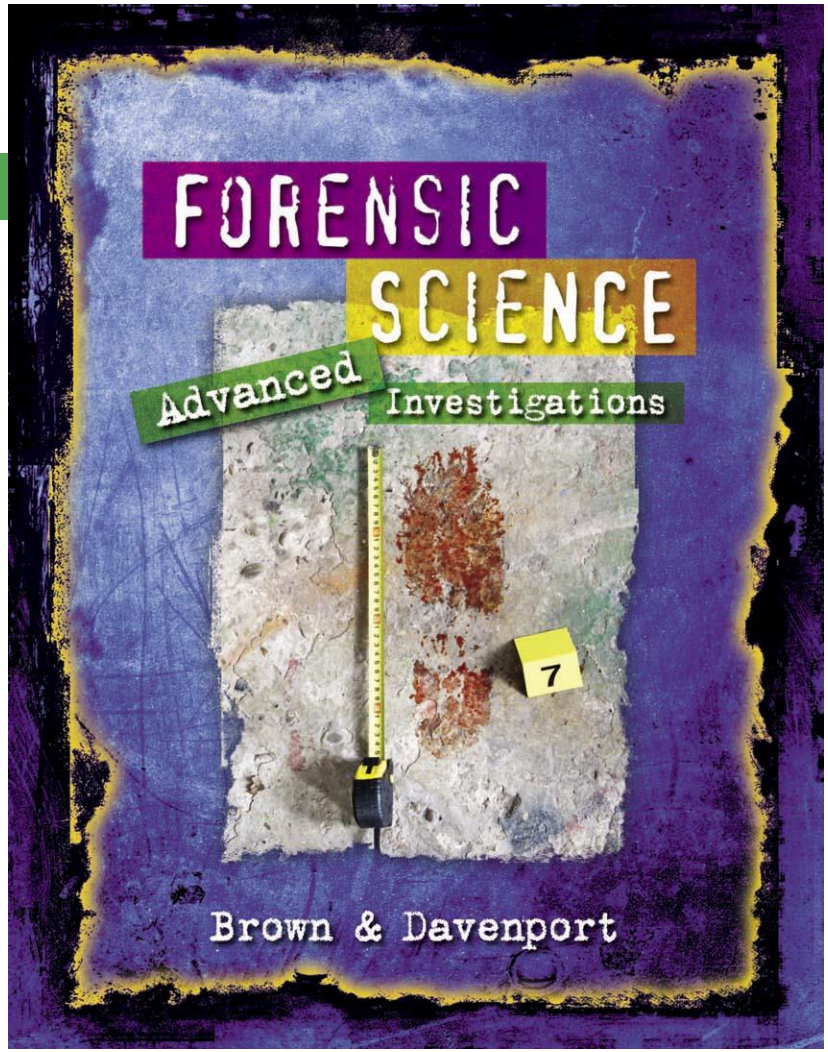
Chapter 3

Forensic Laboratory Techniques



Objective: You will be able to describe the theory of chromatography.

- Read the Laci Peterson case on p. 70
- Compile a list in your notebook of evidence that was found.

Introduction

- **Physical properties** are properties that can be measured without changing the identity of the evidence

- **Chemical properties** determine how a substance behaves in the presence of other substances.

Presumptive & Confirmatory Tests

- **Presumptive tests** allow for a preliminary identification.
  - Saliva
  - Semen
  - Blood
  - Urine
- **Confirmatory tests** are used to make a more specific identification.

Analyzing Organic Compounds

- Quality versus quantity
  - Quality identifies exactly what it is
  - Quantity may be important because larger amounts of illegal substances may carry longer jail time

- Many times substances are in fact mixtures
  - For example; drugs may have been “cut”
  - This requires a different technique to identify the substance

Chromatography

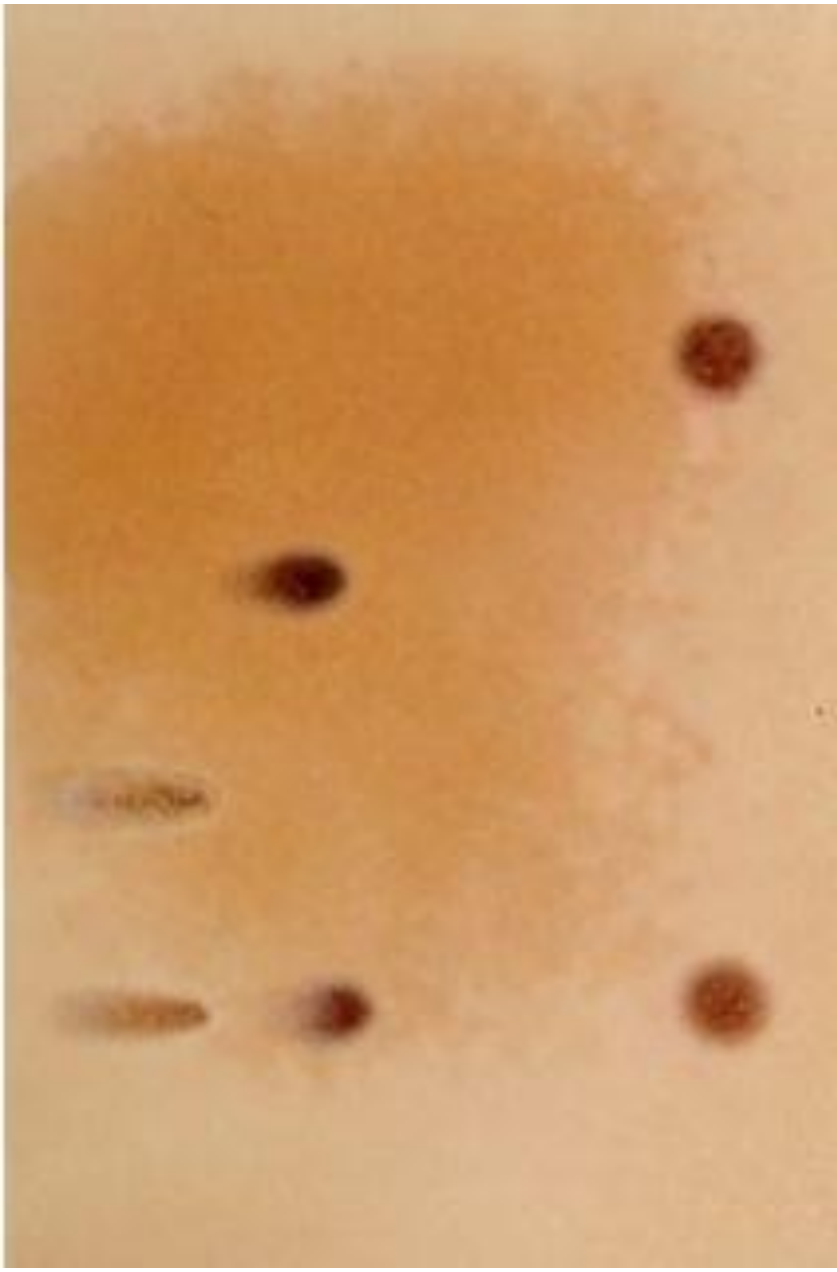
- This technique has the ability to purify substances
  - It rips each component from mixture and separates them into single components

