# Forensic Paper Chromatography

**Introduction:**

Chromatography is a separation technique involving two different phases. The sample is applied to the stationary phase, and a mobile phase is then introduced. The sample, which is usually a mixture, will be carried along the stationary phase by the mobile phase. The components of the mixture will move at different rates based on polarity. Substances with polarities more similar to that of the mobile phase will move along the stationary phase at a faster rate.

The colors in magic markers are often due to a mixture of several compounds. These inks can be separated using paper chromatography. Porous paper serves as the stationary phase. Depending on the type of ink, the mobile phase will vary. Permanent inks require isopropyl alcohol to separate, while washable markers require only water. After separation, one can observe the different colors that make up a particular color of magic marker.

Paper chromatography can be used to help solve crimes involving notes. The ink from the note can be extracted with methanol. The ink can then be spotted onto paper and separated by chromatography. Each dye will have a specific retardation factor, or $R_f$ value.

$$R_f = \frac{\text{distance from origin to spot}}{\text{distance from origin to solvent front}}$$

**Purpose:**

The purpose of this experiment is to use paper chromatography to determine which pen was used in a crime.

**Materials:**

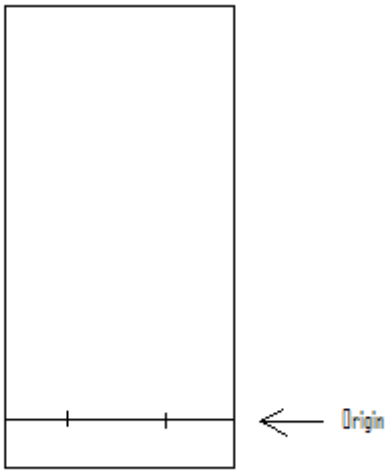
Developing chambers
Chromatography paper
Pens
Water
Small vials
Methanol
Droppers
Pulled capillary tubes
Ransom note
Rulers
Scissors

**Safety:**

- Always wear safety glasses in the lab.

**Procedure:**

1. Obtain a piece of chromatography paper. About 1 cm from the bottom, draw a straight line across the paper with **pencil**. This line is called the origin.
2. Place two tic marks on the origin as shown in the diagram on the preceding page. Label one tic mark as the suspect pen



and one as the note.

3. For the suspect pen, place a small dot from the pen at the intersection of its tic mark and the origin.
4. Cut out one of the letters from the ransom note. Place the letter in a vial with 2-3 drops of methanol. (The less methanol, the more concentrated the sample; the more concentrated the sample, the better the results.)
5. Place the pointed end of a pulled capillary tube into the methanol solution. Carefully spot the sample where the other tic mark intersects the origin. Spot quickly so the dot does not get too large. Let the spot dry. Keep spotting until the spot is dark.
6. Insert a straightened out paper clip through the top of the paper. Place some water in a developing chamber. The height of the water must be below the origin.
7. Carefully insert the chromatography paper into the developing chamber, spotted end down. Add more water if necessary, but make sure the origin does not fall into the water. Also, be certain that the sides of the paper do not touch the developing chamber.
8. Allow the developing chamber to remain undisturbed until a good separation is obtained or until the solvent front is near the top of the paper. In a good separation, the colors are separated and the solvent is clearly above the top color.
9. Remove the chromatogram.
10. Mark the solvent front with a pencil.
11. Calculate the $R_f$ values ($R_f$ = distance solute moved/distance solvent moved).

**Data/Calculations:**

Marker color and brand _____

Name of Suspect _____

| Colors absorbed top to bottom (Suspect Pen) | $R_f$ Values |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

| Colors absorbed top to bottom (Ransom Note) | $R_f$ Values |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

**Questions:**

1. Why does the spot need to be above the level of the solvent when the chromatogram is placed into the solvent?

2. If the spot doesn't move with the water, what should be done?

3. According to your data, who's pen was used to write the ransom note?