

Paper Chromatography

Background Information:

Paper Chromatography is used for separating chemicals based on their different properties (ex: solubility, size, mass, etc.) and thus, allows scientists to distinguish various organic and inorganic materials. This technique is commonly used in crime scenes or in laboratories to identify an unknown compound by comparing it to known compounds.

Paper Chromatography is divided into two phases: *Stationary Phase* and *Mobile Phase*. Stationary Phase describes the paper before the solvents start to move up and Mobile Phase is when the solvents travels up the chromatography paper while carrying the solute (e.g. pigments).

Objective:

In this experiment, we will observe black ink consists of other pigments and how different pigments in black ink separate based on their solubility. Capillary action allows solvent to travel up the paper and different pigments in black ink will separate based on their solubility. Pigment that is more soluble in polar solvent will travel up the paper along with the solvent, but pigments that are less soluble in polar solvent will travel more slowly because of their interaction with the chromatography paper.

Materials Needed:

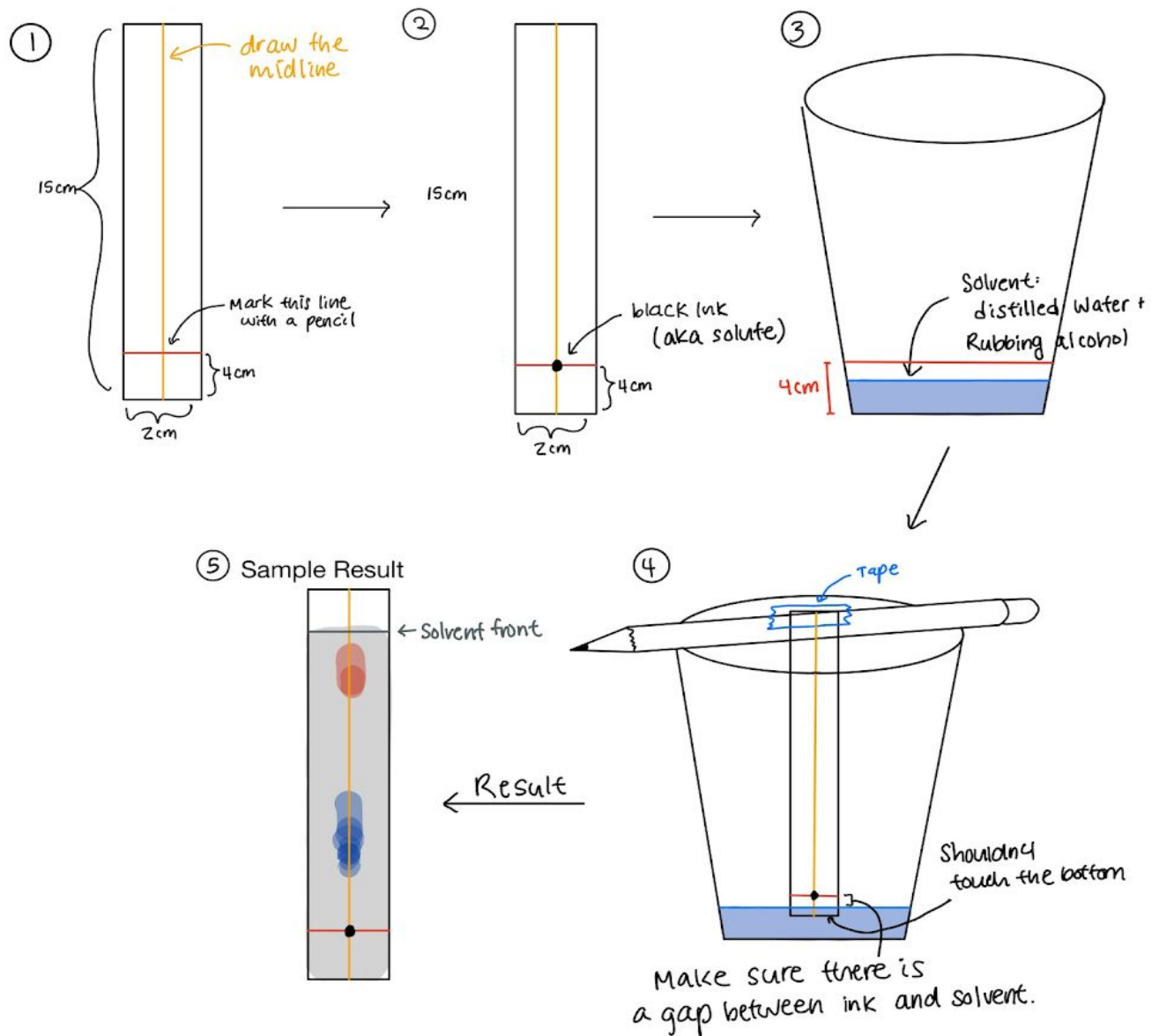
1. Chromatography Paper (White Paper Towels can be used as a substitute)
2. Solvents: must be polar (Ex: distilled water & rubbing alcohol)
3. Ruler
4. Pencil
5. 3 Black Ink Pens/ Markers
6. Cup (preferably clear, plastic cup but not necessary)
7. Tape

Procedure:

1. Preparing chromatography paper: Cut the paper towel: 2 cm by 15 cm. Then, measure 4 cm from one end and draw a line using a pencil and also a midline dividing the 4 cm line you just drew (as shown in the picture below). This is the *baseline*. It's important to use *pencil* because lead will not dissolve in water, preventing experimental error in chemical separation.
2. Using black ink pen or marker, draw a small dot at the cross section of two lines you have drawn previously.
3. Preparing Solvent: Mix equal amounts of water and rubbing alcohol in the cup (height ~ 2 cm). Rubbing alcohol by itself is also fine. Make sure the height of the solvent is less than 4cm. (You don't need large amounts of solvent, just a little bit as depicted in the picture below).