Known
Cocaine

Known
Heroin

Known
Methamphtamine

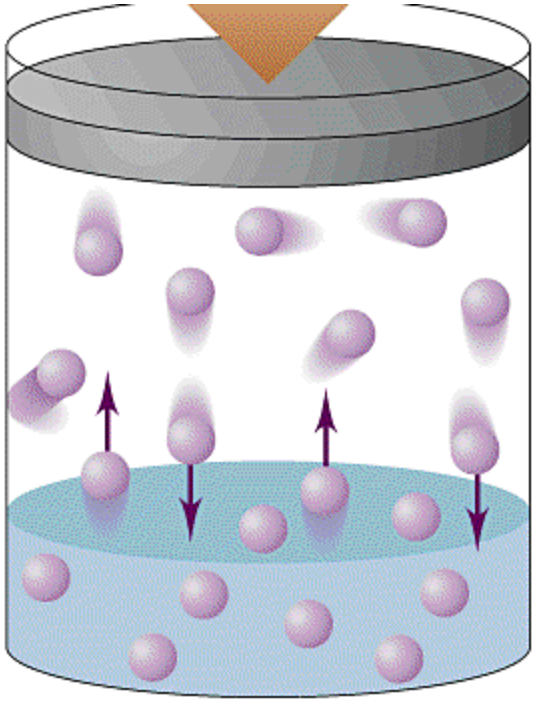
Unknown
From Case



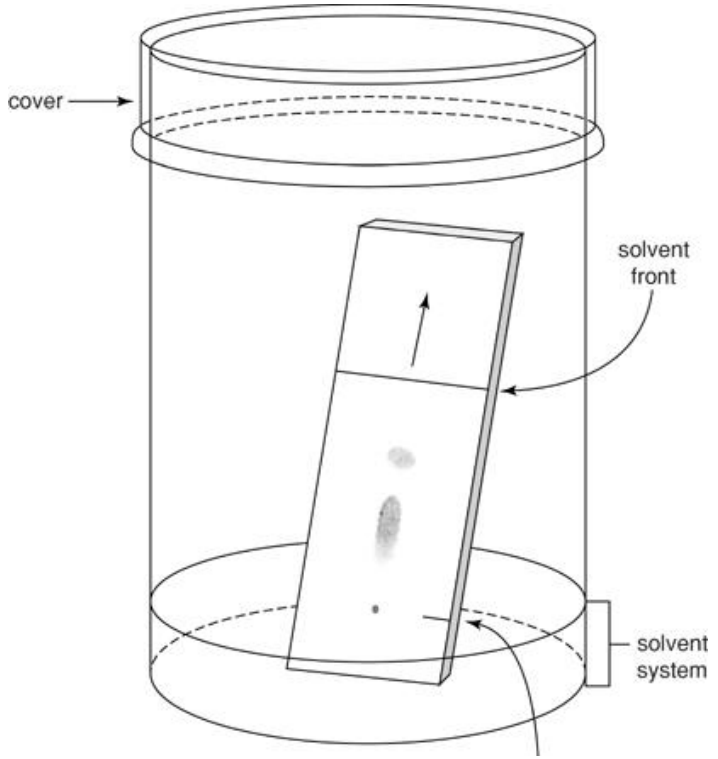
Chromatography

- Theory of chromatography
  - Chemical substances partially escape into surroundings when:
    - Dissolved in a liquid
    - Absorbed into a solid

Dissolved in liquid



Dissolved on a solid



Gas chromatography

TLC

Thin Layer Chromatography (TLC)

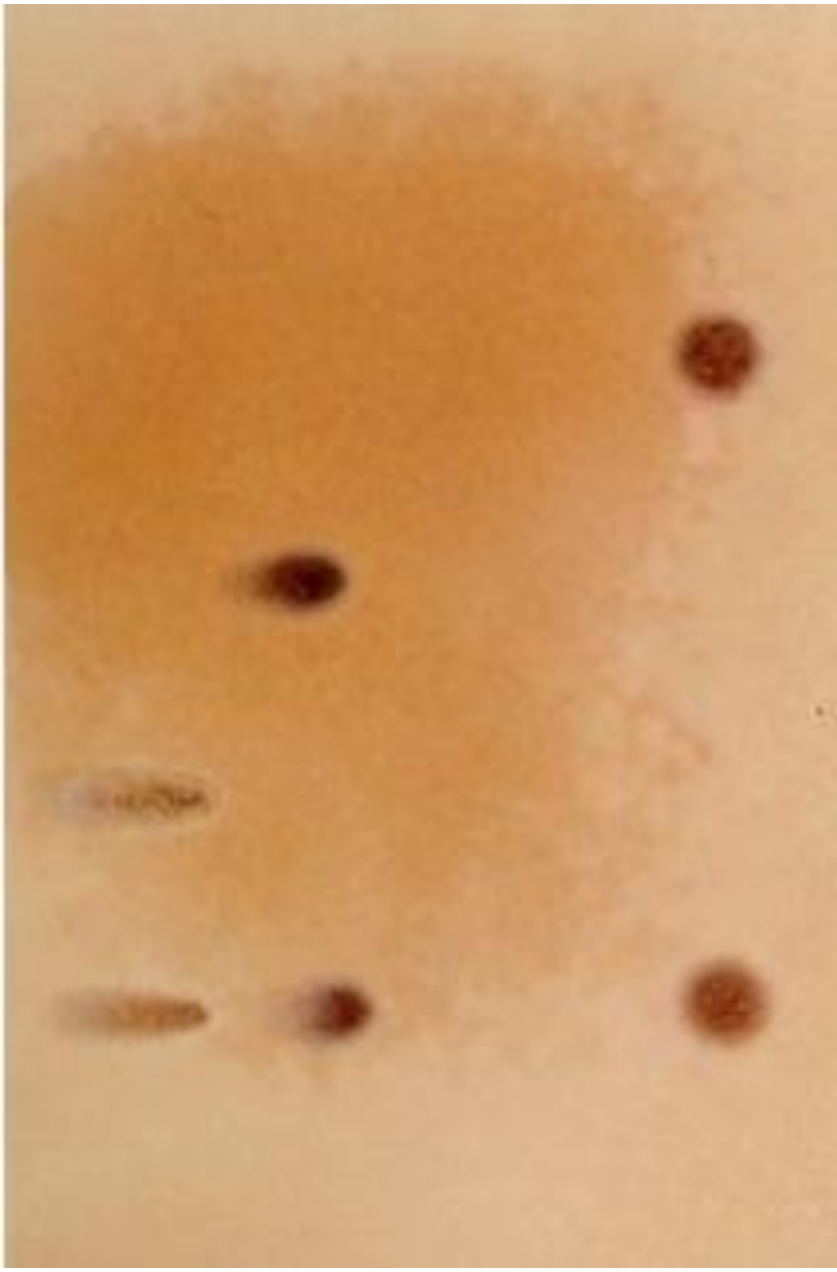
- Separation of mixture is done by using a stationary solid phase (paper) and moving liquid phase
- Still based on solubility of each substance in the liquid
- Substances that are highly soluble move faster
- Must run unknown sample alongside knowns

