeter increased the bigger the area became. As the number of sides of a regular polygon increased the more and more it look like a circle. At this time I made a new hypothesis stating that the curve of fixed perimeter of the largest area is the circle. The remainder of my data supported this hypothesis.

Conclusions/Discussion
At the beginning of the experiment I hypothesized that the square had the largest area for a curve of fixed perimeter. I thought this because it is the widest on all sides. In fact my hypothesis was wrong and the shape of a fixed perimeter enclosing the most area is the circle. Based on my research I know that Steiner and Hurwitz were able to prove in the 1830s that the circle encloses the largest area for a fixed perimeter.

Summary Statement
My project determined experimentally the shape of fixed perimeter that encloses the maximal area is the circle.

Help Received
Father helped explain some equations, Mother helped cut out shapes, Father and Mother showed me how to plot charts using Excel.