CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Vadim Korolik

Project Number
J1810

Project Title
Refraction of Light: Using Refraction of Light to Study Diffusion in Liquids

Abstract

Objectives/Goals
to test the hypotheses:
refraction of light strongly depends on liquid properties, the nature of the solution;
refraction of light is larger for solutions with higher densities;
refraction of light can be used to determine solution concentration and to measure diffusion.

Methods/Materials
The setup included blue, green, and red laser pointers, mirrors with appropriate rotational adjustments, a container filled with different sugar and salt solutions. The deflection of light passing various salt and sugar solutions was measured.

Results
The laser light deflection for sugar solutions showed that deflection strongly depends on the solution concentration, its density and weakly depends on the light wavelength. Comparison between sugar and salt solutions showed that refraction of light depends on the nature of the solute: sugar solutions refract light more than salt solutions of the same concentration and density.
From the geometry of the experimental setup and the measured deflection values, the index of refraction for different sugar solutions was calculated.
Calculated values were compared to literature values and appeared very similar.
Also, the concentration of the unknown sugar solution was determined by measuring the deflection of the laser beam with that solution and comparing it with the deflections vs. weight percent graph. The concentration was determined correctly.
In another experiment, the light bending was observed for the sugar solution with the strong concentration difference between the top and the bottom of the container. The light bending disappeared after the concentration became the same due to the diffusion.

Conclusions/Discussion
Deflection of light strongly depends on the solution. concentration and density and weakly depends on the light wavelength. Refraction of light depends on the nature of the solution. For salt and sugar solutions of the same concentrations and density, deflection of the laser beam is larger for sugar solutions. The index of refraction of sugar solutions is larger compared to the index of refraction of salt solutions. Dependence of Index of Refraction on concentrations can be used to build a device for concentration measurements. Refraction of light can be used to study diffusion in liquids.

Summary Statement
Deflection of light passing through various sugar, salt solutions including solutions with non-uniform concentrations were studied.

Help Received
Father helped me find mirrors and mounts; Mother bought an optical wooden stand; Sister mixed in the unknown sugar solutions.