Known
Cocaine

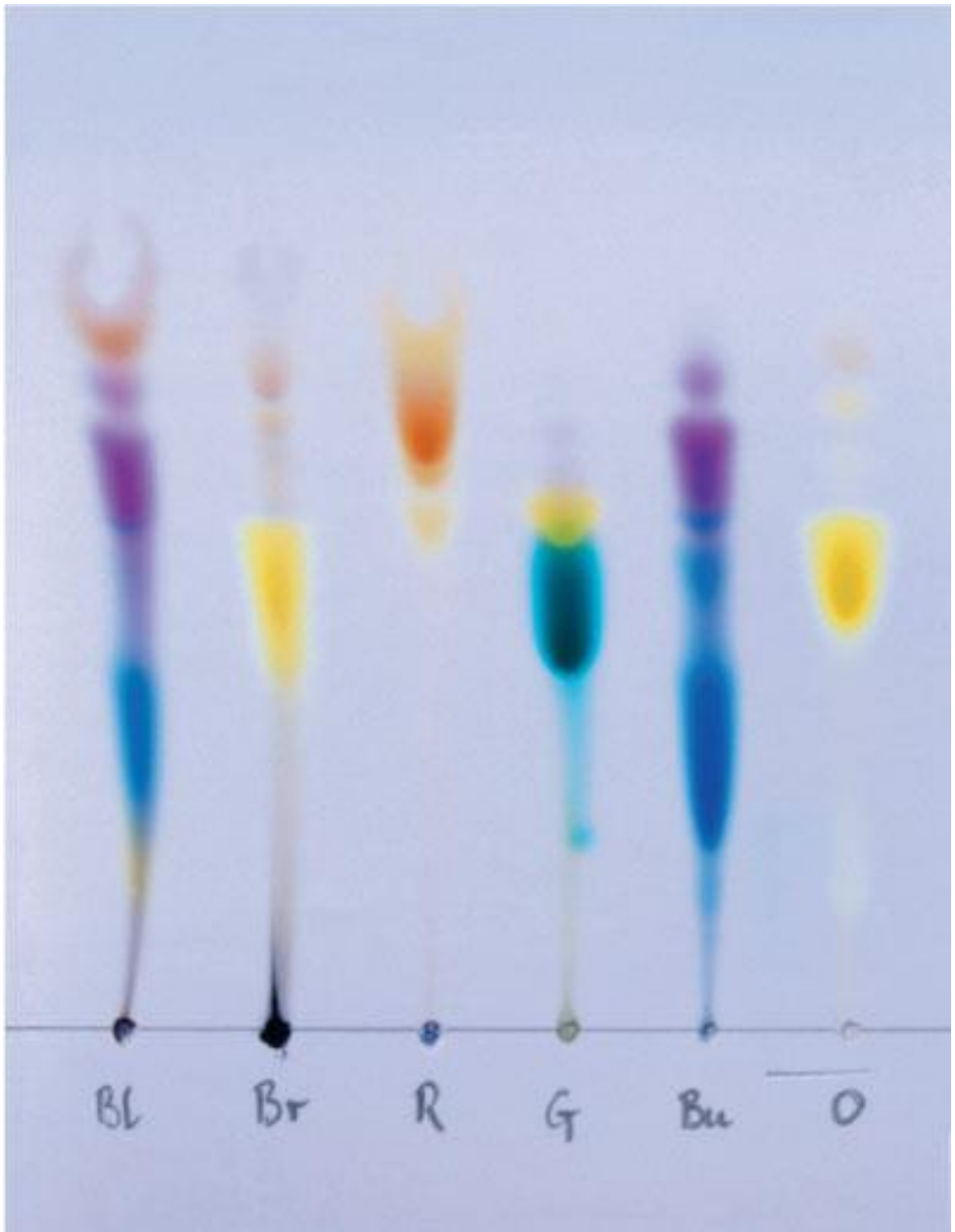
Known
Heroin

Known
Methamphtamine

Unknown
From Case



Chromatography—Paper



Chromatogram—R_f value

$$R_f = \frac{\text{Distance substance traveled}}{\text{Distance solvent traveled}}$$

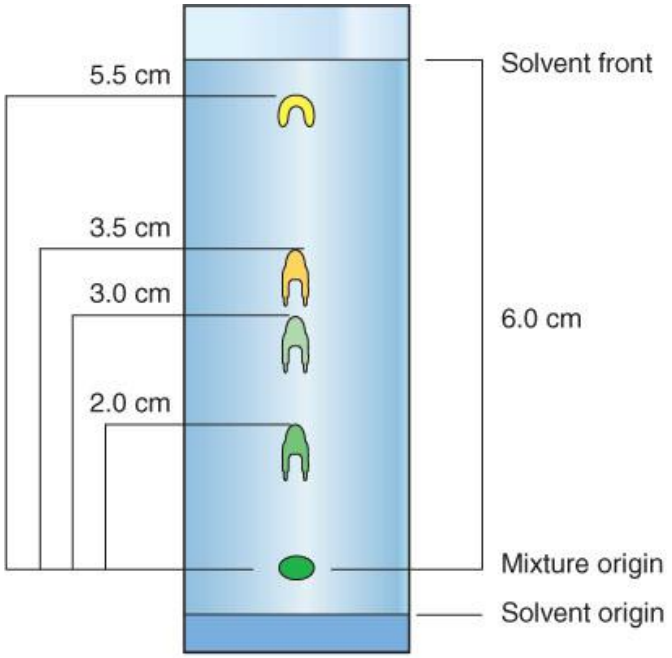


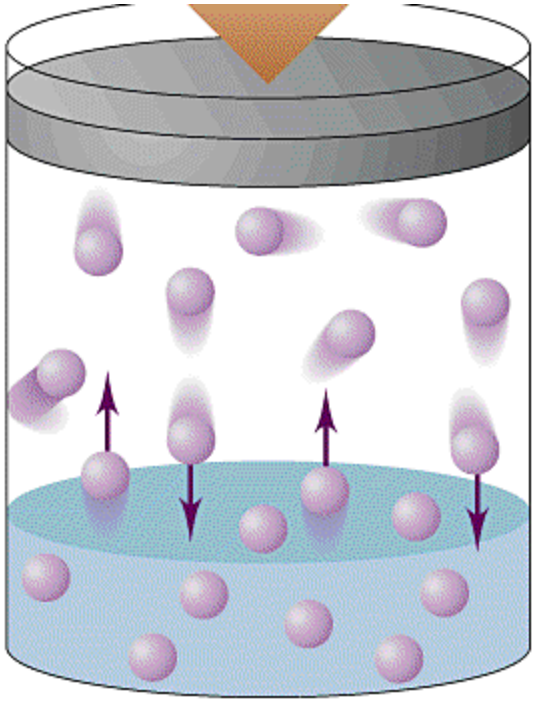
Figure 3-8. *Chromatogram used for calculating R_f.*

Objective: You will be able to describe how gas chromatography separates substance from a mixture.

