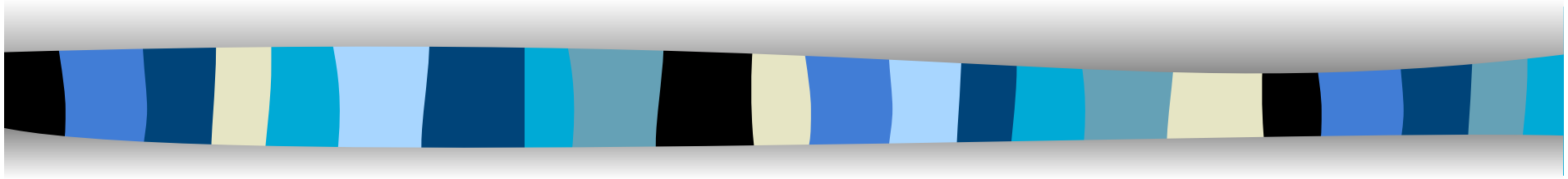
Forensics



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Safety

- Students must wear:
  - Closed shoes
  - All skin from neck to toes covered
  - Lab coat or lab apron
  - Indirect vent or unvented chemical splash proof goggles.
  - All skin from neck to wrists covered
  - Long hair (shoulder length or longer) must be tied back.
  - Visorgogs now permitted

Students can bring

- Spot plate or something to do reactions in
- Micrspatula or something to get powders out
- Forceps/ Metal Tongs
- pH paper
- Hand lens

Students Can Bring

- Test Tubes
- Test Tube rack
- Test Tube holder
- Eye droppers
- Funnel
- Filter Paper
- Battery Conductivity meter
- Flame loop/cobalt blue glass
- Ruler
- Calculator-non-image capable

Students Can Bring

- Stirring rods or something to stir with
- Slide & cover slip
- Pencil
- Paper towels
- A test tube brush
- 5 sheets of paper on which anything is acceptable.
- A writing instrument
- Nothing else is allowed

Supervisors will provide

- Unknowns
- Iodine Solution
- 2 M HCl
- Benedicts Solution
- 2 M NaOH
- Differential Density materials
- Chromatography Materials
- Wash bottle with Distilled or ROI water
- Candle and matches

Supervisors will Provide

- Bunsen Burner or other heat source of similar BTU
- Hot water bath
- Waste Container
- (Microscope?)
- (Other reagents?)

Main Focus

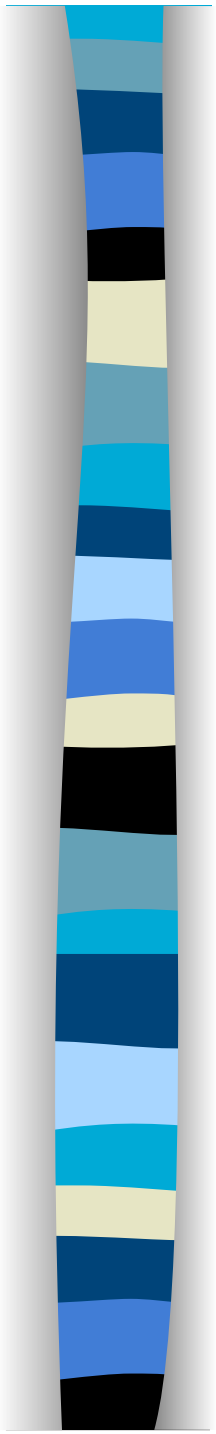
- Chemical Analysis
- Polymers
  - New this year
    - Dog and Cat out
    - Cow and Squirrel in
- Chromatography
- Crime Scene Physical Evidence
- How to prepare students
- Resources

How To Prepare Students

- Have students develop a dichotomous key for identifying chemicals
- Practice identifying chemicals in as short a time as possible.
- Practice identifying plastics
- Practice identifying hairs (only human, **squirrel**, **cow**, bat, & horse possible)
- Practice identifying fibers

