



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Adam J. Shartle	Project Number J1916
Project Title Snell's Law, Refractive Index, and the Speed of Light in Water	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Measuring the speed of light in air is pretty difficult. It took Albert Michelson years to make an accurate measurement. Measuring the speed of light in water might be easier, using Snell's Law and the definition of refractive index. The goal of this study was to measure the speed of light in water, and to compare it to the speed of light in air.</p> <p>Methods/Materials To measure the speed of light in water, I used Snell's Law and the definition of refractive index. Using the CRC Handbook of Chemistry and Physics, I found values for the refractive index of air, and the speed of light in a vacuum.</p> <p>Using a .8 mW diode laser, I measured the change in angle of the laser beam as it moved from air into water. To visualize the beam in water, I added a drop of Elmer's Glue to the water. Using a drafting program, I made protractors to measure the angle of the laser in air and in water. Measurements were made using angles in air of 30, 45, and 60 degrees.</p> <p>Results At an angle in air of 30 degrees, the angle in water was 22 degrees. At an angle in air of 45 degrees, the angle in water was 32 degrees. At an angle in air of 60 degrees, the angle in water was 40 degrees. Using Snell's Law and the definition of refractive index, the speed of light in water was found to be 225,000,000 meters/sec, 225,000,000 meters/sec, and 222,000,000 meters/sec. These values were off by 0.23%, 0.20%, and 1.17%, according to the handbook.</p> <p>Conclusions/Discussion This method was both precise and accurate. When measuring the angles in water, I repeated the measurements 5 times and got the same value each time. It really helped printing out the protractors. The speed of light in air is 299,705,543 meters/second, so light travels about 25% slower in water than in air. Even in water, light travels really fast, making it around the earth more than 5 times in a single second. It's amazing that I could measure the speed of light in water so accurately using a laser, a drop of Elmer's Glue, and some water!</p>	
Summary Statement Using Snell's Law and the definition of refractive index, the speed of light in water was measured.	
Help Received Experimentation was performed at home, with my parent's supervision.	