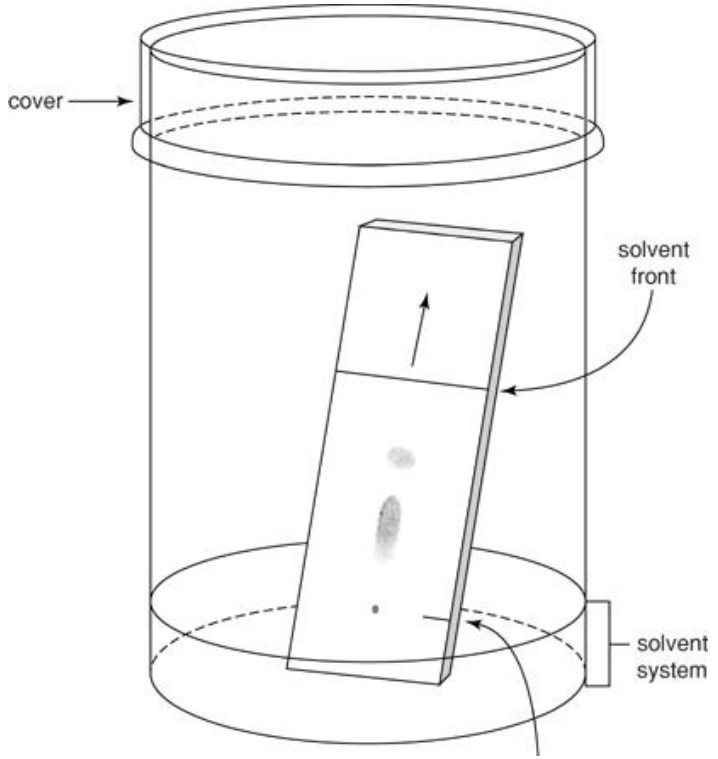
Do Now:

- Take out your lab from Friday
- Finish calculating R_F values

Dissolved in liquid



Dissolved on a solid



Gas chromatography

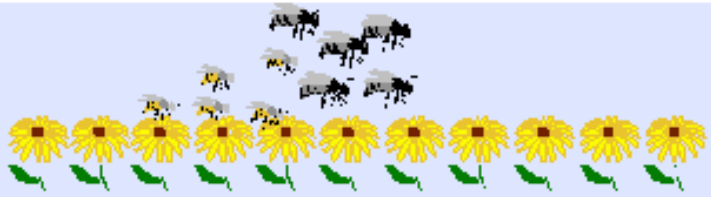
TLC

Gas Chromatography

An Analogy for

Chromatographic Separation

mixed swarm of bees & hornets enter flower bed…



bees visit flowers; hornets don't…

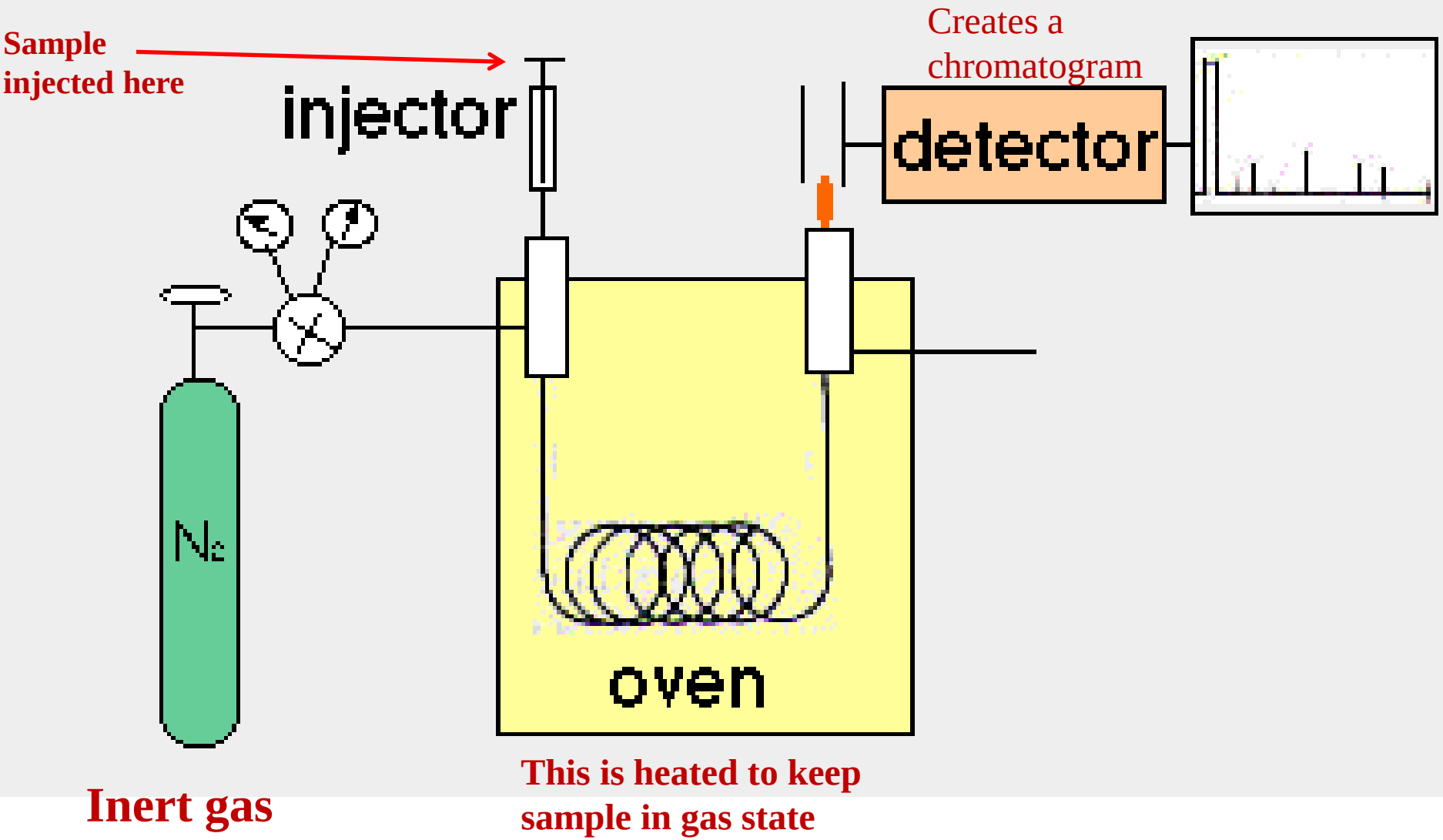
hornets leave the bed first.

