CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
J1533

Project Title
Wavelength Absorption in Liquids

Abstract

Objectives/Goals
My goal was to use a spectrometer to observe the absorption of the visible wavelengths of light in liquids. My goal was also to determine the amount of light absorption in liquids by building a simple colorimeter and quantifying the amount of light being absorbed. Using this method I was able to determine the amount of food dye in other liquids such as Kool-Aid and Gatorade. I believe that liquids do absorb light depending on what chemicals, elements, or dyes are present in the liquid.

Methods/Materials
I placed a glass jar filled with a household liquid and set it between a 100-watt halogen bulb and a spectrometer. I was able to observe and compare the spectrum of the light bulb against the spectrum that made it through the liquid. In order to further study the light absorption, I devised a more advanced setup. I built a simple colorimeter using RGB light-to-voltage Sensors. It was important that I used white LED's for my light source in this setup. I placed an acrylic container filled with a dyed liquid between the white LED's and the RGB Colorimeter. Using Beer's law I was able to determine the absorbance of particular wavelengths. As a result of using Beer's law I observed a linear relationship between the light absorbance and dye concentration in the liquid.

Results
Olive Oil and Pink Car Wash Gel were the two with the most interesting absorption characteristics. In the Car Gel's spectrum all the green wavelengths were missing and in the Olive oil, some single wavelengths were missing. When I tried to quantify the absorption of the dyed liquids, all the liquids had linear relationships between concentration and absorbance. I was able to determine the amount of dye in the Kool-Aid and the Blue Gatorade but because the blue Gatorade's linear line did not go straight through zero, I was only able to estimate the concentration of dye in the liquid.

Conclusions/Discussion
Most colored liquids do absorb light in the visible spectrum because they are dyed. The dye acts as a filter and only lets particular wavelengths get through the liquid. Using the relationship of Beer's Law, I was able to find out how much light was being absorbed and compare that to how much dye was in a liquid. The reason why the Blue Gatorade's linear line didn't go through zero was because the substances in the liquid were cloudier and these particles scatter some of the light.

Summary Statement
The study of wavelength absorption in liquids, and the use Beer's Law to quantify the concentration of dye in liquids.

Help Received
My dad helped me obtain my RGB sensors. Set Engineering provided the Data Acquisition Card used to gather the sensor voltages. Dave Sasscer at the Santa Cruz Public Works Department helped explain the practical applications of colorimeters.