- Place the chromatography paper (aka. Paper towel) inside the cup and make sure that the solvent Does Not reach where the ink is (there should be a gap between ink and solvent). Also, make sure that the chromatography paper doesn't touch the bottom of the cup. Tape the other end of chromatography paper to a pencil and place it on the cup.
- Wait for about 15 minute. Then, take out the chromatography paper.
- Using the same set up, repeat the experiment with different types of black ink pen/ marker.

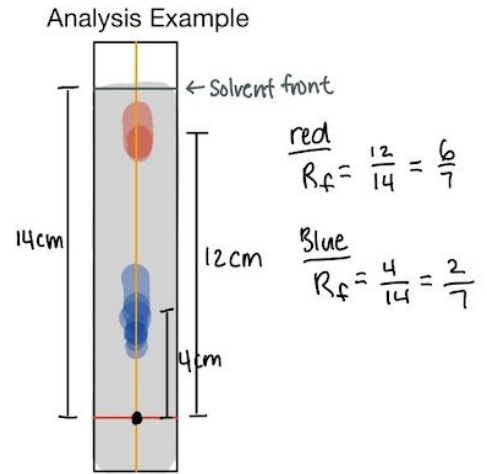
Procedure (drawn out):



Analysis:

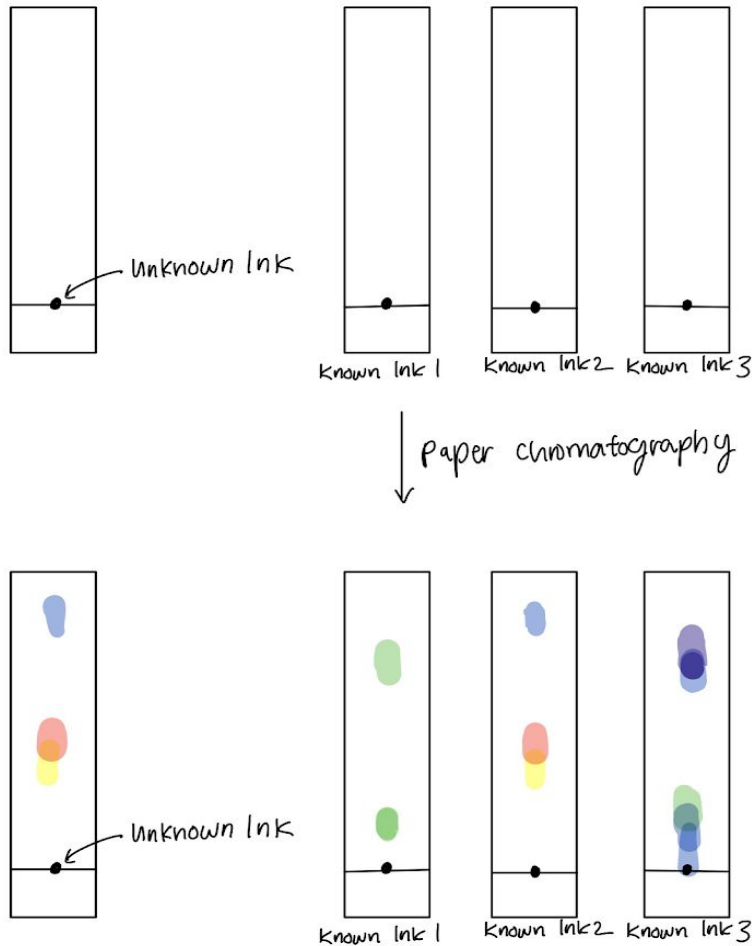
1. Were you able to see separation of color from the black ink you used? What colors were in there? (Faster travelled pigment is more soluble because)
2. Based on your experimental result, what pigment do you think was more polar? (Polar pigments travel faster in paper chromatography because they have higher solubility. "Like dissolves like")
3. Calculate the Rf value:
 - Rf value describes how soluble a substance is.

$$R_f = \frac{\text{distance travelled by solute (ink) from baseline}}{\text{distance travelled by solvent from baseline}}$$



Practice Question:

How paper chromatography is used to identify unknown chemical



Which ink is the unknown ink?

Answer: Ink 2 (By inspection, the unknown ink has not similar pigment separation as the ink 2, but we can also compare using Rf values)

More Experiments:

- Try another experiment with different, same colored pens (such as three blue pens or three red pens) to see which pen's ink is most soluble in solvent.
- Use Spinach extract (and any other plant extracts) to observe different chlorophyll held by plants. Hint: you will be able to observe more colors than just green.

Online Resources about Paper Chromatography:

- Online Simulation: <https://amrita.olabs.edu.in/?sub=79&brch=17&sim=124&cnt=4>
- Videos:
 - https://www.youtube.com/watch?v=23W5Z_redfs
 - <https://www.youtube.com/watch?v=SnbXQTTHGs4>
- Enrichment reading: <https://www.chemguide.co.uk/analysis/chromatography/paper.html>