CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

S1320

Project Title

Morphing Circles with Trig: A Third Year Investigation

Abstract

Objectives/Goals

The main purpose of this year's project is to investigate how the area changes when a sine curve is added to the graph of a circle. By using the program Nucalc, I plan on calculating the areas of different morphed circles and see how they change with distinct sine functions. My hypothesis is that when adding a sine curve to a circular graph, the area of the morphed circle will not change from that of the original circle.

Methods/Materials

In rectangular form, I graphed a circle and overlaid it with the graph of a circle with the same radius but with a sine function added to its equation. I decided to calculate the area of the whole morphed circle and compared it to that of the original circle. I repeated this with circles ranging from radii of 2 through 5 and with sine functions with various periods. Next, I looked at morphed circles in polar form. I graphed the circle r = 2. and overlaid it with the equation r^2 + sin(theta) = 4. I then calculated its area. I repeated this several times using the same circle, but I just increased the value of n in sin(ntheta). I also looked at graphing the morphed circles by using r + sin(ntheta) = 2. I calculated the area using the same formula, and I then compared it to the original circle. I also altered the value of n to look at different morphed circles.

Results

In rectangular form, I noticed that the morphed circle areas were really close in value to the areas of the original circle. This is because the area of the morphed circle is going to be equal to the area of the original circle. The integral of sine from 0 to 2pi is simply 0, so when you add it to any graph that you are calculating the area of, you are simply just adding zero. Since I was approximating the limits of the morphed circle in order to find the area, my calculations were not the exact values.When calculating the areas of the morphed circles with the equations r + sin(ntheta) = c, in which c is a constant representing the radius of the original circle, the area would always be pi/2 more than the area of the original circle. When I looked at morphed circles with equations r^2 + sin(ntheta) = c^2, the areas of these equaled the areas of the original circles.

Conclusions/Discussion

My hypothesis was fairly accurate. Knowing how to calculate the areas of morphed circles could be helpful because you can take a complex shape and make them into simpler ones, which would be easier to work with.

Summary Statement

I want to see how the area changes when a sine function is added to a circular graph.

Help Received

Mother helped put together board; Mrs. Herrington helped proofread my work.