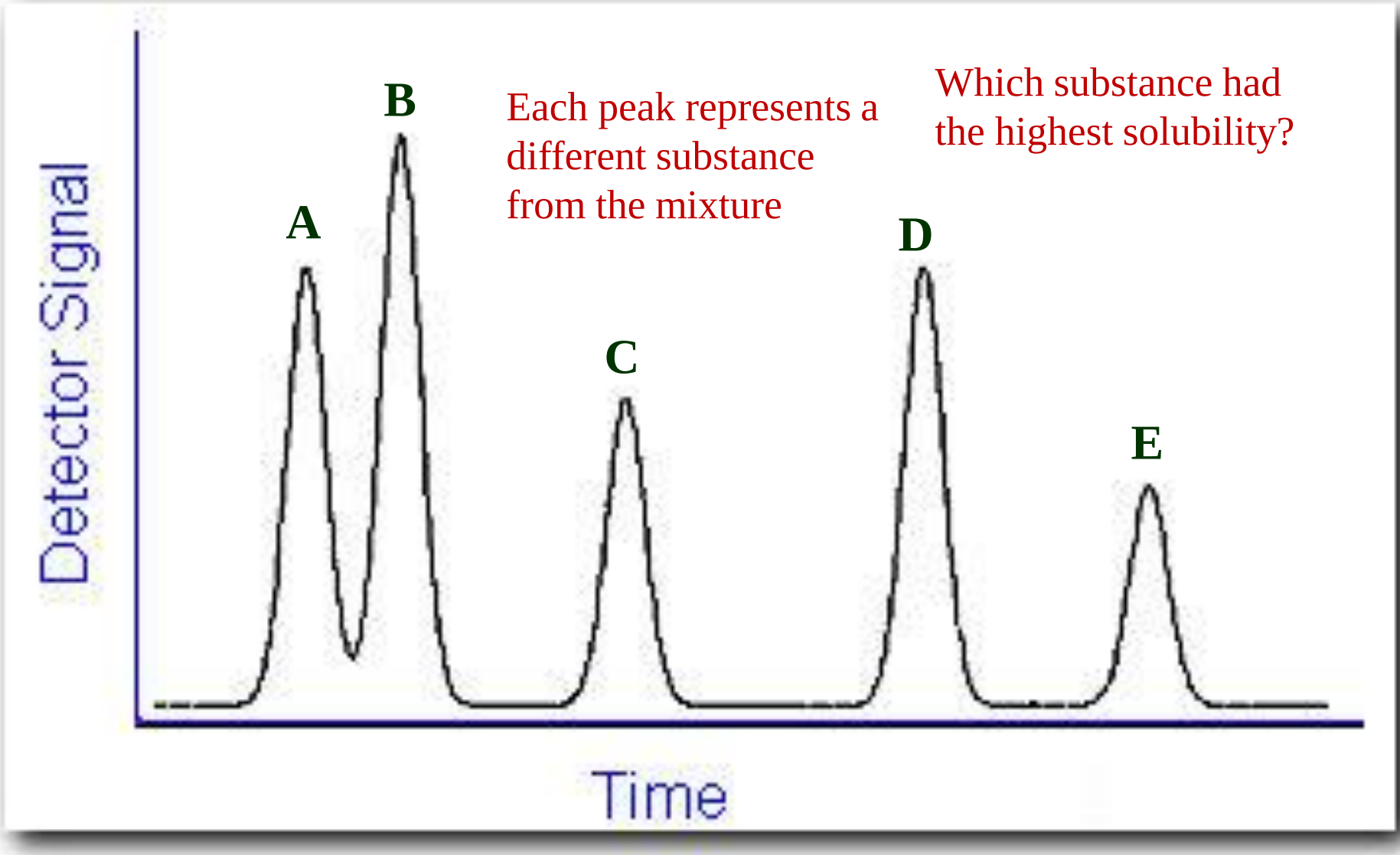
Gas Chromatography

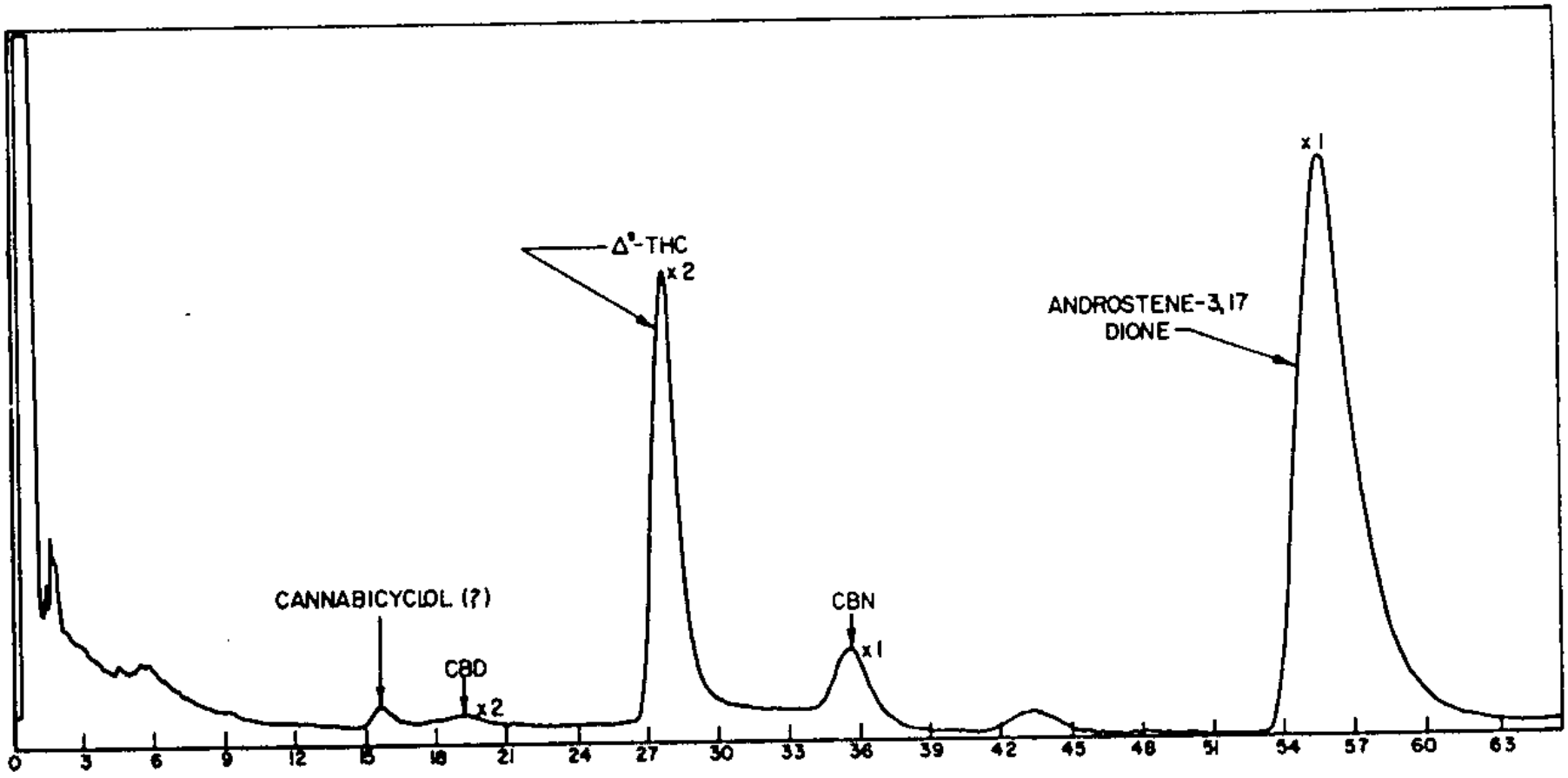
- Can separate substances because of differences in solubility in a liquid
  - Force air to continuously move in one direction
  - Gas phase is moving phase, liquid phase is stationary phase

