**Black Marker Chromatography**

**Curriculum Links:**

MS7.1 Distinguish between pure substances and mixtures (mechanical mixtures and solutions) using the particle model of matter. [SI, CP]

MS7.2 Investigate methods of separating the components of mechanical mixtures and solutions, and analyze the impact of industrial and agricultural applications of those methods. [SI, TPS]

MS7.3 Investigate the properties and applications of solutions, including solubility and concentration. [SI, DM]

**Science Background:**

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.

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).

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.

**Materials:** Filter paper (coffee filters, paper towels, or chromatography paper strips), 4–6 different brands of black markers, Scissors, Small cups or beakers–one for each marker being tested, Toothpicks, Rulers, Calculators, 2 Reference Pages with marker brand names to allow them to dry, Water, Pencils

**Directions:**

1. Cut a strip of filter paper to fit the width of the beaker.
2. Using a pencil, draw a horizontal line 1cm away from the end of the paper.
3. Pour some water into the beaker to a maximum depth of 0.5cm.
4. Put large dots of black ink on the horizontal line using different markers. Make sure the dots aren’t too close to each other.
5. Curve the paper so that it can stand up on its own in the beaker. Place the paper in the beaker so that the bottom of the paper is on the bottom of the beaker, but making sure that the horizontal line is above the water.
6. The water will move up the paper. When the colour reached the top of the paper take it out of the water and allow it to dry.

**Inquiry Questions:**

**Source:** <https://www.exploratorium.edu/science_explorer/black_magic.html> and Pearson Saskatchewan Science 7 page 119