



**CALIFORNIA STATE SCIENCE FAIR  
2004 PROJECT SUMMARY**

<b>Name(s)</b> <b>Gabriel H. Burnworth</b>	<b>Project Number</b> <b>J1509</b>
<b>Project Title</b> <b>Ruben's Tube</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of my experiment was to observe the interactions of sound waves using a flammable gaseous medium. I calculated and determined through experimentation the frequencies that resonated in a Ruben's Tube, causing standing waves to be established.</p> <p><b>Methods/Materials</b> I filled a 6-foot long and 3-inch diameter galvanized steel tube with propane gas using a propane torch valve. On one end of the tube a speaker emitted frequencies from a frequency generator program loaded on a laptop computer. A plastic stopper in the other end set the length of the Ruben's Tube. Gas coming out of one-sixteenth of an inch holes drilled one inch apart along the top of the tube became flames when lit. Fine-tuning the frequencies generated on the computer allowed me to use the antinodes (peaks) and nodes (valleys) in the flames to determine the frequencies that resonated in my tube.</p> <p><b>Results</b> The resonating frequencies determined in my experiment closely matched the calculated frequencies. When the longitudinal sound waves traveled through the tube, bounced off the end and returned, I was able to observe the compressions and rarefactions of the waves by the effect of the pressure on the gas. I was able to see standing waves clearly and determined frequencies for the fifth through tenth harmonics.</p> <p><b>Conclusions/Discussion</b> By using the scientific method and paying close attention to the many different variables that might have thrown off my results, I was able to experimentally confirm the resonating frequencies calculated for the tube. The knowledge gained in this experiment is useful in the design of musical instruments such as organ pipes.</p>	
<b>Summary Statement</b> I calculated and measured resonating frequencies observed in standing waves created by the constructive and destructive interference of sound waves in a Ruben's Tube.	
<b>Help Received</b> Brother helped with the design of the apparatus and with the understanding of the physics; Dad encouraged me and made sure experiment was done safely.	