CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)
Darik Gevorkian

Project Number
J1207

Project Title
Mathemusicians: How to Play Music Notes with Mathematical Equations

Abstract

Objectives/Goals
The objective of my project is to prove that music notes are mathematically realated, and to find an equation that will explain the relation. I hypothesized that different lengths of a 60cm. string where the fret is placed, will produce speculated note and will fit in a mathematical equation.

Methods/Materials
I used a monochord that consists of a single string with one fixed bridge and a movable fret. I plucked the open string, and I measured the frequency with the CBL (I connected a microphone to the CBL and linked the calculator to the CBL and used the program SOUND and FREQ to find the frequncy of the note)and it was the frequency of the "do" in the first octave. I also used the intellitouch tunner to confirm the result. With the same method, at the length 30cm, I could hear the #do# again. Then I tried to define an octave. I had to find a multiplier that could be used 12 times (there are 13 half steps in each octave) to produce 30 from 60. I wrote an equation 30 = 60 x12. x = 1/ 12, also a geometric sequence, where t13 = 30 , t1= 60, and t13 = t1 * r 13-1 . Both ways, the ratio = 0.943874313. I used the multiplier (ratio) to find the length for all the 13 notes in one octave. I put the fret to the calculated lengths and plucked the string and measured the frequency. The frequency of the notes produced by calculated lengths was the frequency of my speculated notes. I worked on three different octaves, and repeated the same procedure for each octave more than ten times; the result always supported my hypothesis. I also worked on the frequency of the notes to find if they fit in a mathematical equation.

Results
The results supported my hypothesis. I proved that there is a lot of math in music.

Conclusions/Discussion
1)I found out that the string length for each note, in any given octave fits in a geometric sequence. 2) Two notes that are one octave apart, the string lengths are in a ratio of 1:1/2. 3) The note sol, in all the octaves is 2/3 of the length of the string. 4) The ratio works for all the octaves. 5) In each measure the tempo given should be maintained mathematically. If the time signature is 3:4 the note lengths should add up to #. 6) As you move one octave higher, the frequency of all the notes are doubled. 7) By looking at the graph for the string length, one can see the resemblance of a Grand Piano.

Summary Statement
Mathematical relation in the music notes.

Help Received
Mother helped to prepare the board.