



**CALIFORNIA STATE SCIENCE FAIR  
2003 PROJECT SUMMARY**

<b>Name(s)</b> <b>Melissa K. Hoffman</b>	<b>Project Number</b> <b>J1515</b>
<b>Project Title</b> <b>Sound Off: Frequency Dependent Sound Absorption</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> My objective was to determine if sound absorption by foam and similar materials changes with the frequency of sound. Based on the energy content of sound at different frequencies, I hypothesized that foam would not absorb high-energy bass waves and would work well for lower-energy middle and high ranges of sound frequencies. More layers of foam and increased surface area should also increase absorption.</p> <p><b>Methods/Materials</b> I placed 2-foot squares of light and heavy-weight flat foam, raised foam blocks, dimpled bed foam, special acoustic foam (Sonex) and soundboard in front of a speaker and measured reduction in sound pressure behind the material with a sound pressure meter. I tested 5 frequencies of simple sine waves from 40Hz to 15,000Hz at constant sound pressure (85dBC) and compared sound reduction to controls (no material) at a fixed distance from the speaker.</p> <p><b>Results</b> Sound absorption did change with the frequency of the sound. Nothing absorbed low frequency bass waves and everything absorbed high frequency sounds. Foam and soundboard worked well to absorb mid-range frequencies. Greater levels of high and middle frequency sounds were absorbed with denser foam or more layers of foam. Sound absorption also increased with the amount of surface area facing the sound. Sonex was the best foam tested overall.</p> <p><b>Conclusions/Discussion</b> The amount of sound that materials can absorb depends on the frequency of the sound. Foam and soundboard are lightweight materials and are able to absorb middle and high frequency sounds. This makes them useful products for controlling sound levels for environments like offices or sound rooms. My results suggest that these lightweight materials will not work well to control higher energy, low-frequency bass waves.</p>	
<b>Summary Statement</b> My project demonstrated that sound absorption by foam and similar materials works well for lower-energy middle and high ranges of sound frequencies but will not absorb higher-energy, low-frequency bass waves.	
<b>Help Received</b> My dad loaned me his speaker, CD player and Radio Shack SPL meter, and he used his Skil saw to cut the foam into blocks. My mom helped me cut out the presentation board.	