

Chromatography Flowers

Target Grade: Grades K-5

Time Required: 10-15 minutes

Standards/Topics Covered:

NGSS Standards

- 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best
- 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.
- 5-PS1-3. Make observations and measurements to identify materials based on their properties.

Central Focus:

In this activity, students will make observations while conducting chromatography using simple household items. This activity can be adapted to become an experiment where students control for different variables or to become an art project in which students can create colorful chromatography flowers.

Background Information:

- Capillary action: The movement of a liquid along a surface or material, in spite of other forces acting against it, such as gravity. Ex: A paper towel dipped into a spill will suck the water up.
- Adhesion: When two completely different molecules stick together.
- Cohesion: When two similar molecules stick together.

When coffee filters are dipped in water, the water moves up the coffee filter using capillary action. Capillary action occurs because the bonding between the water molecules and the molecules of the coffee filter (or any other material) is greater than the bonding between water molecules. The adhesion between the water molecules and the coffee filter is stronger than the cohesion between the water molecules in the cup, allowing the water to move up the coffee filter, even against the force of gravity.

Chromatography is a technique used in science to separate the individual parts of a mixture. As the water rises up the coffee filter, the water dissolves the marker and pulls the color along with it as it travels against gravity. Why does a black marker create multiple colors as it travels? The

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black marker creates several colors because the black ink is actually comprised of many different color pigments. Some pigments are more easily able to dissolve in the water and are pulled with the water further distances. Some of the other pigments are more attracted to the coffee filter and move slower. This causes a different streak of colors as the “black” ink moves up. A similar effect can be seen in any color marker because the markers use different pigments to make the exact color.

Materials

- Non-permanent markers
- White coffee filters
- Small cups of water
- Newspaper
- Paper towels
- Scissors
- Green pipe cleaners

Instructions

1. Lay the coffee filter flat on the table. Make sure to put newspaper down under the filter so that the colors don't bleed onto the table.
2. Using one of your colored non-permanent markers, draw a thick circle in the middle of the filter. Make sure to not cover the direct middle with color!



3. Fold the coffee filter in half twice to make a cone.



4. Pour a small amount of water into a small glass.

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5. Place the coffee filter into the glass, and pull it apart so that the tip of the cone (without the color) just barely touches the water.



6. Allow the glass and filter to sit for about 5 minutes, or until the colors have separated. You should be able to observe the colors creep up the coffee filter.
7. After the color has moved up the coffee filter, remove the coffee filter from the water and lay it flat on paper towels to allow it time to dry.



8. As part of an experiment, students can experiment with different marker brands, different liquids, different types of paper, or starting with dyed water rather than markers.

Flower Instructions

1. After the coffee filters dry, refold them in half several times.



2. Cut the edges of the coffee filter to round it off.



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3. Unfold the flower back to the cone shape.
4. Take one of the pipe cleaners and twist the top of it around the bottom tip of the coffee filter.



Closure

1. What did you observe about the marker as the coffee filter sat in the water? Why do you think this occurred?

As the coffee filter sits in the water, you are able to observe the colors moving up the filter. This occurs because the color is made of pigments that are able to be dissolved in the water. The water molecules are more attracted to the molecules of the coffee filter than the other water molecules, which causes them to travel up the coffee filter, pulling the pigments of the marker along with it.

2. How many colors do you see? Why did the colors not remain the same as the original marker color?

The colors seen on the final product will differ based on the color of the marker that is initially used. However, there are different colors that are streaked along the coffee filter. This is because markers are made of many different pigments of color. As the color is dissolved into the water, the pigments are separated. This causes the different colors that are visible.

When the original circle is drawn with a black, non-permanent marker, there are many different colors that become visible. This is because black ink is actually made of many different colored pigments. As the water dissolves the marker, the pigments are separated. Some pigments are more attracted to the water and are able to move further. Other pigments are more attracted to the coffee filter and are harder to be pulled along with the water, leaving them further down the coffee filter.