



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Jeanie C. Benedict	Project Number J0399
Project Title The Effect of Air Flow Restriction on the Performance of a Vortex Tube	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals A vortex tube has the ability to separate faster and slower moving air molecules. When compressed air is injected tangentially into a circular chamber, the faster (hotter) air molecules take the longer route on the outside, and the slower (colder) molecules are forced to the center. The swirling air exits on opposite ends of the chamber through two holes of different diameters, with the hot molecules exiting the large hole and the cold molecules the smaller. The objective of my project was to obtain the largest temperature difference between the two ends of my homemade vortex tube. I hypothesized that if I added a cap on the larger hole with a vent of various diameters, then the smallest vent diameter would provide the largest temperature difference.</p> <p>Methods/Materials I designed and built a wooden vortex tube. Relative amounts of air flow between the two holes were adjusted by using various vent diameters (independent variable) on the larger hole. Eight independent variable levels were chosen, including a control. My control was the largest vent diameter because that is where air stopped coming out the smaller hole; this meant all the air was exiting the larger hole. Five tests for each variable level were conducted. I measured temperatures with thermocouples and recorded data using a DATAQ (data acquisition) program.</p> <p>Results After testing my project and averaging my data to eliminate any variability in the measurement system, I found that the smallest vent diameter, 7.9 square mm, resulted in the greatest temperature difference, 5.9 degrees Celsius, between the two ends (smaller and larger holes) of the vortex tube.</p> <p>Conclusions/Discussion I designed and tested my homemade vortex tube. My results concurred with my hypothesis - the smallest vent diameter resulted in the largest temperature difference by providing the most selective passing of only the hottest air molecules from that hole. I believe if my design was optimized, it might be possible to separate lighter from heavier gasses or separate water vapor or oil vapors from compressed air.</p>	
Summary Statement My project's purpose was to find the optimum configuration which provided the largest temperature difference between the two ends of my homemade vortex tube.	
Help Received My dad helped me with the set up of the DATAQ (data acquisition) program.	