

Black Magic Markers

Thank you for downloading the science and mathematics activity packet! Below you will find a list of contents with a brief description of each of the items. This activity packet contains all the information (including any handouts) you will need to run this activity in your own classroom or at a science festival.

Please note: some activities might require the need for a facilitator to be present to oversee the activity. Activities that require a facilitator will be clearly noted.

-Community Resources for Science



ACTIVITY PACKET CONTENTS

1. Organizer instructions
 - Print suggestion: 1 for the facilitator
 - This is for the person running the activity
 - Includes information for setup prior to the event (e.g., materials prep_
2. Supplemental background information for organizer/facilitator
 - This provides additional information for the organizer or activity facilitator regarding the science behind the activity
3. Background info (aka What's Going On?)
 - Print suggestion: 1 to put in a plastic sign holder
 - Tabletop sign for the participants to read
 - Explains the science behind the activity
4. Participant instructions (tabletop)
 - Print suggestion: 1-2 to put in a plastic sign holder, about 4 for the table
 - Tells the participants what they need to do
5. Take home ½ sheet for participants
 - Print suggestion: number of expected participants; each page contains 2 half-sheet handouts
 - Easy-to-follow instructions for participants to try the activity at their homes



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ORGANIZER INSTRUCTIONS

Grades: K-5

Standard Connections:

NGSS - Constructing Explanations and Designing Solutions: Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.

Objective: Students will perform liquid chromatography to observe the different pigments found in a black pen

Activity Overview and Background: As water travels up the paper it will move the pigments from the ink with it. Different pigments will travel different distances depending on their size.

This activity requires a facilitator to replace the water in cups for participants

Estimated cost for activity supplies: \$10-14.50

Estimated number of participants per set of supplies: 150 (less if participants are trying other colored markers)

Materials:

- Scissors
- White paper coffee filters (\$3/150 ct pack)
- Black markers (not permanent; \$6/12 ct pack)
- Colored markers (\$2.50/8 ct pack)*
- Water
- Plastic cups (\$3/50 ct pack)
- Large bucket for used water (or access to outside lawn to dump water)

Set Up:

- Fill cups with water about ½ inch high, or leave full water cups out for students to pour themselves (facilitator can decide which is easiest)
- Set out Instructions and What's Going On documents with the materials

Note:

- *Can exclude the colored markers from activity and only use black markers
- Plastic cups can be reused after each participant



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SUPPLEMENTAL BACKGROUND INFORMATION

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 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 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 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 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).



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 the 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. Because 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.

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 color that you add absorbs more light. That leaves less light to reflect to your eye. Because the mixture absorbs light of many colors and reflects very little, you end up with black!

Instructions

Discover the secret colors hidden in a black marker!

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
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 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 colored marker, draw a line on a clean, dry coffee filter circle
 - Put the circle in some fresh water
 - *Does this marker make different colors than the first one?*

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TRY THIS AT HOME!

Materials:

- Scissors
- White paper coffee filters
- Black markers (not permanent)
- Water
- Coffee cups or mugs

Instructions:

1. Cut a circle out of the coffee filter, 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
3. Put some water in the cup—enough to cover the bottom
4. Curl the coffee filter circle so it fits inside the cup and make sure the bottom of the coffee filter is in the water
5. Watch as the water flows up the paper
 - When it touches the black line, you'll start to see some different colors
6. Leave the paper in the water until the colors go all the way to the top edge
7. Repeat steps 1-6 with another colored marker
 - *Does this marker make different colors than the first one?*

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6. Leave the paper in the water until the colors go all the way to the top edge
7. Repeat steps 1-6 with another colored marker
 - *Does this marker make different colors than the first one?*