

Black Magic

Discover the secret colors hidden in a black marker!

What do I need?



- scissors
- white paper coffee filter
- black marker (not permanent)
- water
- coffee cup or mug

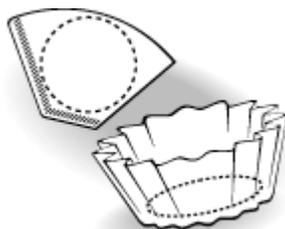


3 Put some water in the cup-enough to cover the bottom. Curl the paper circle so it fits inside the cup. Make sure the bottom of the circle is in the



What do I do?

1 Cut a circle out of the coffee filter. (It doesn't have to be a perfect circle, just a round shape that's about as big as your spread-out hand.



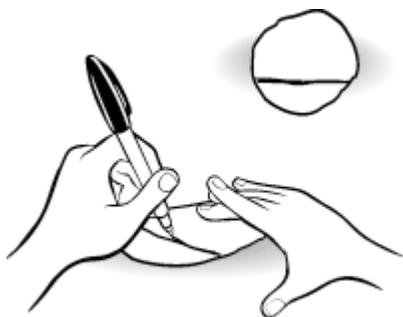
2 With the black marker, draw a line across the circle, about 1 inch up from the bottom.

water.

4 Watch as the water flows up the paper. When it touches the black line, you'll start to see some different colors.

5 Leave the paper in the water until the colors go all the way to the top edge. How many colors can you see?

6 If you have another black marker, draw a line on a clean,



Center Stage

Use a clean, dry coffee filter circle. Use your marker to draw a black spot in the center. Put the circle on a saucer, and put a few drops of water on the spot. In a few minutes you'll see rings of color that go out from the center of the circle to the edges. Our picture is in black and white, but when you do this, you'll see some amazing colors.



dry coffee filter circle. Put the circle in some fresh water. Does this marker make different colors than the first one?

What's Going On?

How does Black Magic work? Why do some black inks separate into many colors on a wet coffee filter?

Most nonpermanent markers use inks that are made of colored pigments and water. On a coffee filter, the water in the ink carries the pigment onto the paper. When the ink dries, the pigment remains on the paper.

When you dip the paper in water, the dried pigments dissolve. As the water travels up the paper, it carries the pigments along with it. Different-colored pigments are carried along at different rates; some travel farther and faster than others. How fast each pigment travels depends on the size of the pigment molecule and on how strongly the pigment is attracted to

your experiment) flows through a stationary substance (like your coffee filter). Since different ingredients in a mixture are carried along at different rates, they end up in different places. By examining where all the ingredients ended up, scientists can figure out what was combined to make the mixture.

Chromatography is one of the most valuable techniques biochemists have for separating mixtures. It can be used to determine the ingredients that make up a particular flavor or scent, to analyze the components of pollutants, to find traces of drugs in urine, and to separate blood proteins in various species of animals (a technique that's used to determine evolutionary relationships).

the paper. Since the water carries the different pigments at different rates, the black ink separates to reveal the colors that were mixed to make it.

In this experiment, you're using a technique called chromatography. The name comes from the Greek words *chroma* and *graph* for "color writing." The technique was developed in 1910 by Russian botanist Mikhail Tsvet. He used it for separating the pigments that made up plant dyes.

There are many different types of chromatography. In all of them, a gas or liquid (like the water in

Why does mixing many colors of ink make black?

Ink and paint get their colors by absorbing some of the colors in white light and reflecting others. Green ink looks green because it reflects the green part of white light and absorbs all the other colors. Red ink looks red because it reflects red light and absorbs all the other colors. When you mix green, red, blue, and yellow ink, each ink that you add absorbs more light. That leaves less light to reflect to your eye. Since the mixture absorbs light of many colors and reflects very little, you end up with black.

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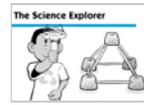


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