

Water to Grape Juice to Milk

A Refreshing Demonstration



Introduction

Magically turn water to grape juice to lemonade to 7-Up® to milk to finally—after consuming all that, you'll surely need—Pepto-Bismol®!

Concepts

- Acids and bases
- Solubility and precipitates

Materials

Barium nitrate solution, $\text{Ba}(\text{NO}_3)_2$, saturated, 8–10 mL
Phenolphthalein solution, 1%, 3–4 drops
Sodium bicarbonate, NaHCO_3 , 1 g
Sodium hydroxide solution, NaOH , 0.1 M, 10 drops
Sodium hydroxide solution, NaOH , 6 M, 5–6 mL

Sulfuric acid solution, H_2SO_4 , 9 M, 1.5 mL
Water, distilled or deionized, 200 mL
Beral-type pipets, 5
Glasses or beakers, 400-mL, 6



Safety Precautions

Sulfuric acid solution is severely corrosive to eyes, skin and other tissue. Sodium hydroxide solution is corrosive and a body tissue irritant. Barium nitrate solution is a strong oxidizer and moderately toxic by ingestion. Phenolphthalein solution is an alcohol-based solution; it is flammable and moderately toxic by ingestion. Avoid body tissue contact with all solutions. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Wash hands thoroughly with soap and water before leaving the laboratory.

Preparation

Prior to audience arrival, treat and label six glasses or beakers as follows

Glass 1—Water	200 mL of distilled or deionized water and 3–4 drops of 1% phenolphthalein solution
Glass 2—Grape Juice	10 drops of 0.1 M NaOH solution
Glass 3—Lemonade	1.5 mL of 9 M H_2SO_4 solution
Glass 4—7-Up®	1 g of NaHCO_3 and 1 pipet (2–3 mL) of water; swirl gently
Glass 5—Milk	3 pipets (7–9 mL) of saturated $\text{Ba}(\text{NO}_3)_2$ solution
Glass 6—Pepto-Bismol®	2 pipets (5–6 mL) of 6 M NaOH solution (must be sufficient to overcome the acid)

Procedure

1. Begin with a story (if you like) as glass 1 (“water”) is held up. Phenolphthalein is colorless in a neutral environment.
2. Pour the contents of glass 1 into glass 2. A pink/purple color forms (“grape juice”). Phenolphthalein is pink in a basic environment.
3. Pour the contents of glass 2 into glass 3. The pink color disappears and the solution is once again colorless (“lemonade”). Phenolphthalein is colorless in an acidic environment.
4. Pour the contents of glass 3 into glass 4. The acidic solution reacts with the sodium bicarbonate to create bubbles of carbon dioxide gas (“7-Up®”).
5. Wait for the fizzing to stop and then pour the contents of glass 4 into glass 5. The clear solution turns a cloudy white (“milk”). The white precipitate is a result of the barium ions interacting with the sulfate ions to form barium sulfate.
6. Pour the contents of glass 5 into glass 6. The cloudy white mixture turns to a cloudy light pink mixture (“Pepto-Bismol®”). The pink color forms because phenolphthalein is pink in a basic environment.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The final solution may be flushed down the drain with excess water according to Flinn Suggested Disposal Method #26b.

Tips

- Perform this demonstration twice—once for entertainment and once to discuss the chemistry. Be creative and dramatic for more effect. Use a variety of glasses, such as a water goblet for the water and a juice glass for the grape juice. A few drops of yellow food coloring and perhaps a lemon slice in glass 3 will help with the lemonade.
- You may have seen this demonstration done as water to wine to a martini to champagne to milk to Pepto-Bismol®.

Discussion

Phenolphthalein indicator solution is an acid–base indicator that remains colorless in an acid solution but turns from colorless to pink at about pH of 9, having a distinct pink color in a basic solution. The following is a summary of what is occurring in each glass.

Glass 1: Phenolphthalein + Water → Colorless solution

Glass 2: Phenolphthalein + Base → Pink solution

Glass 3: Phenolphthalein + Acid → Colorless solution

Glass 4: $\text{HCO}_3^-(\text{aq}) \rightarrow \text{CO}_3^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ *Fizzing*

Glass 5: $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ *White precipitate*

Glass 6: Phenolphthalein + Base → Pink and cloudy

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

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 and properties of matter, chemical reactions

Materials for *Water to Grape Juice to Milk* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP4867	Water to Grape Juice to Milk Chemical Demonstration Kit
B0147	Barium nitrate solution, saturated, 500 mL
P0019	Phenolphthalein solution, 1%, 100 mL
S0043	Sodium bicarbonate, 500 g
S0149	Sodium hydroxide solution, 0.1 M, 500 mL
S0242	Sodium hydroxide solution, 6 M, 500 mL
S0413	Sulfuric acid solution, 9 M, 500 mL

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.