CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

James T. Uejio

Project Number

J1920

Project Title

The Effect of the Shape and Symmetry of a Guitar on the Amplitude and Decay of Its Sound

Abstract

Objectives/Goals

My goal is to determine how the shape and symmetry of a guitar affects the amplitude and decay of the sound produced by the instrument.

Methods/Materials

I built four different shaped guitars: a square, rectangle, equilateral triangle, and a right triangle and controlled for volume. I built a reusable guitar neck with a single string of fixed length and tension. I placed the reusable neck on the guitars and plucked ten times displacing the string the same distance each time. Using a computer program, I measured the amplitude, in relative dB readings, from 0-1, and the decay, in seconds.

Results

The equilateral triangle guitar had the highest amplitude and decay, then the square guitar, then the right triangle guitar, and the rectangle guitar had the lowest amplitude and decay.

Conclusions/Discussion

When two waves travel at the same frequency and same distance and they interfere with each other, they produce a wave twice the height of the original waves. This is called constructive interference. All waves of the same pitch travel at the same frequency, so the waves radiate from the center of the hole throughout the guitar. If the distance from the hole to the side of the guitar is the same all around, it takes the same amount of time, and distance, to hit the side of the guitar and bounce back towards the middle. And if multiple waves do this, then when they collide, they will cause constructive interference. However, where the distance from the hole differs in each direction, such as in the rectangle, most of the waves take different time to bounce back from each side, and they all reach the hole at different times causing deconstructive interference. Also, each pluck of the string has the potential to give its highest amplitude and longest decay through constructive interference unless acted upon by another force. If there is more constructive interference, then the amplitude would be higher and the decay would be longer because it takes longer for a larger amplitude to decrease. My conclusion from my research and experiment is that it isn#t necessarily the symmetry that affects the amplitude and decay, but constructive, and deconstructive interference and the distance from the hole to the side of the guitar.

Summary Statement

To investigate how the shape and symmetry of a guitar affects the amplitude and decay of the sound produced by the instrument.

Help Received

Carpenter helped build guitars.