Methylene Blue

"Feeling Blue"

Introduction

No one is exempt from an occasional bout with the blues. Whether it is because your parents won't let you borrow the car, or you just lost the big game to your crosstown rival, we are all susceptible to a period of brief sadness. Still, in time, we recover and return to our normal, happy state of mind. The following demonstration provides a visual representation of how the "blues" come and go when our lives get a little shaken up.

Concepts

- Oxidation–reduction
- Gas–liquid reactions

Materials

Dextrose, $C_6H_{12}O_6$, 8 g
Methylene blue indicator solution, 1% aqueous
Potassium hydroxide, KOH, 8 g
Cylinder, graduated, 500-mL
Flask, 500-mL with cap or stopper
Weighing dishes, disposable, 2

Safety Precautions

Potassium hydroxide is strongly corrosive as a solid and as a solution; skin contact causes severe blisters; extremely dangerous to eyes; very harmful if swallowed; LD_{50} 365 mg/kg. Methylene blue is moderately toxic. Wear chemical-resistant goggles, chemical-resistant gloves, and a chemical-resistant apron. Practice strict hygiene when using these materials. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

Add 8 grams of potassium hydroxide to 300 mL of water in a 500-mL flask. Stir until the solid has dissolved. Add 10 grams of dextrose and a few drops of methylene blue indicator solution. Fill to 500 mL mark, cap, and mix thoroughly.

Procedure

1. Show students stoppered flask of colorless solution.
2. Shake vigorously. Note the blue solution.
3. Watch patiently as the solution becomes colorless.
4. Ask your students for possible explanations.
5. Repeat process (remove stopper periodically if necessary).

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Dispose of solution by neutralizing with dilute hydrochloric acid, and flush the neutralized solution down the drain with excess water according to Flinn Suggested Disposal Method #10.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement

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Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions

Tip

- An extension of this activity uses a 0.1% resazurin solution in place of the methylene blue solution. The resulting solution will be pink in its oxidized (shaken) state and colorless in its reduced (resting) state.

Discussion

This chemical reaction is an oxidation-reduction reaction. The combination of a basic sugar solution (glucose solution), called a glucoside, and methylene blue results in the reduction of methylene blue causing the disappearance of the blue color.

When the bottle is shaken, oxygen from the air inside the flask oxidizes the methylene blue. As the methylene blue is oxidized, the blue color reappears. The reaction occurs in four (4) steps

$$O_2(g) \rightarrow O_2(\text{dissolved})$$

$$\underset{\text{(colorless)}}{O_2(\text{dissolved})} + \underset{\text{(blue)}}{\text{methylene blue}} \rightarrow \text{methylene blue}$$

$$\text{glucose} + OH^- \rightarrow \text{glucoside}$$

$$\text{glucoside} + \underset{\text{(blue)}}{\text{methylene blue}} \rightarrow \underset{\text{(colorless)}}{\text{methylene blue}} + OH^-$$

Acknowledgment

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Reference

Abbott, G. E., J. Chem. Educ. 1947, 2, 45.
Abbott, G. E., J. Chem. Educ. 1948, 26, 100.
Campbell, J. A., J. Chem. Educ. 1963, 40, 578.
Dutton, F. B., J. Chem. Educ. 1960, 37, A799.

Materials for *Methylene Blue—"Feeling Blue"* are available from Flinn Scientific, Inc.

Catalog No.	Description
D0002	Dextrose, 500 g
M0074	Methylene Blue, 100 mL, 1% Aqueous Solution
P0058	Potassium Hydroxide, 100 g Pellets, Reagent
R0012	Resazurin, 1 g

Consult the Flinn Scientific website for current prices.