CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
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Project Number
S1715

Project Title
Make Home Cellphone Spectrophotometer to Apply Beer's Law

Abstract

Objectives/Goals
The purpose of this science project is to build a simple and inexpensive spectrophotometer using a cellphone that will work as well as commercial spectrophotometers, and test it by using it to investigate how visible light is absorbed by differently colored solutions. I will also create a calibration plot (Beer's Law plot) of the dye#s absorbency at known concentrations, then use that to determine the concentration of dyes in the PowerAde drinks.

Methods/Materials
I used a white LED bulb powered by a coin battery as my light source. I made eight different concentrated solutions for each of the Red 40, Blue 1, and Yellow 5 food dyes in water. I used water as my reference. I placed each sample solutions, in a cuvette, next to my LED light source, and then put a diffraction grating slide between the samples and the detector, which is my cellphone. The diffraction grating slide diffracted the light into the color spectrum which I captured with my cellphone camera. Then I uploaded the pictures onto my computer and analyzed them in a software program to calculate the ëmax, absorbance, and transmittance of each solution. These data were used to create a Beer#s plot of the dye#s absorbency at known concentrations and used the plot with the absorbance of red, blue, and yellow PowerAde drinks to determine their unknown dye concentrations.

Results
With my simple spectrophotometer I was able to estimate the wavelength of maximum absorbance (lambda max) of commercial Red Dye #40 solution to be around 498nm, Blue Dye #1 solution to be around 606nm, and Yellow Dye #5 solution to be around 440nm which is 2% to 4% in nanometers different from the values given by the FD&C. The absorbance of my dye solution was directly proportional to its concentration. The more concentrated my solution was, the higher the absorbance. I used the calibration plot and the absorbance of the PowerAde drinks and found out the dye concentrations in the PowerAde drinks to be between 0.1%mL and 0.5%mL.

Conclusions/Discussion
My hypothesis proved to be correct. My inexpensive cellphone spectrophotometer was good and affordable and provided good estimates with small margin of error. It helped me find the lambda max, absorbance and transmittance of different dye solutions and PowerAde drinks, and calculate the unknown dye concentration in PowerAde drinks.

Summary Statement
Make affordable spectrophotometer to estimate absorbance of colored solutions and to find the unknown dye concentrations in PowerAde drinks.

Help Received
My teacher reviewed my project and my mom helped me buy the materials and prepare the board.