Paper Chromatography: Is Black Ink Really Black?

https://www.sciencebuddies.org/science-fair-projects/project-ideas/Chem_p008/chemistry/paper-chromatography (https://www.sciencebuddies.org/science-fair-projects/project-ideas/Chem_p008/chemistry/paper-chromatography)

Procedure PDF Date: 2022-01-18

Experimental Procedure

To make sure you can compare your results, as many of your materials as possible should remain constant. This means that the temperature, type of water used, size of paper strips, where the ink is placed onto the paper etc. should remain the same throughout the experiment.

1. Cut the chromatography paper into strips approximately 2 centimeters (cm) wide by 6.5 cm long. Prepare a total of 15 chromatography strips this way.
    a. *Science Buddies Kit*: The kit comes with 20 long strips of chromatography paper; two 6.5 cm strips can be cut from each long strip.
2. Take one of the chromatography strips and use a ruler and pencil to draw a line across it horizontally 1 cm from the bottom. This is the origin line or baseline, see Figure 3 below for details. Repeat this step for all 15 of the chromatography strips.

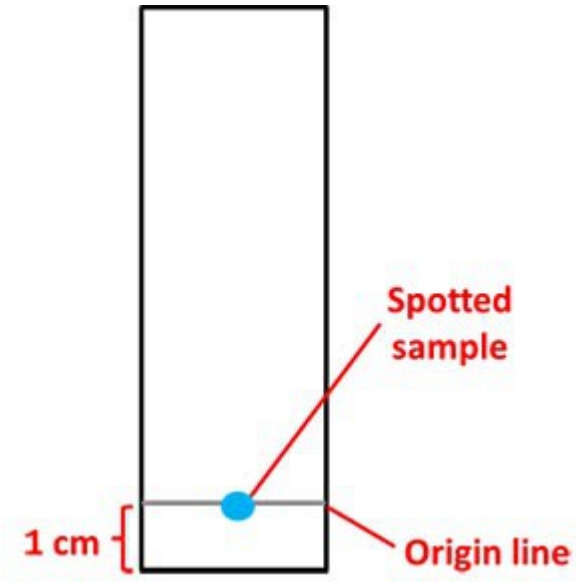

Figure 3. Each chromatography strip will have an origin line (baseline). The pen/marker ink to be tested will be spotted in the middle of the origin line.

3. Using one of the pens/markers, place a small dot of ink at the center of the origin line of a chromatography strip. This is your spotted sample as shown in Figure 4 below.
    a. Use a *pencil* to label which pen/marker you spotted on the chromatography strip. Do not use a pen labeling the strips: the ink will run when the solvent passes through the strips.
    b. Repeat this step until you have spotted ink on 5 chromatography strips for *each* pen/marker.