How to Prepare Students

- Practice doing pen chromatograms/doing R_f
- Practice doing juice chromatograms/ doing R_f
- Practice doing TLC/doing R_f
- Practice identifying masses from mass specs
- Practice identifying fingerprints-primary and secondary structure



How to Prepare Students

- Practice matching DNA chromatograms/ electropherograms
- Practice matching shoes & tires to their tracks
- Practice blood typing
- Do a liquid spatter activity
- Practice using a waste container
- Do a glass refractive index activity

Resources

- Plans for classroom use
  - http://mypage.iu.edu The National SO Website www.soinc.org
- To prepare For Event Supervisors
  - http://mypage.iu.edu/~lwoz/socrime/index.htm
- For Lesson students for test
  - http://mypage.iu.edu/~lwoz/socrime/index.htm
- Source for mass specs http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre_index.cgi

Resources Continued

- How to do flame tests:
  - http://www.youtube.com/watch?v=oJcDOTzr5Cw
  - http://www.youtube.com/watch?v=q_DhUTVTqeg&feature=related
  - http://www.youtube.com/watch?v=vFx86jkzygY&feature=related

Questions?

- Thank You

Time to Play

- I have a crime for you to solve if you want to get your hands wet so that you will know what you are doing with your students
- I am prepared to show you how to do any of the tests with either knowns or unknowns except the flame tests
- What do you want to do? Some can work & I will help while others may have specific requests of me

Crime

- Let's solve the crime
- Step one – read over crime
- Best to divide and conquer
- One partner starts on chromatography
- One partner starts on Qualitative Analysis
- Partner finishes chromatography & starts polymers
- Should finish in about 30 minutes and have remaining time to analyze.

Chromatography

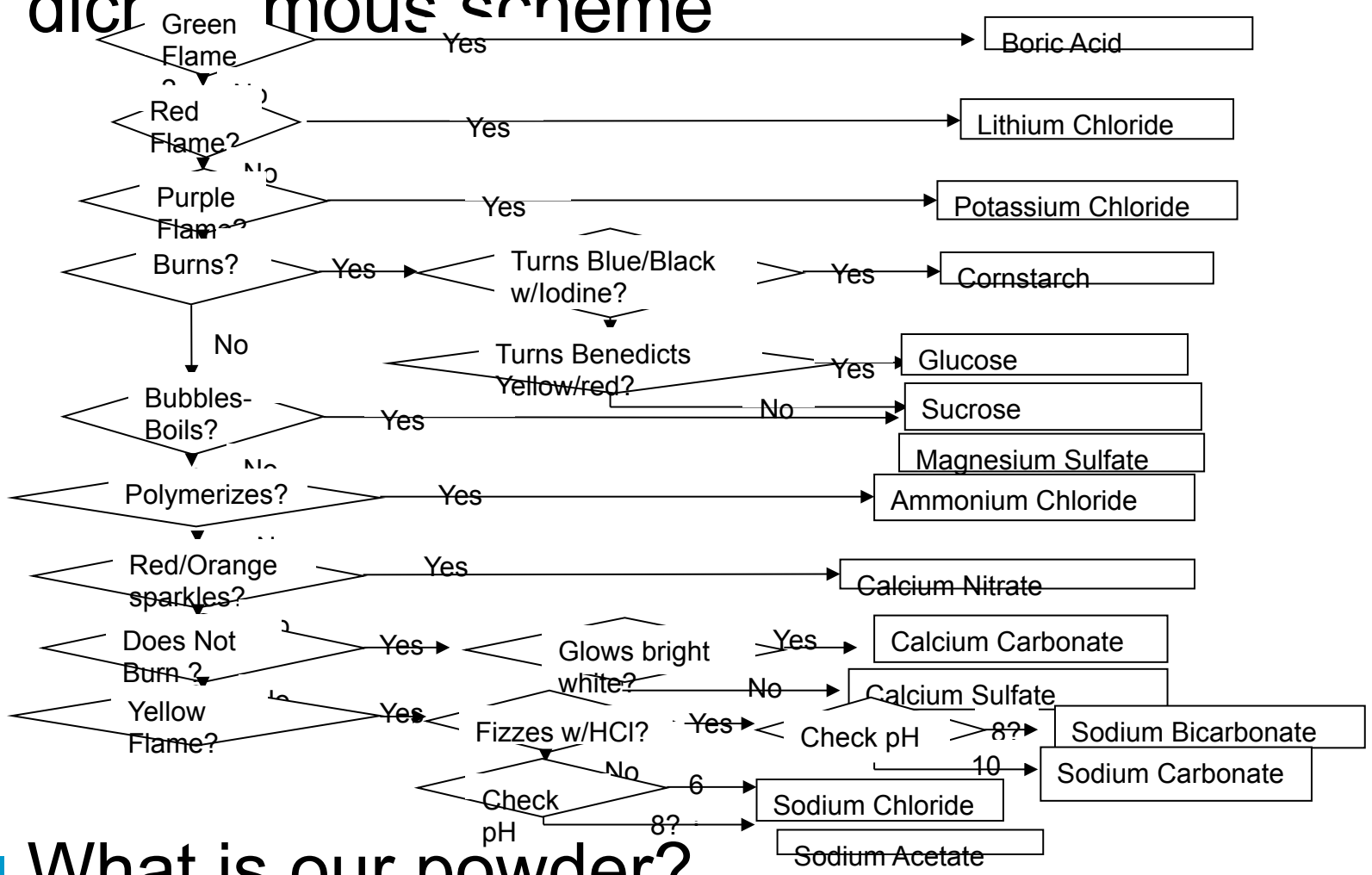
- Used to separate mixtures into components
- Uses stationary (paper or TLC sheet) and mobile (water or solvent) phases
- Depends on affinity of molecules for the 2 phases for how fast molecule moves
- Strip or Sheet
- Draw a line ~ 2 cm from bottom in pencil
- Spot on line. Use toothpick for liquids.
- Use pencil to label at top above spot.
- Put bottom only of paper in water
- Put TLC in chamber w/air saturated with solvent

