

Indicator Sponge

Discrepant Event—Physical Properties



Introduction

The discrepant event of placing a red sponge in a red solution and having it turn blue is sure to capture your students' attention. This will surely stimulate a lively discussion leading to a generation of possible hypotheses.

Concepts

- Acid and bases
- pH indicators

Materials

Congo red indicator, 1 g	Water, tap
Hydrochloric acid, HCl, 1 M, 100 mL	Beakers or large jars, 1000-mL or larger, 2
Sodium hydroxide, NaOH, 1 M, 100 mL	Indicator sponge
Red food coloring, 1 mL	Tongs
Blue food coloring, 1 mL	Sponge, cellulose
Water, distilled or deionized	

Safety Precautions

Hydrochloric acid is corrosive to skin and eyes and toxic by ingestion and inhalation. Sodium hydroxide solution is corrosive to skin and eyes. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Indicator Preparation

Make a 1% solution of Congo red indicator by adding 1 g of Congo red to 100 mL of distilled or deionized water. Rinse the sponge (including new sponges) with water to remove residual soap, surfactants, or acids. If the sponge is too large for the beaker of indicator solution, cut the sponge in half. Place the sponge in the Congo red solution, immersing it completely. Wearing rubber gloves to keep from staining hands, periodically squeeze out the liquid. Allow the sponge to soak in the liquid for about 15 minutes. Squeeze out as much liquid as possible and rinse the sponge with fresh water a few times. The indicator sponge is now ready to use. The remaining Congo red solution can be used to make additional indicator sponges.

Preparation

Demonstration Note: This demonstration works fine with any acid or base concentration above 0.05 M. The procedure works best if the concentrations of the acid and base are similar to one another.

1. Add 100 mL of 1 M hydrochloric acid to a 1000-mL (or larger) beaker. Fill the beaker about $\frac{3}{4}$ full with tap water.
2. Add enough red food coloring (about 1 mL per 1000 mL solution) to the acid solution in the beaker until it is a deep red color.
3. Add 100 mL of 1 M sodium hydroxide solution to a 1000-mL or 2000-mL beaker. Fill the beaker about $\frac{3}{4}$ full with tap water.
4. Add enough blue food coloring to the basic solution in the beaker until it is a deep blue color.
5. If the sponge is red, then wet the sponge with tap water and rinse it out.
6. If the sponge is blue, place the sponge in the blue base solution to convert it to a red color.

Procedure

1. Slowly place the red sponge halfway into the beaker containing the red acid solution. Raise it back out and notice that the sponge has turned blue. Completely submerge the sponge. Use tongs or a gloved hand.
2. Remove the sponge and squeeze out as much red acid solution as possible back into the acid beaker.
3. *Optional:* Rinse the sponge in tap water to show that the sponge is actually blue and it is not just saturated with a blue solution. This step also minimizes the amount of acid and base being transferred between solutions. If most of the liquid is squeezed out of the sponge, this step may not be necessary.
4. Slowly place the blue sponge into the beaker containing the blue base solution. Use tongs or a gloved hand. The sponge will immediately turn red!
5. Remove the sponge and squeeze out as much blue base solution as possible back into the blue beaker.
6. Rinse the sponge in tap water, if necessary, to show that the sponge is actually red and it is not just saturated with a red solution.
7. Repeat the demonstration if requested.

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 acid and base solutions can be used several times before they become neutralized or the dyes start to decompose. When ready to dispose, simply mix the two solutions together to neutralize them. Pour the neutral solution down the drain with excess water according to Flinn Suggested Disposal Method #26b.

Tips

- Food coloring is an excellent dye and will stain fingers and clothing—wear gloves and an apron.
- The concentration of the two solutions are not critical as long as they are above 0.05 M. If the sponge is rinsed out between the acid and the base, then it is not necessary that the two solutions have similar concentrations.
- At a HCl concentration of 0.01 M (pH 2), the sponge will turn blue but it does not have the intensity or completeness that the lower pH values give.
- Rinsing the sponge out between each color change will keep the acid and base solutions fresher. It minimizes the amount of acid and base and also the amount of food coloring that is transferred between beakers. *Note:* The liquid coming out of the sponge is the color of the solution and not the color of the sponge.
- Squeezing out as much solution from the sponge will also keep each solution fresher.
- Rinse the indicator sponge with water prior to use the first time to remove any excess congo red solution.

Discussion

The indicator sponge is saturated with congo red solution. Congo red is a dye, a biological stain, and a pH indicator. It has been used as a direct fabric dye for cotton to produce a bright red fabric. Biologists use Congo red as a general contrast stain for cellulose. Congo red is also used as a pH indicator. The color transition is between pH 3.0 and 5.0. Below a pH of 3.0 (very acidic solutions), the indicator is blue. Above pH 5.0, the indicator is red.

When a cellulose sponge is soaked in a Congo red solution, the dye becomes permanently bonded to the cellulose fibers. The active acid/base sites on Congo red are still available and the sponge now becomes an indicator sponge for acids. It can also be used to check for acid spills on counters after students have used acids. Simply wipe down the work area using the indicator sponge. If it turns blue, the students did not use safe laboratory procedures.

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

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

Answers to Worksheet Discussion Questions

1. Describe what happened in this demonstration.

A red sponge was dipped into a red solution. The sponge turned blue, and remained blue even after rinsing it with water. The sponge was then dipped into a blue solution and turned back to red.

2. Identify the chemicals used in this demonstration. Explain how the “discrepant event” occurred.

Hydrochloric acid, sodium hydroxide, and congo red indicator were all used in this demonstration. The red solution was hydrochloric acid and red food coloring. The blue solution was sodium hydroxide and blue food coloring. The sponge had been saturated with congo red, an acid–base indicator which turns blue at a pH <3 and red at a pH >5. This explains why the sponge turned blue in the HCl/red dye solution and red in the NaOH/blue solution.

3. Based on what you observed, what color is congo red in a basic solution? What color is it in a very acidic solution?

Congo red is red in a basic solution and blue in a very acidic solution.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Indicator Sponge* activity, presented by Steve Long, is available in *Discrepant Event—Physical Properties* and in *Introduction to Acids and Bases*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Indicator Sponge* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Indicator Sponge—A Discrepant Event Demonstration* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP6160	Indicator Sponge—A Discrepant Event Demonstration
H0013	Hydrochloric Acid Solution, 1 M, 500 mL
S0148	Sodium Hydroxide Solution, 1 M, 500 mL
V0003	Food Coloring, Set of 4
C0120	Congo Red, 10 g
AP1343	Cellulose Sponge, 6" × 3 ³ / ₈ " × 1"

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