- The chemical race
  - High solubility means it wants to stay in liquid
  - This makes the highly soluble substance move **slower**

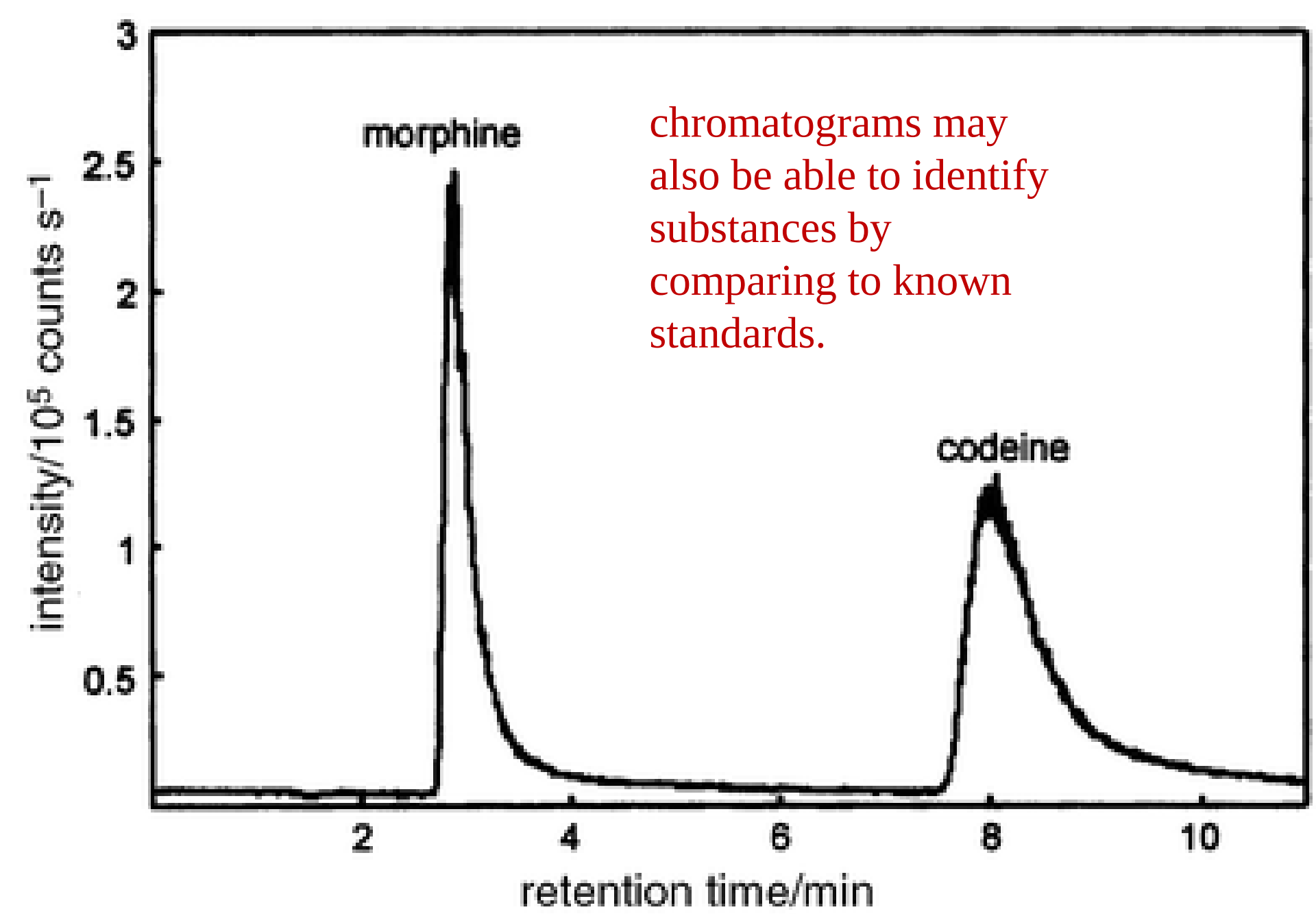
Components of a Gas Chromatograph




Detector Signal
Time
A
B
C
D
E
Each peak represents a different substance from the mixture
Which substance had the highest solubility?



Mixture of material in marijuana



chromatograms may also be able to identify substances by comparing to known standards.

Caylee Anthony Case

Key moments in the Caylee Anthony case

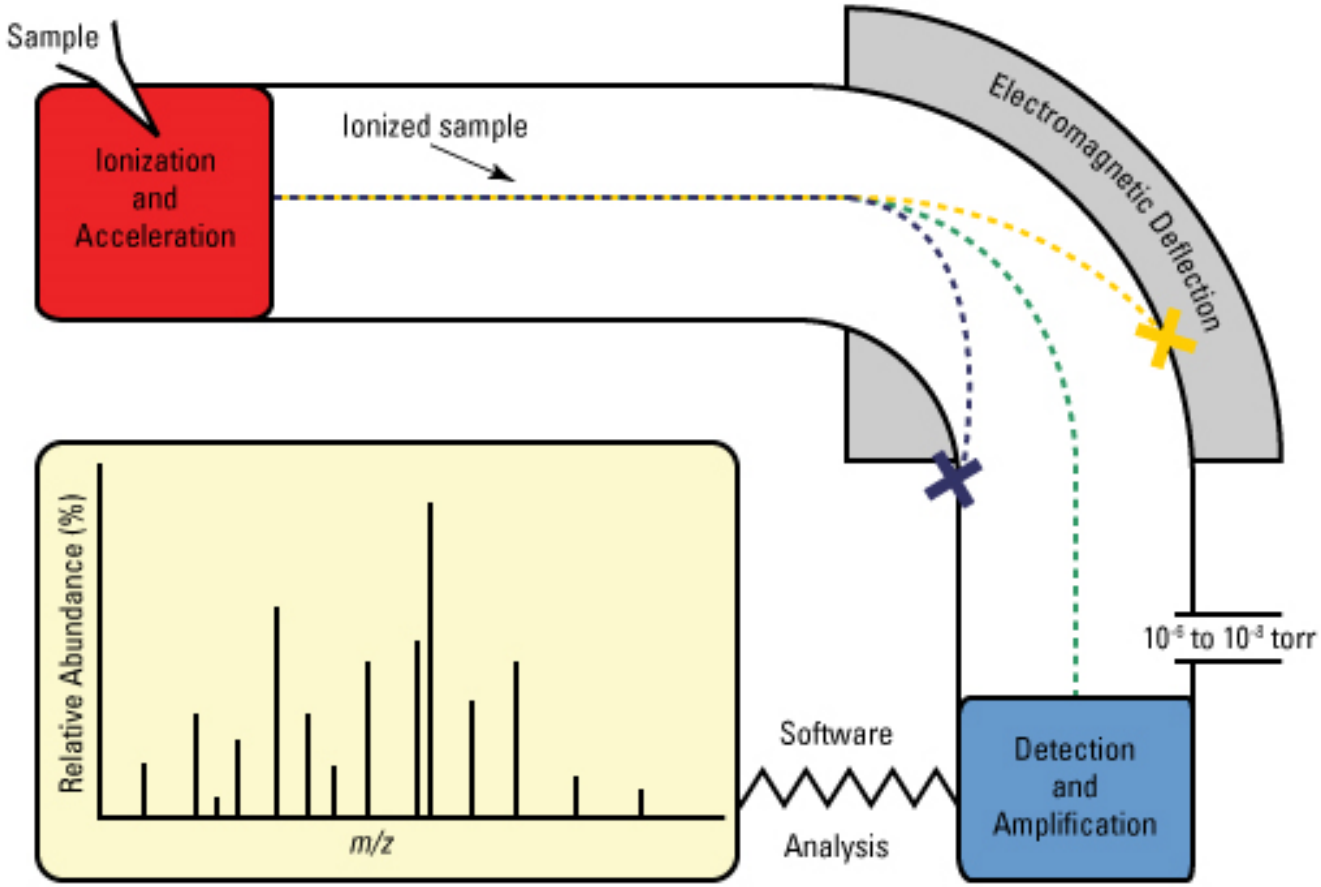
Objective: You will be able to explain how spectrometers can be used to specifically identify a substance.

