

Investigate with Chromatography

At-Home

If you want to figure out how something is put together, a great strategy is to take it apart. This might seem challenging in chemistry when different substances are mixed together in a beaker. Fortunately, chemistry has a solution! Chromatography is one technique that chemists use to take mixtures and solutions apart to find out what they are made of. In this activity, you will do chromatography to separate the colors mixed together in a marker.

Question to investigate

What colors were mixed together at the factory to make different colors of markers?

Chemistry concepts

- Chromatography is a technique used to separate mixtures.
- Secondary colors separate into the primary colors that make them up. For example, green separates into blue and yellow.
- Primary colors do not separate.

Activity logistics

- **Ages:** 3 and up
- **Time:** 10 minutes or as long as you like

Be Safe

- No eyewear is required for this activity. However, if you have safety glasses, wear them.
- Protect the tabletop surface with a plastic tablecloth or placemat.
- Always place a piece of paper underneath the filter paper when coloring it.
- Tie back long hair, roll up sleeves, and secure loose clothing.
- Be sure to clean up and dispose of materials properly after the activity.
- Wash your hands and clean your area after the activity.

What you'll need

- White coffee filters (At least 5)
- Water-soluble markers (Crayola, Cra-Z-Art, Rose Art, Mr. Sketch, or store brands)
- Plastic cup
- Dropper or paintbrush
- Water
- Plastic cups or bowls to hold the filter paper off the table
- Pipe cleaners

- Scrap paper
- 3 different brands of black markers (Vis-à-Vis, Crayola, and dry erase work well)

Procedure

Compare different colors of markers

1. Choose three markers--one primary color, one secondary color, and your favorite color.
2. Place one coffee filter on top of a piece of scrap paper.
3. With each marker, make one spot of color on your coffee filter, each about as big around as a marker cap. You should end up with three spots, each a different color.

Add water and wait

4. Half-fill a cup with water.
5. Pick up the coffee filter and place it over a plastic cup or bowl, so that the sides hang down like a tablecloth.
6. Use either a dropper or a paintbrush to pick up some water and drop it on the center of each spot of color.
7. Watch as each spot spreads out a little. Then wait about 5 minutes more.

Solve a mystery

8. Choose the black marker from three different brands of markers.
9. Make three spots, each with a different brand of black marker, on a piece of coffee filter. Use a pencil to label the dots with the name of each marker.
10. Have a friend make a spot on a coffee filter with one of the black markers without you knowing which one it is.
11. Place each over its own cup or bowl.
12. Add water and wait. Can you figure out which marker your friend used?

What did you observe?

Do you see small bits of color that are different from the color marker you used? Primary colors are made of just one color, but secondary colors are made by mixing two primary colors together. Did you choose primary or secondary colors. Which colors are mixed together to make black? Do you think that each brand makes the color black the same way? What makes you think that?

Continue exploring chromatography with a dash of your own creativity.

Craft with chromatography

1. Choose colors you would like to explore.
2. Make dots of color over two coffee filters.
3. Place them over two cups or bowls and add water to the center of each dot. If using a paintbrush, "paint" with water to get all the dots wet.
4. Wait about 15 minutes or until the coffee filter dry all the way.

Make a butterfly

1. If making a butterfly, fold the pipe cleaner in half. Make a couple of twists at the folded end.
2. Put both coffee filters between the pipe ends. Make a couple of twists about 4 cm from the pointed ends of the pipe cleaner to hold the wings in place.
3. Use a rounded marker to curl the pipe cleaner ends to make antennae.

Make a flower

1. If making a flower, stack two coffee filters on top of each other and pinch them in the center.
2. Wrap one end of a pipe cleaner around the pinched center a few times. Fluff the petals and bend the pipe cleaner until you are satisfied with your coffee filter flower.

How does it work?

In this activity we used a chemical process called paper chromatography. The water moves through the filter paper, carrying the marker pigments at different speeds depending on the size of the molecule and how attracted the molecule is to the paper. For example, pigments in the secondary color, orange, separates out to show a range of yellows and reds. Black markers are made by mixing many different colors. Even though they might look the same on paper, chromatography reveals the truth. Each company uses a different mixture of pigments.

Chemists use the process of chromatography to separate and analyze the different parts of a mixture. Different methods of chromatography use different materials (besides paper) to separate mixtures. Scientists can make chromatograms of fall leaves to show how the different leaf pigments that give plants their color break down in cooler weather. Chromatography can also be used by law enforcement in crime scene investigations, by art experts to determine original paint pigments in restoration projects, and even when analyzing food.

References

This activity is adapted from "Chemistry is Colorful" from the collection titled, Let's Do Chemistry by the NISE Network and from "Chromatography Butterflies" from Celebrating Chemistry by the American Chemical Society.