CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
J1524

Project Title
Can You Hear Me Now? Part 2: Determining the Relationship between Density and Sound

Abstract

Objectives/Goals
I chose to expand upon my project from last year (determining the relationship between air pressure and sound). My curiosity first led me to test various material densities and their affect on sound. As I learned more, I decided to also test what happens when there is a change of distance and frequency. I will attempt to calculate if the data will follow Newton's Inverse Square Law. Since this project is multi-layered, my hypotheses are as follows: I believe that as the density increases, the decibels will decrease. Also, I believe that as the distance increases, the decibels will decrease. I further believe that different frequencies will not affect the density and distance hypotheses.

Methods/Materials
A Density Measurement was first used to calculate the density of seven test mediums (polyethylene, sponge rubber, plywood, sheet rock, fiber board, aluminum and steel). Next, a Decibel Test was conducted to measure the sound level passing through each material. The test was repeated using two different frequencies (3800Hz and 400 Hz), and it was repeated for seven distances (4, 8, 12, 16, 20, 24 and 256 inches). The test rig was created using various lengths of 2 inch ABS open drainage pipe, buzzers attached to two different end caps, a sound meter, and ½ inch thick test materials.

Results
The Density Measurement resulted in three groupings of density measurements. The least dense were polyethylene and sponge rubber. Plywood, sheet rock, and fiber board were very similar in density, while aluminum and steel were the densest. For each test material, the Decibel Test data was analyzed for the linear distances (4, 8, 12, 16, 20 and 24 inches) and then separately analyzed for the exponential distances (4, 16 and 256 inches). For the higher frequency of 3800 Hz, there was a fairly constant decrease of decibels as the distance increased. The results were more varied for the lower frequency of 400 Hz, but it still had a general decreasing decibel trend.

Conclusions/Discussion
The data shows there is an inverse relationship between the increasing density and the decreasing decibels. There is also an inverse relationship between the increasing distance and the decreasing decibels for each test material. The different frequencies did not significantly affect the results, so my multi-layered hypotheses were correct. Due to the nature of the data, I was unfortunately unable to apply the inverse square law.

Summary Statement
This project examines the relationship between density and sound, plus it tests how linear and exponential distances and high/low frequencies affect sound passing thru various test materials.

Help Received
Several neighbors helped provide some of the test materials and equipment. My science teacher assisted me by reviewing my ideas and answering my questions. My mother was my test assistant, helped me with Excel and reviewed my work.