

# CSI (Chemistry Stinks Investigation)

## LAB PC 1

### INTRODUCTION

Somebody has left a nasty note for your teacher. The note was written with black ink on a piece of filter paper. In an effort to uncover the author of the note, your teacher has confiscated all the black pens used during the class when it appeared. As a member of the CSI team, you will use your chemical knowledge to identify the pen used to write the note, and ultimately, who wrote it.

Chemists use the technique of chromatography to separate compounds for purification and identification. Many types of chromatography have been developed, but utilization of

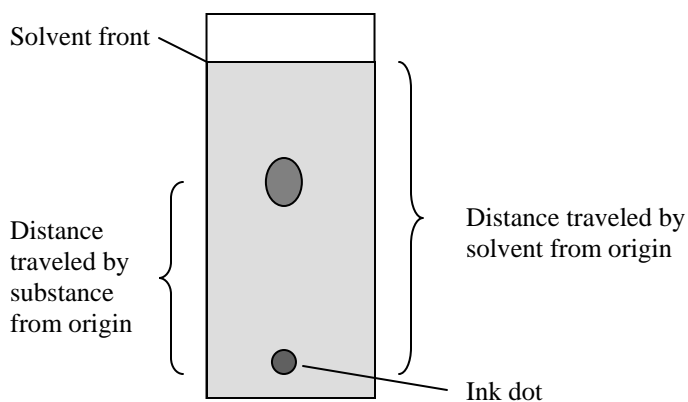


Figure 1

a moving phase and a stationary phase is common to this category of techniques. In paper chromatography, the method used in this experiment, the moving phase is the solvent, and the stationary phase, or adsorbant, is the filter paper.

Chromatography works because of differences in polarity between the stationary phase, the solvent, and the components of the mixture being studied. When using a solvent with low polarity, the majority of the components of the mixture, if not all of them, will be held more strongly to the adsorbant than the solvent molecules, so the solvent will not displace them and carry them along with it. If a more polar solvent is chosen, it will displace the majority of the molecules in the sample, but depending on the polarity of each of the components, some may travel farther with the solvent than others, resulting in separation of each of the components. The distances traveled with the solvent are characteristic of different molecules and make identification possible (see Figure 1).

A solvent much more polar than the components of the mixture will displace all of the molecules and carry them all very easily on the solvent front, yielding no separation that

Reference: This lab was developed by Gary Krenzer, Mercer High School, 545 West Butler Street, Mercer, PA 16137.

would be useful in identification. Finding a solvent suitable for separation of a mixture or identification of a sample usually requires trying several solvents of different polarity.

In this experiment, four solvents will be used to study the inks of the confiscated pens and to provide a way to tell them apart. This will allow the confirmation of the pen used to write the nasty note and the identity of the person who wrote it.

## PURPOSE

The purpose of this lab is to use paper chromatography to identify an unknown ink sample.

## EQUIPMENT/MATERIALS

Beaker	0.1 M hydrochloric acid
Watch glass	Deionized water
Scissors	Isopropyl alcohol (rubbing alcohol)
Filter paper	Ethanol
Nasty note	Confiscated pens
Pencil	4 test tubes
Forceps	Ruler
Test tube rack	

## SAFETY

- Always wear an apron and goggles in the lab.

## PROCEDURE

### Testing the Confiscated Pens

1. Obtain a piece of filter paper and cut it into a rectangular shape.
2. Fold the filter paper as you would fold a paper fan.
3. Use each of the confiscated pens to place a separate dot of ink on each panel of the “fan” one centimeter from the bottom (See Figure 2).
4. Use a pencil to label each ink sample with the pen number it came from (See Figure 2).
5. Pour  $\frac{3}{4}$  cm of deionized water into the beaker. Insert the folded filter paper into the water. **Be sure the ink dots are above the water level.**
6. Cover the beaker with a watch glass.

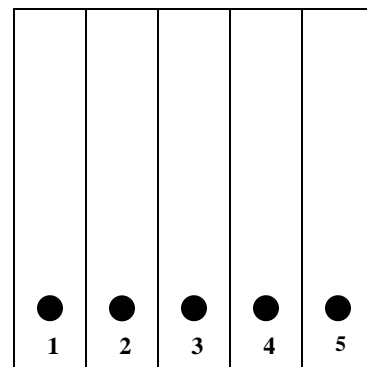


Figure 2

7. Remove the paper from the beaker just before the water climbs to the top of the paper.
8. Use a pencil to note the solvent used for that run on the dry portion of the filter paper.
9. When the paper has dried, circle ink streaks (in case they fade) with a pencil. Set the paper aside until all solvents have been used.
10. Repeat steps 1-9 with each of the other solvents.

### **Testing the Note**

1. Cut out four separate strips of paper from the nasty note, each one containing one letter. Be sure the letter is approximately one centimeter from one end of the strip and that the strip is narrow enough to fit into a test tube.
2. Label four test tubes A, B, C, and D.
3. Place  $\frac{3}{4}$  cm of deionized water into test tube A.
4. Place  $\frac{3}{4}$  cm of isopropyl alcohol into test tube B.
5. Place  $\frac{3}{4}$  cm of hydrochloric acid into test tube C.
6. Place  $\frac{3}{4}$  cm of ethanol into test tube D.
7. Insert one strip of the note into a separate test tube so that the letter is just above the surface of the solvent.
8. When the solvent has traveled most of the way up the paper strip, use a pair of forceps to remove the strips from the test tubes.
9. Use a pencil to label each strip with the solvent used and to circle the ink streaks in case they fade.
10. When dry, compare the strips with the chromatographs produced by the confiscated pens.
11. Use the similarities to identify the pen used to write the note.

**DATA SHEET**

Name \_\_\_\_\_

Name \_\_\_\_\_

Period \_\_\_\_\_ Class \_\_\_\_\_

Date \_\_\_\_\_

**CSI (Chemistry Stinks Investigation)****QUESTIONS**

1. Identify each solvent as polar, nonpolar, or having characteristics of both.

<b>Solvent</b>	<b>Polarity</b>
Water	
Isopropyl Alcohol	
Hydrochloric Acid	
Ethanol	

2. Identify the ink of each pen as polar (P), nonpolar (NP), or having characteristics of both (B) and list them in the appropriate column in the table below.

<b>Polarity</b>	<b>Polar</b>	<b>Nonpolar</b>	<b>Both</b>
<b>Pen</b>			

3. Which pen was used to write the nasty note? Explain how you know.