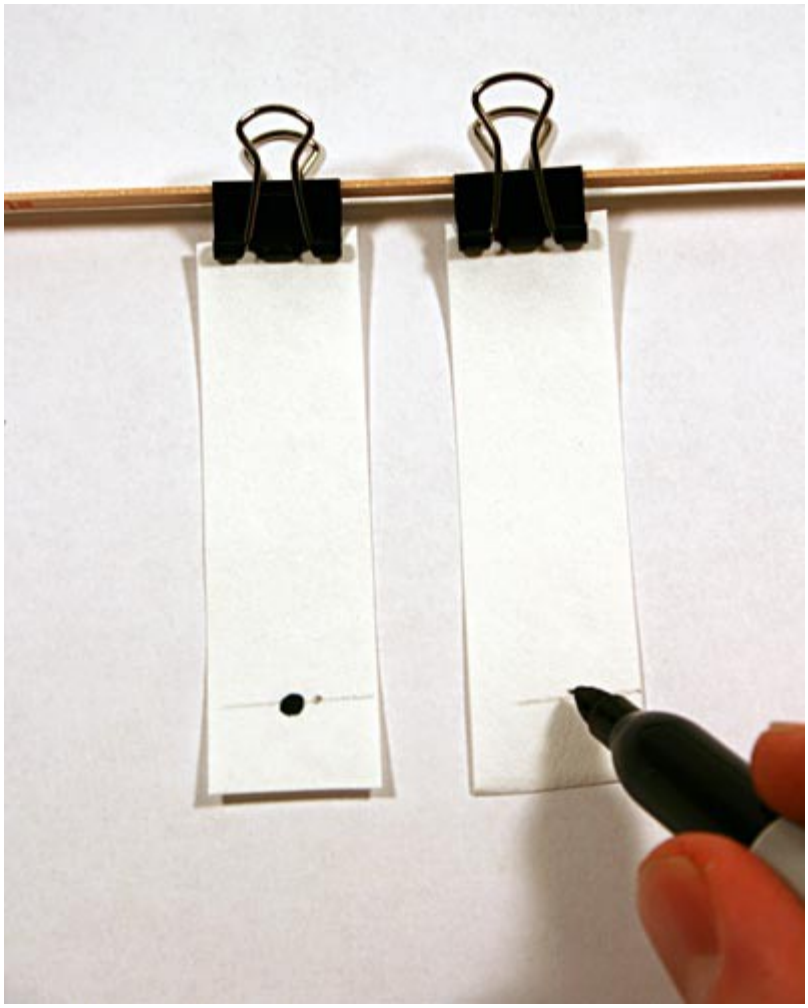

Figure 4. A marker or pen should be used to put a single spot of black ink in the middle of the origin line on the chromatography strip.

4. Make a 45% isopropyl alcohol solution to use as your chromatography solvent.
    a. Pour 20 milliliters (mL) of 90% isopropyl alcohol into the 100 mL beaker. Add 20 mL of water to the beaker so that the final volume is 40 mL. Stir thoroughly with the wooden splint.
    b. Pour the 40 mL of approximately 45% isopropyl alcohol solution into the 500 mL beaker. Cover the beaker with plastic wrap, so that the solution does not evaporate. This is your solvent, or mobile phase.
5. Pour about 8 mL of the solvent back into the 100 mL beaker and run two prepared chromatography strips in the beaker.
    a. Clip two of the prepared chromatography strips to a wooden splint. Make sure the two strips do not touch each other and the bottoms align. Rest the splint on top of the beaker so that the strips hang into the beaker and do not touch the sides of the beaker.
    b. If necessary, add more solvent to the small beaker. The goal is to have the end of each chromatography strip just touching the surface of the solvent solution as shown in Figure 5 below. Add solvent as needed to achieve this goal.
    c. Cover the top of the beaker with plastic wrap.
    d. Set aside the remainder of the unused solvent (covered with a lid or plastic wrap) for additional runs.

Figure 5. The edge of the chromatography strips should just barely touch the solvent. Remember to cover the top with plastic wrap so that the solvent does not evaporate.

6. Let the solvent rise up the strip (by capillary action) until it is about 0.5 cm from the top. Depending on the chromatography paper, this can take anywhere from 30 minutes to several hours. Once the solvent has almost reached the top of the strip, remove the strip from the solvent. Regularly check on your chromatography strip and the solvent front — if you let it run too long the dye may run off the paper and become distorted.
    a. Be patient and do not take the paper strip out of the solvent early. The longer the paper strip stays in the solvent, the better the separation will be!
7. Use a pencil to mark how far the solvent rose.
8. Allow the chromatography strip to dry, then measure (in centimeters) and calculate the R_f value for each pen/marker dye component. Record your results in your lab notebook.
    a. *Tip:* The equation for calculating the R_f value is given in the Introduction.
9. Repeat steps 5 - 8 until you have run all of the chromatography strips.
    a. Each time you run the experiment make sure there is enough solvent in the beaker. The chromatography strips should be just touching the surface of the solvent. Add more solvent (45% alcohol solution) as needed.
10. Using the five repeated strips for each pen/marker, calculate the average R_f for each dye component.

Analyzing Your Results

1. Create a data table like Table 1 for each marker or pen that you tested in your lab notebook.

Type of Marker or Pen:	
Component Color	Component R_f value
Total number of components:	

Table 1. Data table in which to record each of the separated components from one specific marker or pen.

2. Record all your results for one marker/pen in a different data table.
3. Make a bar graph that shows the R_f values for each marker/pen. The x-axis of the bar chart should have a separate bar for each color component (label each bar appropriately), and the height of the bar on the y-axis should correspond to the R_f value for each color component.

Questions

- Did the inks from the different pens/markers separate differently? By looking at the R_f values, can you tell if any of the ink components from the different pens/markers are the same?
- If the ink components separated differently for each marker, why did this happen? *Hint:* Think about the strength of the attractions.

Frequently Asked Questions (FAQ)

FAQ for this Project Idea available online at
https://www.sciencebuddies.org/science-fair-projects/project-ideas/Chem_p008/chemistry/paper-chromatography#help.