



What We Will Explore

What are the color components of various colors of ink? In what order do colors separate? How might a mixture of dyes be separated?

Who This Exploration Is For

Children of all ages can have fun with this activity. Younger explorers will enjoy making and displaying the butterfly shape. You also can use this as a springboard for discussing and reading books about colors and butterflies. Older explorers can delve more deeply into the topic of chromatography.

Materials Needed

Per Person

- 18-ounce, wide-mouth plastic cup filled with a half inch (1 cm) of water
- coffee filters (#6 size or similar size)
- black, water-soluble marker (nonpermanent markers for overheads work best)
- scissors
- pencil
- 2-3 paper towels
- coleus leaf or other brightly colored leaf (optional)
- other colors of markers, food colorings, etc.



Safety Considerations

Normal care should be taken when using scissors. Younger explorers should probably use blunt scissors. If you are doing this activity in the library, you may wish to consider the “safety” of library materials when children are using water and markers. Even though not that much water is used, plan to have a lot of newspaper and paper towels for spills.

Adaptations for Explorers with Disabilities

- Participants with hearing impairments should be able to do this activity without any modifications other than those necessary for communicating the instructions.
- Children with limited manual dexterity may work with a partner. You also can tape the bottom of the cup to a table surface so that it will be more stable.

Curiosity Starter

Fill two colorless plastic or glass cups about 3/4 full of water. To one of these add a few drops of blue food coloring and to the other a few drops of yellow. Mix well. (The colors should be pretty deep for a good effect.) Pour about 1/3 of each colored solution into another empty cup. Mix well. What is observed? The new color (green) seems to be a mixture of blue and yellow. To a fourth



COLOR BURST

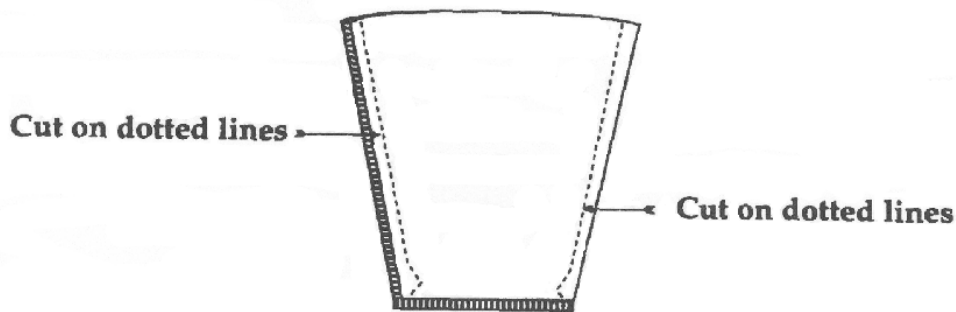
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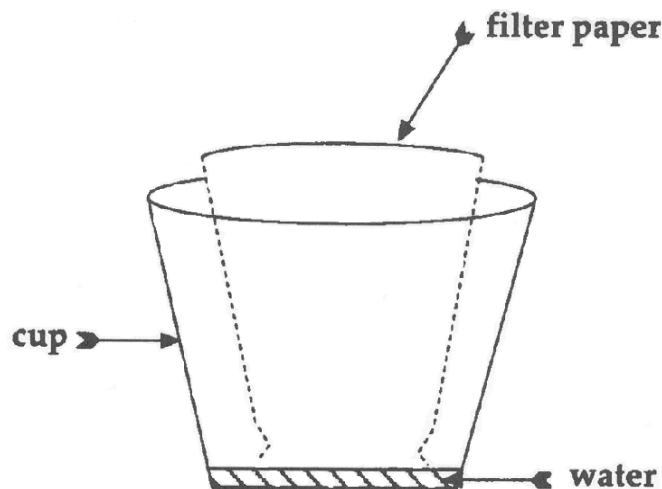
cup of water, add a few drops of green food coloring. Ask explorers: “Can you tell the difference between the color in this fourth container from that in the third? Is the green food coloring a mixture of blue and yellow? How can we find out?” Try to guide the explorers to think about how to separate a combination of dyes into its individual components in order to figure out what the combination is.

What to Do

- With a pencil, explorers should draw dotted lines on the coffee filter as shown (in order to make a butterfly shape when the paper is later unfolded.)



- Cut the filter on the dotted lines. The remaining filter should still be in one piece.
- Using the black marker, have explorers decorate both sides of the filter with a few dots, lines, or other markings. **The simpler the pattern, the more striking the results will be. Be sure not to mark the ribbed bottom edge.**
- Have explorers place their filters in the cup of water as shown in the picture below. Only the ribbed edge should be in the water.





- Allow the filter to sit undisturbed. Every few minutes, explorers should check to observe what is happening and make drawings of what they see. Ask them: “Is there a color separation? Is it the same for each mark made?”
- As soon as the water level has risen to the top of the paper, remove the filter from the cup, and gently open the filter. Compare the filters. Have explorers answer the questions on the activity sheet.
- After you have finished discussing the results, set the filters aside to dry.

Guiding the Exploration

Even though it takes 10 to 15 minutes for the colors to fully separate, explorers should be attentive to the separation process as it goes on. You may decide to have students record what they observe in five-minute intervals, or you may simply ask guiding questions, such as those below, to keep students focused on the observation:

- What is happening to the black ink? Describe what you see.
- What colors do you see on the filter before you open it up? After you open it up?
- What happened in this activity that you didn't expect or was different from what you expected?

For Younger Explorers

Younger explorers may lack the attention span to observe the entire color separation process. You may wish to occupy them with a discussion of color or with books about color and discuss the color separation after the water has climbed the paper, using questions such as those listed below. However, you should have them check the cups occasionally to see how the filter changes over time.

- What colors do you see when you open the filter?
- What shape is the coffee filter when you open it up? Why do you think the activity is called "color burst"?
- What do you think happened to the water? What happened to the black ink?

Where to Go from Here

You can ask the explorers these questions to get them to further explore the concepts:

- Do you think the same thing would happen if you used red ink? Green ink? Purple ink? Try it.
- What is the effect of temperature on color separation? How can you find out? Try it.
- Does the shape of the filter make a difference in what you observe? Does the kind of mark (dot, line, etc.) make a difference? How can you find out? Try it.
- What if you used a different liquid in the cup? Do you think the colors would still separate? Try it.
- What do you think would happen if you ground up a coleus or other brightly colored leaf, placed a dot of the leaf's pigment on a filter, and repeated the activity? Try it.



Why It Happens

This activity uses a technique called paper chromatography. The water is absorbed by the coffee filter and rises up the filter. When the water reaches a spot of black ink, it carries the component of the spot up the filter. As the water continues to rise, the components do not all travel with it at the same rate. Some are more soluble in water than others, and the more soluble ones travel faster. After a time, the various components are at different distances from the original spot. They have now been separated from one another. Substances that can cause other substances to dissolve, like water can, are called solvents.

Water is the simplest solvent to use in paper chromatography. Not all components in a sample may dissolve in water. Other liquids that can be used as solvents include alcohol and ammonia, but these should not be used with young children.

Scientists use chromatography frequently to separate and identify the component parts of solutions. It is a valuable tool for helping us understand what makes up the many solutions in our environment.