



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Philip S. Zehnder	Project Number J1923
--	---------------------------------------

Project Title Tune-A-Car: An Investigation into Car Window Buffeting

<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Car window buffeting is known as Helmholtz oscillation. The sound made could be considered musical. Based on a model of this phenomenon, I wanted to see how this "note" could be manipulated. The objectives were to observe how the window opening and speed affect the frequency and amplitude of car window buffeting.</p> <p>Methods/Materials A test rig was constructed consisting of a latex membrane stretched over a cooking pot. A pointer was attached to the membrane and a 60 frame per second digital video camera was positioned so that the pointer, a scale and a stopwatch (located behind the pointer) were visible. The rig was placed in two cars (Honda Odyssey and Toyota Camry) and the cars were accelerated to 50, 60, or 70 mph. The window was rolled down to intervals of 1/3, 2/3 and 3/3 open with a control of 0/3 open. When the window was rolled down, the resulting pressure waves caused the membrane to move in and out. These movements were filmed. The footage was slowed down, and oscillations were measured and timed by looking at the stopwatch and scale.</p> <p>Results When the car window opening is increased, the amplitude of the resulting sound increases, and the frequency decreases. When the car is accelerated, both the amplitude and frequency of the resulting sound increase.</p> <p>Conclusions/Discussion By creating an accurate method of measurement, I attained my objectives. I confirmed that the amount of the window opening and the car speed caused a response that matched my understanding of Helmholtz oscillation.</p>
--

Summary Statement This project investigated the effects of window opening and speed on car window buffeting.
--

Help Received My father drove the car during my tests and bought me the camera. My mother taught me how to use excel. I participated in a mentoring program at my school, which helped greatly. My father also showed me where to buy the latex membrane and he gave my advice.
