TITLE

Beer's Law Lab

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COURSE

General Chemistry II

TYPE

Recitation / Tutorial Guided-Inquiry Activity

TEACHING MODE

Facilitated Group Inquiry

LEARNING GOALS

Students will be able to:

- Describe the relationship between solution concentration and the intensity of light that is absorbed/transmitted.
- Explain how wavelength, solution color, and absorbance are related by comparing different solutions.
- Use a sketch of an absorption spectrum to describe the concept of maximum absorbance wavelength

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BEER'S LAW LAB

Open the Beer's Law Lab simulation on your laptop or tablet:
http://phet.colorado.edu/en/simulation/beers-law-lab

INTRODUCTION

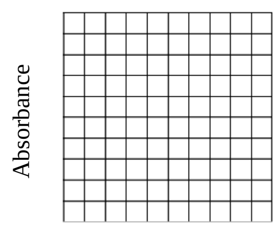
1. **Explore** the *Beer's Law* screen for a few minutes. Try to figure out what all of the controls show and do.

2. How does Concentration affect how much light is **absorbed** and **transmitted** through the solution?

INVESTIGATING ABSORPTION AND CONCENTRATION

1. **Predict** what a graph of absorbance versus concentration would look like. Sketch your prediction.

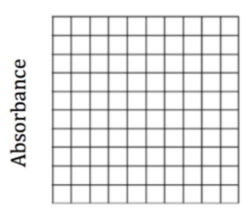
Prediction



2. Choose a solution from the simulation and **measure** the Absorbance for different concentrations on the preset wavelength setting.

Data from the Simulation

Concentration ________M	Abs



3. How does your second graph compare to your prediction?

Commented [JC1]: This section of the activity focuses students on predicted and measured relationships between absorbance and concentration.

4. Based on Beer's Law ($A = \varepsilon lC$, A = absorbance, ε = molar absorptivity, l = pathlength and C = concentration), do you expect using different wavelengths of light would change the way your previous graph looks? Why or why not?

INVESTIGATING ABSORPTION AND WAVELENGTH

1. a. Compare three solutions of different colors with the same pathlength (width of container).

		Preset Wavelength: Simulation default setting			Variable Wavelength: Set to same color as solution		
Solution	Solution Color	Beam Color	Value (nm)	Abs	Beam Color	Value (nm)	Abs

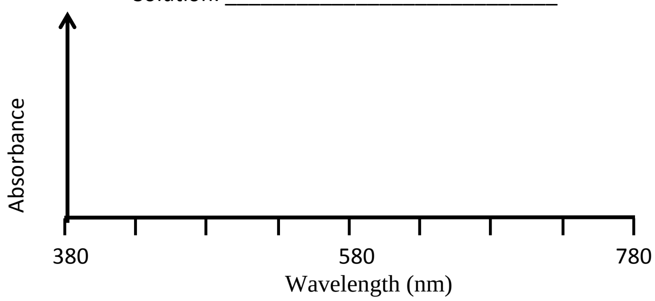
b. What combinations give the most absorbance? Why?

c. How are beam color, solution color, and absorbance related?

Commented [JC2]: The goal of this question (and the above table) is for students to identify that solutions absorb best at "complementary color" wavelengths, and transmit well at wavelengths the same color as the solution.

2. a. Choose a solution and **keep concentration and pathlength constant** as you graph the absorbance for different wavelengths.

Solution: ______________________________



λ(nm)	Abs

   b. What is the value for the "preset" wavelength for your solution? Mark this point on your graph.

   c. Why do you think the "preset" wavelength is the best wavelength to use for this solution?

3. Compare your absorbance spectrum sketch with a group that chose a different solution. Would you use the same wavelength of light to do spectroscopy experiments with different colored solutions? Why or why not?

Commented [JC3]: In this question, students can consider how max absorbance for one solution may differ from another solution.

4. In a lab experiment monitoring the change in concentration of a reddish-brown substance, $FeNCS^{2+}$, a wavelength of 455 nm is used.
   a. Does this wavelength agree with your conclusions about beam color, solution color, and absorbance above? Why or why not?

   b. What other wavelengths might you consider using for $FeNCS^{2+}$ spectroscopy?

Commented [JC4]: This part of the activity connects back to the experiment students will do in their laboratory, but can be used as an extension question even for students not performing this lab.