Chromatography Continued

- Wait until water moves up ~ 3/4ths of paper
- Draw line with pencil where water or solvent has moved to
- Make dot @ middle of each distinct separated molecule
- Measure from bottom line to each molecule mark
- Measure from bottom to solvent line
- Divide distance molecule moved by distance solvent moved to find R_f
- Examine TLC under UV light

Qualitative Analysis

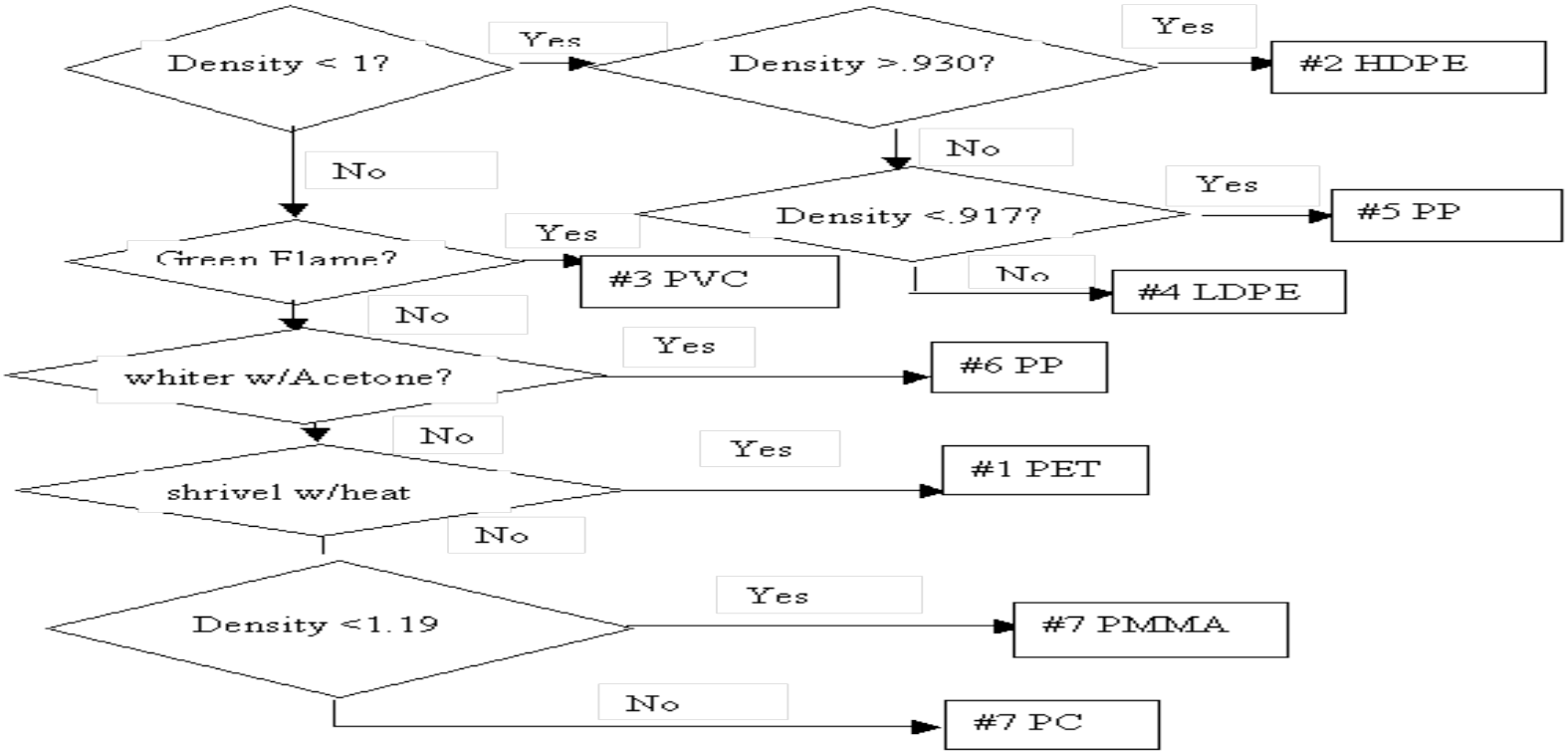
- Start with a well thought out, practiced dichotomous scheme



- What is our powder?

Plastics

- A good dichotomous scheme needed here too.

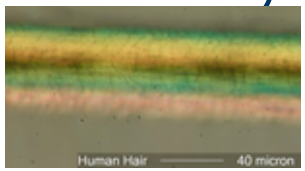


- So what is our plastic?

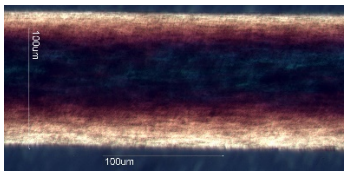