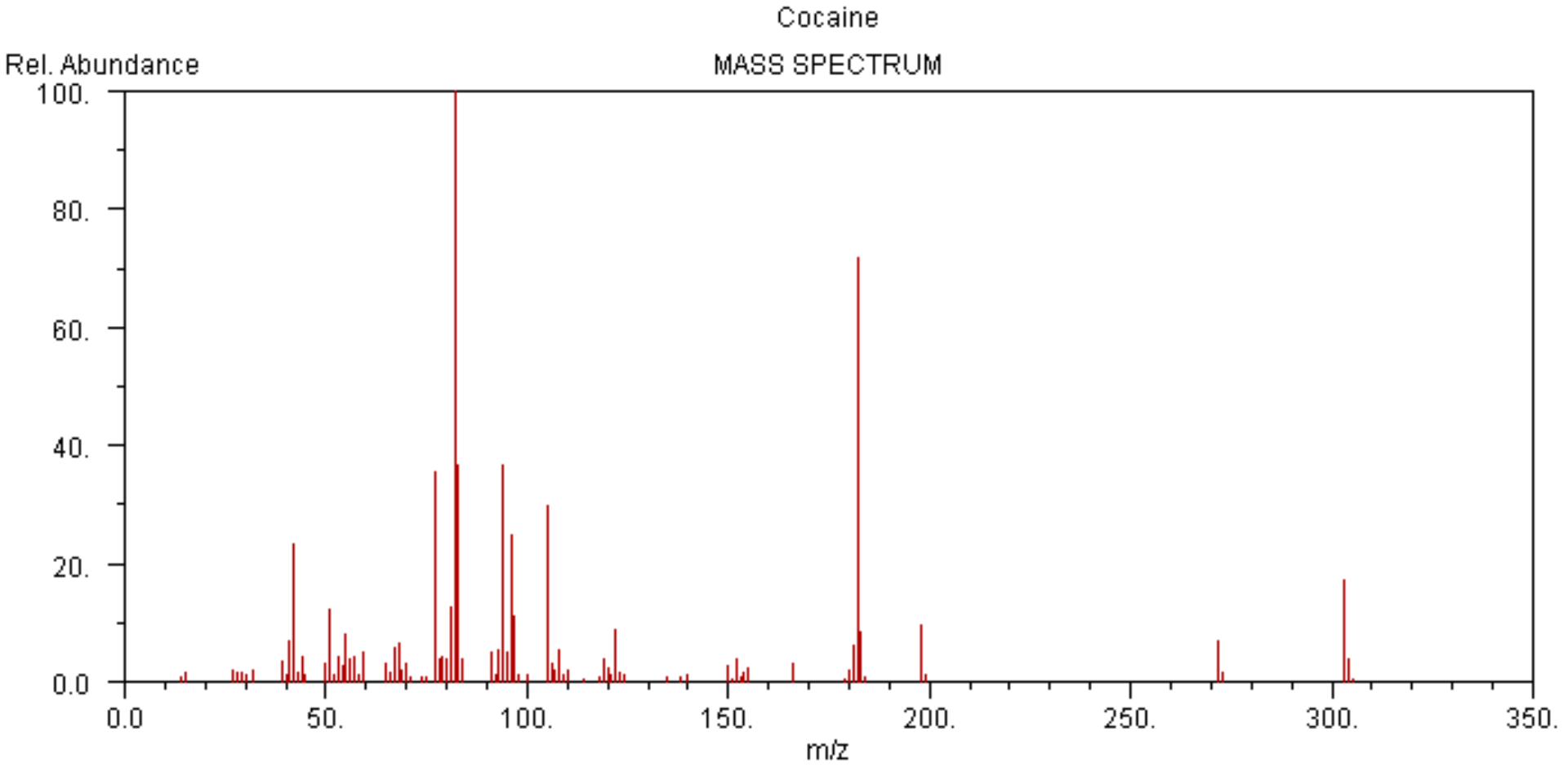
Do Now:

