CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Eric K. Soderstrom

Project Number
J1533

Project Title
How Does Sugar Density Affect the Index of Refraction of Water?

Abstract

Objectives/Goals
The purpose of this project was to determine how the index of refraction (IOR) of water is changed by mixing increasing amounts of sugar (sucrose) into the solution. My hypothesis was that sugar would increase the IOR, and that the increase would be linear.

Methods/Materials
First, I glued 4 glass microscope slides together to make a triangular glass prism that would hold water. I then measured the amount of refraction of a laser beam through the prism, making sure that the laser was perpendicular to the far wall, and parallel to one side of the prism. I measured the refraction distance through an empty prism (the normal), through pure water (control), and through 12 sugar solutions (from 2.5% to 80% wt/vol). I calculated the IOR of each solution using Fermat's Law, which is derived from Snell's Law, for the special case of refraction through a triangular prism.

Results
A comparison of the IORs I obtained for the pure water (1.33) and the 10% sugar solution (1.349), with the published indexes (1.33 and 1.347, respectively) shows that my results were more than 99% accurate. The results from 2 separate experiments using 2 different prisms were very similar. Increased amounts of sugar increased the IOR by about 0.135 per 1% of sugar dissolved in the water. The increase of the IOR was roughly linear.

Conclusions/Discussion
This method of measuring the index of refraction of a solution is simple, accurate, and reproducible. The results showed that the IOR of water increases in linear proportion to the amount of sugar dissolved in it. This proves my hypothesis was correct.

Summary Statement
Dissolving a substance such as sugar in water increases the refraction of light through the water, and the greater the amount of material dissolved, the more the light beam will be bent, and the higher the index of refraction will be.

Help Received
A friend (Mike Jefferson, a physicist), explained the theory to me, gave me some references, and demonstrated the method on a solid prism. My mother helped me make the first hollow glass prism, prepared the sugar solutions, and assisted me with the measurements, editing, and laying out the poster.