Fiber Analysis

- Need to know the difference between Wool, Silk, Cotton, Linen, and Nylon, Spandex, and Polyester fibers
- Easiest to identify with burn test
  - Animal shrivel in heat
    - Wool shorter fibers than silk
  - Vegetable burn
    - Cotton shorter fibers than Linen
  - Synthetic melt & burn
    - Nylon melts, then burns & smells like burning plastic
    - Polyester melts & burns & smells sweetish
    - Spandex stretches
- So what is our fiber?

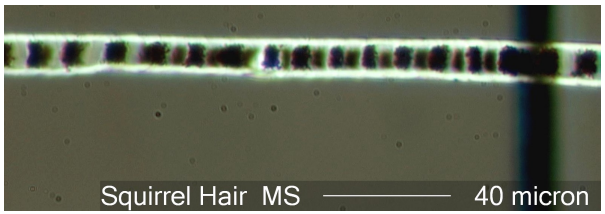
Hair Analysis



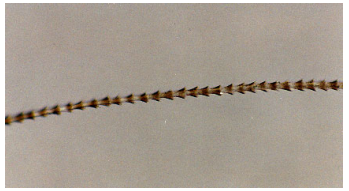
- Only allowed to use Human, Squirrel, Cow, Horse, and Bat
- Best identified by looking at microscope.
- Horse very thick and round.