- Take out the ink lab and pass it forward

Mass Spectrometer

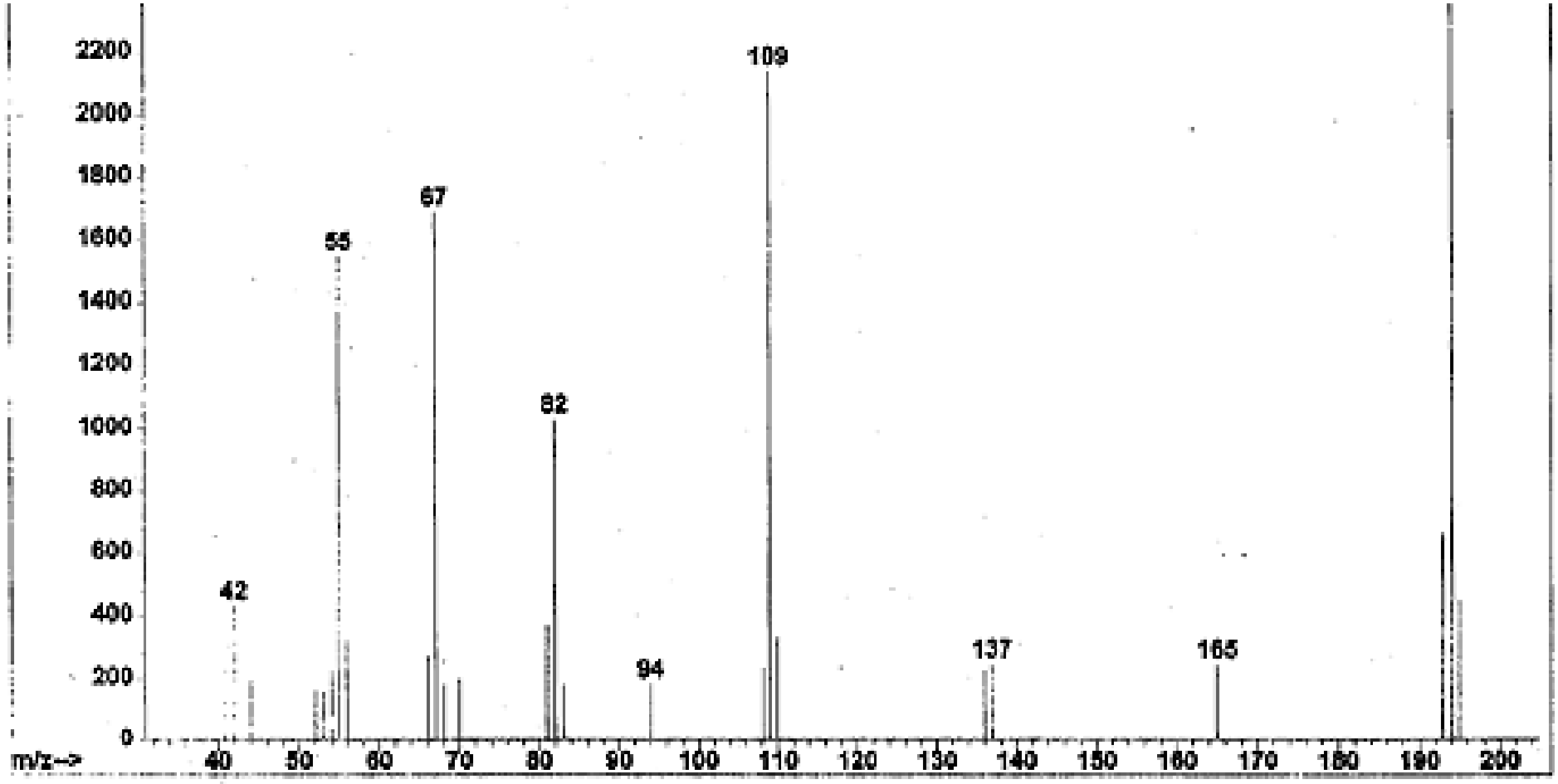
- As the gas leaves the GC, it enters the MS
- Within the MS, a beam of electrons is shot at the substance breaking it down into fragments
- These fragments pass through an electric field which separates them by their masses
- The fragment masses are then recorded on a graph
- Each substance breaks down into its own characteristic pattern


Sample
Ionization and Acceleration
Ionized sample
Electromagnetic Deflection
Relative Abundance (%)
m/z
Software
Analysis
Detection and Amplification
10⁻⁶ to 10⁻⁸ torr


Cocaine
MASS SPECTRUM
Rel. Abundance
100.
80.
60.
40.
20.
0.0
0.0
50.
100.
150.
200.
250.
300.
350.
m/z

MASS →

MS of Caffeine



Microscopy—
Compound Light Microscope

- Magnifcation between 40x to 1000x
- Specimens need to be translucent
- View hair, fibers, and cells

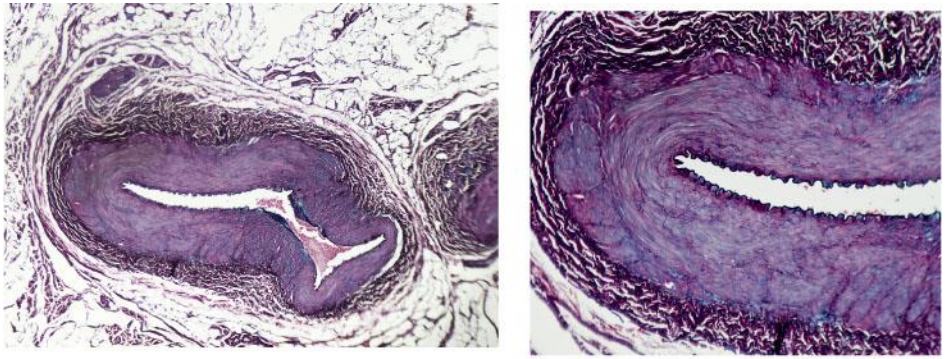


Figure 3-4. *The image on the left has been magnified 40×. The image on the right has been magnified 100×.*

Microscopy—Stereomicroscope

- Sometimes called a dissecting microscope
- Amounts to being a powerful magnifying glass
  - Can view opaque objects
- Inspect insect larvae, paint chips, and other small items

Microscopy—Comparison Microscope

- Two microscopes connected to one eyepiece
- Two samples are visible side by side
- Useful for comparing bullet striations, fibers, and hair

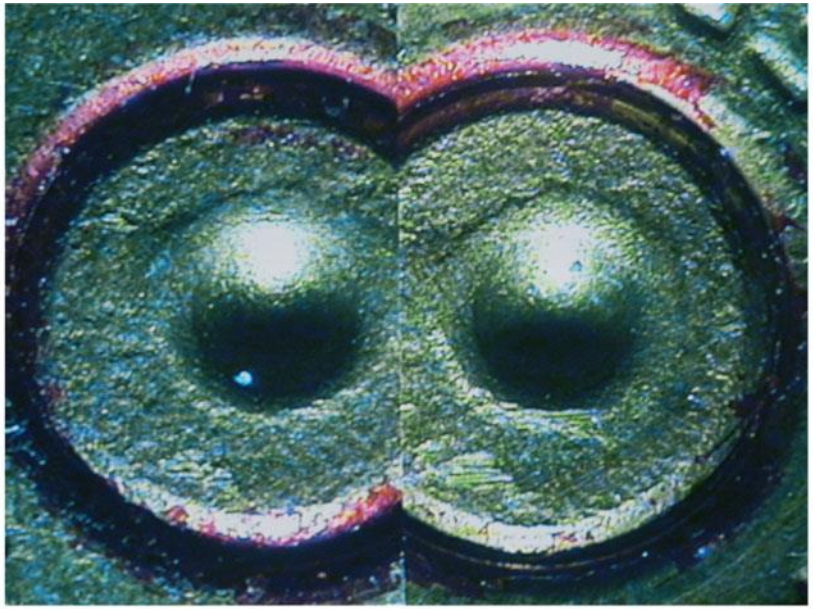


Figure 3-6. *Images of two bullet casings as seen through a comparison microscope. One casing was found at the crime scene. The other was taken from the suspect's gun.*