



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Holly E. Carter	Project Number J1804
Project Title How Do the Sound Properties of a Glass Goblet Depend on the Amount of Liquid?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals A glass goblet can be excited to produce a ringing sounds with a utensil, a wet finger, or the sound of a human voice. The properties of the sound, such as the pitch and duration, depend on the type and amount of liquid the goblet contains and my purpose was to measure these effects.</p> <p>My hypothesis was that if the amount of liquid in a glass is increased, the pitch will decrease because energy is lost to the liquid and the duration of the sound will be shorter because of damping. I expected these effects to be more pronounced with denser liquids.</p> <p>Methods/Materials For each test, I filled the goblet with water, measured the volume using the measured density and a digital scale, started recording the sounds with Sound Analyzer app, and struck the goblet multiple times with the knife. I used the Sound Analyzer app to calculate a spectrogram of each recording. I measured the frequencies of the fundamental and the first overtone and the power of the fundamental frequency as a function of time.</p> <p>Results The resonant frequency of the fundamental and overtones decreased with the amount of liquid. Acoustic power of the fundamental faded at a constant rate. The rate of power loss of the fundamental decreased slightly but noticeably with the amount of water in the goblet, but increased dramatically with the amount of syrup.</p> <p>Conclusions/Discussion The pitch decreased as liquid was added to the glass, gradually at first and then more rapidly. The decrease was slightly larger for syrup than for water, as I expected. The duration of the sound decreased rapidly as syrup was added to the glass, as I expected. However, it increased slightly with the amount of water. This was an unexpected result and I am not sure why this happened. The results of my experiment can help understand the transfer of acoustic energy between solids and liquids and revealed some very interesting and unexpected patterns.</p>	
Summary Statement My project reveals detailed and unexpected patterns in the acoustic properties of a glass goblet filled with different types and amounts of liquid.	
Help Received I performed the experiment and analysis myself. My father, Dr. Paul Carter, helped me find out more about acoustics and spectrograms.	