CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
S1615

Project Title
Effects of Temperature and Solute Concentration on Index of Refraction

Abstract

Objectives/Goals
My objective was to find the effect of varying temperature and solute concentrations on the index of refraction (IOR) of a solution.

Methods/Materials
Materials:
1 He-Ne laser pointer, 3 microscopic glass slides, 1 gram scale, 2 graduated cylinders, 1 calculator with trig functions

Methods:
A. Constructed an equilateral triangular prism from microscopic glass slides
B. Prepared different solutions to test
C. There were 11 different solutions--1 control (pure water), 5 sugar solutions (ranging from 10% to 50%), 5 salt solutions (ranging from 10% to 50%)
D. Each solution was tested five different times, at five different temperatures (a grand total of 25 times per solution)
E. Measured and recorded distance from undiverted laser beam to diverted laser beam
F. Measured and recorded distance from laser emergence point from prism to undiverted laser beam
G. Calculated angle of minimum deviation to substitute into equation--derived from Snell's Law (calculations shown in logbook)

Results
The data showed a linear increase in the IOR as solute concentration increased. However, as temperature of the solution increased in solutions with the same solute concentration, IOR tended to decrease.

Conclusions/Discussion
Because index of refraction is defined as the ratio between the speed of light in a vacuum and the speed of light in a medium, as the light traveling through the medium increases in speed, the index of refraction decreases. Therefore, as the temperature of a solution increases, the particles in the aqueous solution speed up, making it hard for the light to hit to particles. The light from the laser hits less molecules, taking less time to travel through the solution, and as a direct result, the index of refraction decreases. In the case of solute concentration, however, the more molecules added into a solution (and the bigger the molecules are) the more of a chance the light has of hitting the molecules. This slows down the light as it goes through absorbtion and reemission, causing an increase in the index of refration.

Summary Statement
My project is about the temperature and solute dependence of the index of refraction of various water solutions.

Help Received
Cousin supplied equipment