

Title

Liquid Chromatography

Activity Overview

Description: Children will use water and coffee filters in a liquid chromatography experiment to reveal all the hidden colors in different water-based marker ink!

Topic Area(s): Chemistry

Grade Level: P-5

Duration: 20 minutes

Learning Outcomes:

- Optics
- Chemical techniques

Hook

The black ink of a marker might look like one color, but chromatography reveals that the black color is actually a mixture of several shades. Introduce your students to this phenomenon with a simple project that will result in beautiful and unique decorations with a scientific flair.

Background Information

Most of us have gotten paper wet at some time or another, but have you ever noticed what happens to the ink as the water spreads? It doesn't always smudge and blur, as you might expect. Sometimes it splits up into weird colored streaks that creep across the page. When that happens, you're seeing **chromatography** in action. In this case it's totally accidental, but we can also use it by design to split up mixtures and other substances into their components. Chromatography is actually one of the most useful techniques chemists have at their disposal, helpful in everything from identifying biological materials to finding clues at crime scenes.

Chromatography is a pretty accurate description of what happens to ink on wet paper, because it literally means "color writing" (from the Greek words chroma and graphe). Really, though, it's a bit of a misnomer because it often doesn't involve color, paper, ink, or writing. Chromatography is actually a way of separating out a mixture of chemicals, which are in gas or liquid form, by letting them creep slowly past another substance, which is typically a liquid or solid. So, with the ink and paper trick for example, we have a liquid (the ink) dissolved in water or another solvent creeping over the surface of a solid (the paper).

The essential thing about chromatography is that we have some mixture in one [state of matter](#) (something like a gas or liquid) moving over the surface of something else in another state of matter (a liquid or solid) that stays where it is. The moving substance is called the mobile phase and the substance that stays put is the stationary phase. As the mobile phase moves, it separates out into its components on the stationary phase. We can then identify them one by one.

Think of chromatography as a race and you'll find it's much simpler than it sounds. Waiting on the starting line, you've got a mixture of chemicals in some unidentified liquid or gas, just like a load of runners all mixed up and bunched together. When a race starts, runners soon spread out because they have different abilities. In exactly the same way, chemicals in something like a moving liquid mixture spread out because they travel at different speeds over a stationary solid.

For chromatography to work effectively, we obviously need the components of the mobile phase to separate out as much as possible as they move past the stationary phase. That's why the stationary phase is often something with a large surface area, such as a sheet of filter paper, a solid made of finely divided particles, a liquid deposited on the surface of a solid, or some other highly adsorbent material.

Materials

Per student:

- 1 coffee filter
- Water
- Small bowl
- Black markers
- Markers (different colours)

Safety Considerations

None.

Procedure

1. Flatten a coffee filter.
2. Starting at the center of the filter, draw a small circle using a marker you are interested in learning more about (black works the best as it has yellow, green, and blue ink in it).
3. Draw bigger circles around each of the other ones. The most clear results come from circles at least an inch apart from another.
4. Place the coffee filter on top the bowl.
5. Place tiny drops of water along each of the circles. The drops do not have to touch each other. A dropper works best, but you can use fingertips.
6. Avoid using too much water, and let dry.

Wrap-Up/Debrief

- You might want to do all the rings of one color of marker, to repeatedly confirm the hidden colors within. You might want to review what you already knows about colors, like whether orange magic markers contain yellow

and red ink. You might also want to compare different brands of markers. The hidden colors in one brand's of black are quite different than others.

Additional Resources

- Adapted from: <http://www.education.com/activity/article/liquid-chromatography/>