CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Jesse A. Alm

Project Number
J1502

Project Title
The Physics of Sound: Frequency vs. Length

Abstract

Objectives/Goals
The objective is to find the relationship between the length of a string (I tested guitar strings) and the frequency produced when the string is plucked or strummed. In addition to many lengths of string, different string thicknesses are tested as well as multiple tensions applied to the string. I predict that the relationship will be linear: length and frequency will change at the same rate.

Methods/Materials
I first had to construct my apparatus: an imitation of a cello finger board, guitar, etc. with grooves in which frets (nails) can be placed to control how much of the string vibrates. Using my ear, I compared the pitch of the length of string I was testing to that of my electric keyboard. Then I compared both of these to the expected frequency for that note (using a table of known frequencies for musical notes). I recorded three samples of each note on my apparatus into a frequency reading program on my computer. Once I had written down many many frequency readings I could graph them and see patterns relating to the length versus frequency and compare these to the frequencies expected for every note. My results turned out to be amazingly close to my chart of frequencies.

Results
I clearly proved that the shorter the string, the higher the pitch. Also, in general, as the string got shorter and shorter, the notes got closer and closer together. I noticed that for any point on my graph of data, the length times the frequency of that point equaled around the same number for every point, and confirmed that there is a definite rate at which length and pitch are inversely related.

Conclusions/Discussion
After performing many tests and examining my results, I realized that my linear hypothesis was not accurate at all. My graphs showed that there is a curve in the data which never reaches zero on either axis. There is no point where the string stops vibrating, and there is no frequency for a string with a length of zero. I wonder if the string stretched at all during the experiment and am curious if this significantly affected my results.

Summary Statement
The focus of my project is to explain the relationship between the length of a string and the frequency the string produces when plucked or strummed.

Help Received
Dad and Uncle provided advice and tools, and reviewed my work.