CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Stephanie Salcedo

Project Number
S1218

Project Title
Morphing Circles with Trig

Abstract

Objectives/Goals
The purpose of this year's investigation was to see if there was a way to verify mathematically the patterns I noticed last year when I added a sine function to a circular graph. Last year, when I added a sine function to the graph of a circle, the sine curve would create "bumps" on the morphed circle, and the number of bumps would change depending on the period of the added sine function. My hypothesis was that there is a mathematical formula to verify the effect that the sine function has on the circle.

Methods/Materials
To test my hypothesis, I looked at all of last year's work, like the t-charts and graphs I created, and I looked at why the bumps on the morphed circle were occurring. I made tables showing the relationship between the circle, the number of bumps, and the period of the added sine function. I also tried calculating where the morphed circle and regular circle intersect, in hopes of figuring out a formula to the number of bumps. I did not see any new patterns, so I decided to observe the graphs of the morphed circles.

Results
When I observed various graphs of morphed circles, I noticed that wherever the sine curve was at -a for the given domain, the circle would curve out directly above. I noticed this when I worked with phase shifts as well. I also saw that depending on the amplitude of the sine function, the morphed circle would curve in and out of the original circle at a constant distance. When the morphed circle would break apart, I realized that this was because some areas of the graph became undefined due to the added sine function.

Conclusions/Discussion
My results support my hypothesis because based on my observations and all of my data, I was able to see why adding a sine function to a circular graph creates bumps on the circle. Every time asinbx is at -a for the given domain, a bump occurs on the circle. When you have a morphed circle with the equation x^2 + y^2 +asinbx = r^2, r^2 has to remain constant. When asinbx is at -a, x^2 + y^2 has to increase in value in order to keep r^2 constant. When asinbx is at a, x^2 + y^2 has to decrease in value in order to keep r^2 constant. This is why the morphed circle goes inside and outside the original circle.

Summary Statement
My project is about investigating mathematically the affect the sine function has on a circular graph when they are added together and to see if there is a verification for the patterns I noticed last year when investigating this.

Help Received
My mother helped cut everything out to put on my board, my project advisor, Diana Herrington, proofread my work, and my father provided the transportation for me to go purchase the materials that I needed.