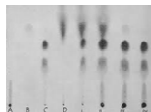


# Chromatography Lab



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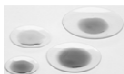
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## The Lab Today (Work in Pairs)

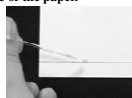
### Extract Dyes From an M&M

Place an M&M on a watch glass  
 Use five different colors ... a different watch glass for each color  
 Add drops RO water to each watch glass (cover the candy)  
 Let stand several minutes ... water will extract the dye from the shell



### Prepare the Chromatogram

Place a pre-cut piece of filter paper on a paper towel.  
 Draw a line along one of the shorter sides, 2 cm from the edge of the paper. (USE PENCIL)  
 Write your initials in pencil at the very top right of the paper.  
 Apply a sample of dye on the penciled line ~ 1.5 cm from the left side of the paper.  
 Let dry  
 Reapply another drop Keep drops as small as possible  
 Let dry  
 Reapply a third drop  
 Spot each extracted dye - leave about 1.5 cm between spots



Push a Cu wire through the top end of the filter paper about 1 cm from the top.  
 Bend the copper wire to suspend the filter paper inside a dry 2-L beaker.  
 Colored dots from samples → 1 cm above the 200-mL line at the bottom of the beaker

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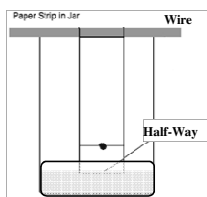
### Develop the Chromatogram

Temporarily remove the filter paper and wire assembly  
 Add ~200 mL 1.0 % NaCl solution  
 Do not disturb the beaker  
 Let it stand until the mobile phase has stopped moving



### Mark Spot Migrations

Remove the chromatogram from the beaker  
 Place on several layers of paper towel  
 Mark with a pencil:  
 progress of the mobile phase (solvent front)  
 outline each colored spot  
 Dry the paper



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**Data: Measure Spot Migrations**  
 For each spot Measure cm to 2 decimal places:  
 Distance from origin to solvent front  
 Distance from origin to spot  
 Calculations:  
 Calculate  $R_f$  for each spot  
 $R_f = \frac{\text{Distance to spot}}{\text{Distance to solvent}}$   
 **$R_f$  has 3 sig figs (0.xxx)**  
 Results:  
 Table of  $R_f$  values  
 Conclusion:  
 Always answers purpose  
 Questions

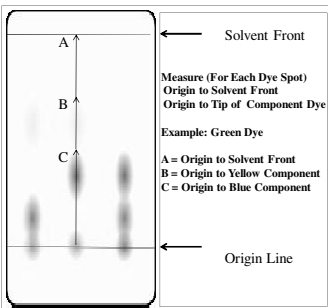


Diagram labels:  
 Solvent Front  
 Measure (For Each Dye Spot)  
 Origin to Solvent Front  
 Origin to Tip of Component Dye  
 Example: Green Dye  
 A = Origin to Solvent Front  
 B = Origin to Yellow Component  
 C = Origin to Blue Component  
 Origin Line

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**Let's Boldly Go Explore Today's Lab**



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**Chromatography**



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## Chromatography

From "Chromos" (Color)


Powerful technique in analytical chemistry  
Separates mixtures into individual components

Improvements continually redefine definition of "chemical purity"

All modes partition between a "moving phase" and a "stationary phase."

**Paper Chromatography**  
Stationary phase → filter paper  
Moving phase → solvent.

Also:  
TLC (Thin-Layer) – thin layer silica; liquid moving phase  
GC (Gas) – gas mobile phase; solid particle non-moving phase  
HPLC (High Pressure Liquid) – liquid moving phase; solid non-moving phase



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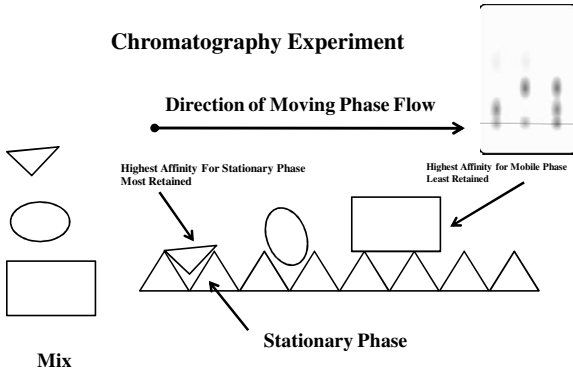
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## Chromatography Experiment

Direction of Moving Phase Flow →




Highest Affinity For Stationary Phase  
Most Retained

Highest Affinity for Mobile Phase  
Least Retained

Mix

Stationary Phase



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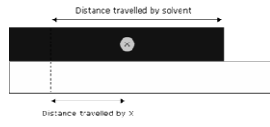
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## Chromatography Experiment

How far a substance "moves" on the chromatogram depends upon:

- Chemical nature of non-moving phase
- Chemical nature of moving phase
- Temperature
- Concentrations of moving phase components
- Affinity of each component for both mobile and stationary phases




Distance travelled by solvent

Distance travelled by x

$R_f$  Value of component  
Compared to  
 $R_f$  Value of Known standard

$R_f = \text{Distance Spot moved} / \text{Distance Solvent Moved}$   
 $R_f = \text{Retention Factor}$



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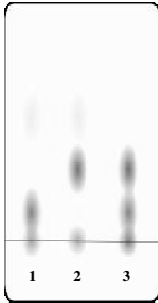
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### Chromatography Experiment





Chromatography great for “what’s not there”

Sample #1 definitely does not contain purple component  
 Sample #2 definitely does not contain red component  
 Sample #3 definitely does not contain yellow component

Need something else to determine chemical identify

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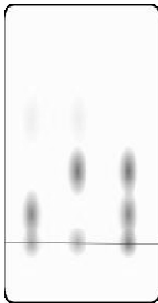
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### Chromatography Experiment: Sig Figs



**Cm measurement with no decimal points:**  
 All  $R_f$ 's either 0 or 1

**Cm measurement with one decimal point:**  
 All  $R_f$ 's have 2 sig figs  
 No discrimination value  
 Experiment of little or no value

**Cm measurement with two decimal points:**  
 All  $R_f$ 's have 3 sig figs  
 Useful  $R_f$ 's  
 Can discriminate spots  
 Useful identity tool

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### You Can Do Chromatography At Home (Kids Love Colors)

Try anything that is colored: inks, dyes, flowers, etc




Chalk as stationary phase





Coffee Filter  
Spot dye in the center



Coffee filter strips as stationary phase

Try different amounts of salt solution as mobile phase

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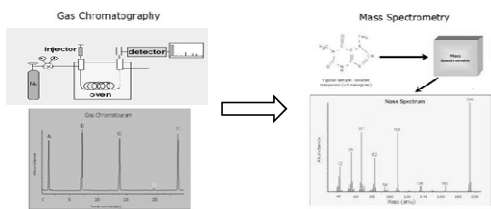
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C.S.I. Often refers to identifying unknown materials with GC/MS  
GC/MS = Gas Chromatography / Mass Spectrometry



GC Separates Components

MS Identifies Components

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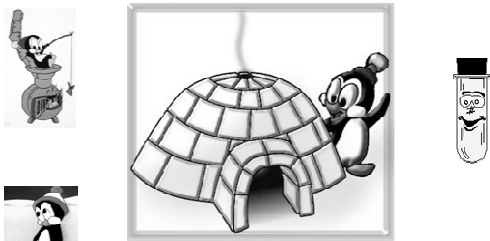
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Thought for today: Chemistry is Cool!



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