- Human hair thick, no distinct cuticle
  - Can be flat or round, generally no medulla
- Cow-lots of ovoid bodies.
- Squirrel-often banded.



- Bat hair looks like chocolate strawberries on a stick
- What type of hair was found at scene?



Soil Analysis

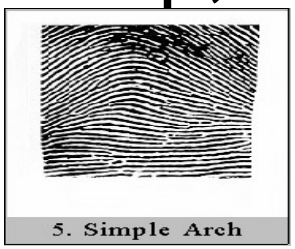
- Sand, Silt, Clay, and Loam
- Students allowed to touch soil to analyze
  - Sand-large grains, does not ball in hand
  - Clay-very small grains, forms ribbons in fingers
  - Silt-medium grains, forms ball, but falls apart
  - Loam-lots of organic material, black
- What type of soil was found at scene?

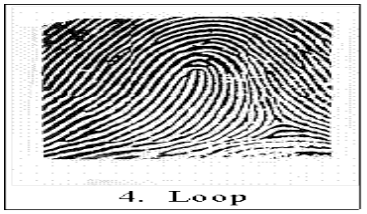
Fingerprints

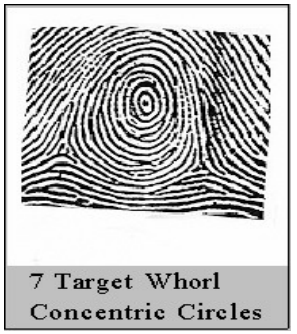
Plain Whorl

Central Pocket Loop

- Need to know Whorl, Loop, and Arch
  - Arch- hill-no deltas
  - Tented Arch-higher
  - Loop – radial & ulnar-around the lake -1 delta
  - Double Loop
  - Plain Whorl-target-2 deltas
  - Central Pocket Whorl
  - Accidental


5. Simple Arch


4. Loop

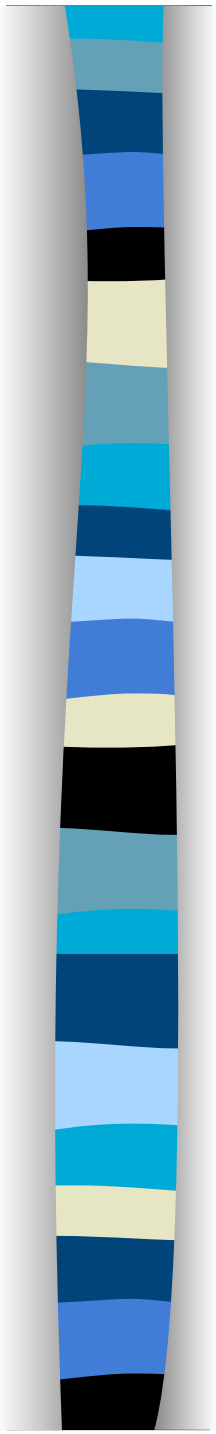

7 Target Whorl
Concentric Circles

ACCIDENTAL

- What type of fingerprint?

Fingerprinting

- Emphasis is on understanding the chemistry of how the fingerprinting works
- Body gives off oils and salts that the chemicals adhere to.
- Some methods of fingerprinting are better for some applications than others.
  - If fingerprinting small, hard, solid object any method will work.
  - If large object, can not put in a developing chamber
  - Some methods of fingerprinting destroy object



DNA

- Need to understand chemistry behind method of reproducing enough DNA for analysis (PCR).
  - Nobel prize won in 1993 by Kary Mullis
- Easy to make electropherograms
  - Make rectangle with drawing program
  - Use spray tool to spray in different width, density lines at various distances.
- Students should understand basic structure of DNA

