



**CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY**

Name(s) Taniel V. Keosseian	Project Number S1715
Project Title Make Home Cellphone Spectrophotometer to Apply Beer's Law	
<div><div>Objectives/Goals<p>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.</p></div><div>Abstract</div><div>Methods/Materials<p>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 λ_{max}, 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.</p></div><div>Results<p>With my simple spectrophotometer I was able to estimate the wavelength of maximum absorbance (λ_{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.</p></div><div>Conclusions/Discussion<p>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 λ_{max}, absorbance and transmittance of different dye solutions and PowerAde drinks, and calculate the unknown dye concentration in PowerAde drinks.</p></div></div>	
Summary Statement <p>Make affordable spectrophotometer to estimate absorbance of colored solutions and to find the unknown dye concentrations in PowerAde drinks.</p>	
Help Received <p>My teacher reviewed my project and my mom helped me buy the materials and prepare the board.</p>	