Chromatography

Background

Chromatography is a technique used to separate mixtures and to analyze their individual components. Chromatography comes from the Greek words for "color writing." It is very useful for identifying unknown substances and has many scientific applications, such as monitoring the environment and investigating evidence from a crime scene.

In liquid chromatography, mixtures are separated when they are transported along an adsorber by a solvent. (An adsorber is something to which atoms or molecules adhere and a solvent is a liquid in which the components of the mixture are dissolved.) In this activity, filter paper is the adsorber, water is the solvent, and water-soluble inks are the mixtures. Although water-soluble inks may appear to be a single color, they are usually mixtures of different pigments. When the solvent rises up the paper, it carries the ink's different components to different heights. Among other factors, how high the component is carried depends on its solubility. (Solubility is the component's ability to dissolve into the solvent.) The more the component "wants" to be dissolved in the solvent, the farther it will be carried before it removes itself from the solvent and adheres to the adsorber.

Skills

- Conducting a scientific experiment
- Making observations
- Comparing and contrasting

Objectives

Students will:

- Observe a compound separate into its component parts.
- Compare and contrast how two different solvents separate mixtures.

Overview

In this activity, students will use filter paper as an absorber, water as a solvent, and water-soluble ink for a mixture, to demonstrate how mixtures can be separated into their component parts.

Key Question

What can the process of chromatography reveal about a substance?

Key Concepts

- Water-soluble inks may appear to be a single color, but they are usually mixtures of different pigments.
- The components of water-soluble inks can be separated out by the process of liquid chromatography.

Materials & Preparation:

- 1 Piece of filter paper or coffee filter per team
- 1 Pair of scissors per team
- 1 Clear plastic glass or small jar per team
- 1 Ruler per team
- An assortment of water-soluble markers
- Rubbing alcohol
- 1 Pair of goggles per student

1. Assign students to cooperative groups of four.
2. Review background information and discuss the importance of and uses for scientific testing of substances.

Management

This activity can be completed in one class period. Be sure to review all safety rules with your students before working with the solvent solutions.

Reflection & Discussion

1. What happens when the water in the filter paper reaches the ink dot?
2. List the order of colors that you observe on the filter paper from bottom to top (that is, from the ink dot upward).
3. If different colored ink markers were used, what do you think would happen?
4. If you used hot water instead of cold, do you think the rate of the experiment would change?
5. Compare the results of the water solvent and the rubbing alcohol experiment. Suggest some reasons for these results.

Transfer & Extension

1. Have students research and write a report on how biologists or criminologists use chromatography for identification purposes.
2. Write a mystery note, left at the scene of a crime. Each suspect has a different marker. Figure out who wrote the note using chromatography.

STUDENT WORKSHEET

Chromatography

Student Procedures

1. With the scissors, cut out a circle of filter paper LARGER than the top of the cup or jar.
2. Make two parallel cuts, 1 cm apart, from the edge to near the center of the filter paper.
3. Fold this cut strip down to hang into the center of the container.
4. With the marker, make a heavy dot 2 cm up from the bottom of the cut strip.
5. Fill the container with water so that the hanging strip touches the water but the dot is above the water level.
6. Observe what happens when the water rises up the paper. Draw what you see in the space below.
7. Continue to observe for 15 to 20 minutes.
8. Repeat the experiment, using 1/2 water and 1/2 rubbing alcohol as the solvent. Observe the change in the pattern of colors on the filter paper.

Questions

1. What happens when the water in the filter paper reaches the ink dot?
2. List the order of colors that you observe on the filter paper from bottom to top (that is, from the ink dot upward).
3. If different colored ink markers were used, what do you think would happen?
4. If you used hot water instead of cold, do you think the rate of the experiment would change?
5. Compare these results with the water solvent and the rubbing alcohol experiment. Suggest some reasons for these results.