Tracks

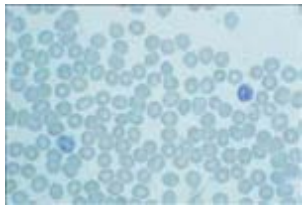
- More pretty picture matching, but inverses.
- Bike tracks easy to get at a bike rodeo
  - Have cookie sheet filled with sand,
  - Take a picture of tire, run through sand, and take a picture of track.
- For footprints photo bottom of shoe
  - Stomp in cookie sheet of flour
  - Stomp onb lack construction paper
  - Photograph paper

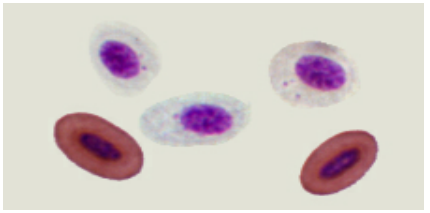
Index of Refraction

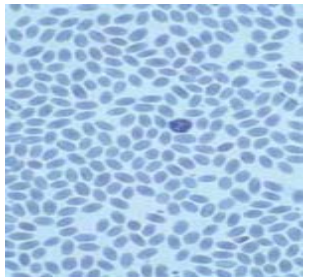
- Light travels at different speeds through different materials.
- Light travels slower through denser media
- Light bends when it goes from one medium to another.
- The index of refraction is the ratio of the sine of the angle the light makes coming in compared to the sine of the angle in the new media
- Objects disappear when put in a liquid with the same index of refraction

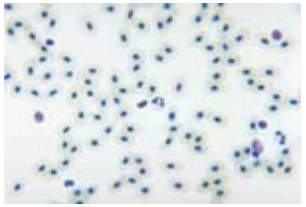
Blood Serology

- Student should recognize
  - human blood cells (round, no nuclei 6-8/ microns),
  - avian blood cells (elliptical, single nucleus, 6-12 microns)
  - mammalian blood cells (no nuclei, 5.5-7.5 microns, can be elliptical or round)
  - reptile/amphibian blood cells (multiple nuclei).
- What animal's blood was found at the scene?









Blood Typing

- Can not use real blood
- Blood typing works on which sugars on cell walls, A, B & O
- Anti A clumps A cells together, etc.
- Fake blood can be made of several recipes
- The one I use is a precipitation reaction
- It requires the students stir to precipitate-seems realistic
- What type of blood was found at the scene?

Spatters

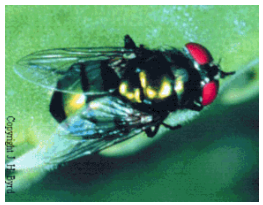
- Should know if strait drop or angle
- Should know if spatter is high or low
- Angle can be determined by taking the inverse sin of the width/length
- Point of origin found by drawing lines along lengths of drops.
- I start with red finger paint, then mix in blue and green until correct shade
- Then I dilute with water slowly until proper consistency.
- Students should put in eye dropper or use paint brush and drop straight down @ 1 cm, 10 cm. 20 cm, etc.

Entomology

- Depends on predictable life cycle of flies.
- Depends on temperature body experiences after death.
- It is assumed that flies will lay eggs immediately after death
- Eggs hatch in ~1.5 days as maggots
- (shows 3 instars)

- Maggots pupate in ~ 5 days

- Flies immerge in~ 15 days



Seeds and Pollen

- Mostly useful if found away from an area naturally found
- Can be useful if embedded in hair or fur
- Small seeds are generally windblown, but can get caught in clothing and hair
- Seed placement can also be very useful in placing time of a crime.
- Pollen very useful because pollen is very species and subspecies specific.
- Pollen needs to be compared under a microscope

Bullets

- This is mostly pretty picture matching
- The idea is to match the scratch pattern on two bullets to determine if they have been fired from the same gun.
- The scratches are a result of the machining done when the gun was made.
- In real crimes this is done with a special microscope that allows the technician to see both bullets at the same time.

The Crime

- Now we use all of the results to solve the crime.
- Logic is used.
- It is a preponderance of evidence that is used to solve the crime
- The correct answer may be one of the suspects, more than one of the suspects, all of the suspects, or none of the suspects.
- The event is won or lost on the basis of the analysis.