



Analysis of Food Dyes in Beverages

Concepts:

Spectroscopy, Beer's law, chemical analysis, analyte concentration determination

Use the following recommendations to increase and/or decrease the challenge difficulty for your students.

Short-on-time Inquiry Lab:

In this laboratory, students will use spectrophotometry and graphical analysis to determine the concentration of a dye in a sports drink. Students will prepare a series of standard dilutions of an FD&C dye stock solution and will measure the absorbance of each. The results will be analyzed graphically to obtain a Beer's law calibration curve of absorbance versus concentration. Using this calibration, students will determine the concentration of dye in a beverage sample.

Guided Inquiry Lab:

In this laboratory, students will use spectrophotometry and graphical analysis to determine the concentration of a dye in a sports drink. Students will prepare a series of standard dilutions of an FD&C dye stock solution and will measure the percent transmittance of each. They will analyze the results graphically to obtain a Beer's law calibration curve of absorbance versus concentration. Using this calibration, students will determine the concentration of dye in a beverage sample.

Open Inquiry Lab:

In this laboratory, students will use spectrophotometry and graphical analysis to determine the concentration of a dye in a sports drink. Students will measure the absorption spectrum of an FD&C dye to determine its wavelength of maximum absorption. Then, they will plan the preparation of a series of standard dilutions of an FD&C dye stock solution, and will measure the percent transmittance of each at this wavelength. They will analyze the results graphically to obtain a Beer's law calibration curve of absorbance versus concentration, which can be used to determine the concentration of dye in a beverage sample.

Advanced Inquiry Lab:

In this laboratory, students will use spectrophotometry and graphical analysis to determine the concentration of a dye in a sports drink. Students will measure the absorption spectrum of an FD&C dye to determine its wavelength of maximum absorption. Then, they will prepare a series of standard dilutions of an FD&C dye stock solution, and will measure the percent transmittance of each at this wavelength. They will analyze the results graphically to obtain a Beer's law calibration curve of absorbance versus concentration, which can be used to determine the concentration of dye in a beverage sample.

Outcomes:

Students will obtain a Beer's calibration curve plotting absorbance versus concentration of dye in standard solutions, along with the linear equation that describes this plot. They will use this equation (Beer's law relationship) to determine the concentration of dye in a sports drink sample.

In the advanced and open versions, students will measure the absorption spectrum of one of the FD&C dyes to determine its wavelength of maximum absorption, prior to preparing the Beer's calibration curve.

Associated Phenomena:

What happens when food is cooked?

Standards

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and using models Planning and carrying out investigations Engaging in argument from evidence	HS-PS1.B: Chemical Reactions HS-PS1.A: Structure and Properties of Matter	Systems and System Models

Performance Expectations

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.