

Colorful Oxidation

Chemical Demonstration



Introduction

Watch colors change as dye solutions are oxidized by sodium hypochlorite (household bleach).

Concepts

- Oxidation
- Pigments

Materials

Ink, black (preferably India), 10 drops

Food coloring, green, 10 drops

Sodium hypochlorite solution (household bleach), NaOCl, 5%, 100 mL

Water, distilled, 600 mL

Beakers, 500-mL, 2

Marking pen

Pipet, disposable

Stirring rods, 2

Safety Precautions

Sodium hypochlorite is a corrosive liquid and gives off toxic chlorine vapors. Ink may dye skin and clothing. 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.

Procedure

1. Label two 500-mL beakers A and B and add 300 mL of water to each.
2. Add approximately 10 drops of green food coloring to beaker A and swirl to mix the solution.
3. Using a disposable pipet, add approximately 10 drops of ink using a disposable pipet to beaker B. Swirl to mix the solution.
4. Have students observe the colors of the two solutions.
5. Add 50 mL of sodium hypochlorite to beaker A. The food coloring solution will instantly turn from green to blue.
6. Repeat step 5 for beaker B. The ink solution will turn from black to reddish-brown.
7. Stir the solutions. The color of each solution will continue to fade. After a few minutes, the food coloring solution will fade to a pale teal, while the ink solution will fade to orange and then yellow.
8. (Optional) Keep the beakers at the front of the classroom and have students observe the color again at the end of class and/or on the following day (the color of the solutions will be very faint or almost colorless).

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The waste solutions may be disposed of according to Flinn Suggested Disposal Method #26b.

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12

Constancy, change, and measurement

Content Standards: Grades 5–8

Content Standard A: Science as Inquiry

Content Standard B: Physical Science, properties and changes of properties in matter

Content Standards: Grades 9–12

Content Standard A: Science as Inquiry

Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Tips

- Add the sodium hypochlorite slowly, localizing it in a particular spot. The color changes will occur at a slower rate as the solution diffuses throughout the beaker, producing a “wave” of color change.
- Try using different amounts of ink or food coloring. Investigate the effect of concentration on the rate of reaction by varying the amount of bleach that is added to the dye solution.
- For best results, use water soluble India black ink from Flinn Scientific, Catalog No. I0028.

Discussion

Sodium hypochlorite has been used since the 1700s for whitening fabrics. The solution is produced by reacting molecular chlorine gas with a mixture of sodium hydroxide and water. Household bleach contains approximately 5% available chlorine, whereas solutions used in industry for disinfecting may have 10–12% available chlorine. The chlorine atom in sodium hypochlorite is a strong oxidizing agent and will react with organic compounds. Organic pigments in dyes or stains have many functional groups and are easily oxidized. When the dye is oxidized, it no longer bonds to the fabric, and the stain is eliminated.

Green food dye contains both blue and yellow pigments. The sodium hypochlorite solution quickly oxidizes the light yellow pigments, resulting in a blue solution. It reacts with the darker blue pigments at a slower rate—similar to the rate at which the black ink pigments are oxidized. Black ink is commonly made of carbon black (a black pigment), which is mixed with a carrier (usually petroleum or vegetable oil), and resins that help bind the ink to the paper. Black inks and dyes often contain several different colored pigments that, when combined, appear to be black. In this demonstration the ink solution fades from black to virtually colorless, revealing pigments of other colors in the process, as they are oxidized at different rates.

Materials for *Colorful Oxidation* are available from Flinn Scientific, Inc.

Catalog No.	Description
I0028	Ink, Black, 2 oz
S0080	Sodium Hypochlorite Solution, 1 L
V0003	Food Coloring Dyes, Set of 4

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