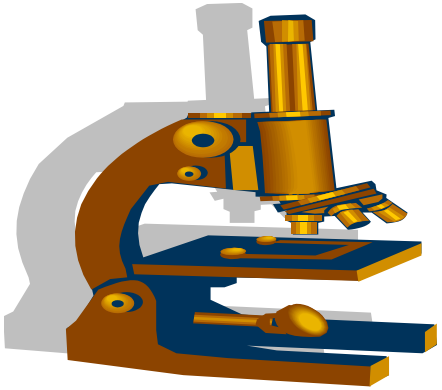
Crime Busters



Safety

- Students must wear:
  - Closed shoes and socks
  - Pants or skirts that come to the ankles
  - Lab coat with long-sleeves that reaches the wrists and knees or long-sleeved shirt that reaches the wrists with a chemical apron that reaches the knees.
  - **Note**: Skin should be covered from neck down to the wrist and toes.
  - Indirect vent or unvented chemical splash proof goggles.
  - Chemical gloves are optional, but if a host requires a specific type they must notify teams.
  - Long hair, shoulder length or longer must be tied back.

Students can bring

- Test tubes (brushes & racks), spot plates, well plates, reaction plates, beakers or similar small containers for mixing
- Something for scooping & stirring
- pH paper
- Magnet (s)
- Hand lens(es)
- Microscope slides and cover slips

Students Can Bring

- Forceps or tweezers
- Writing Instrument
- Paper towels
- Pipettes or Droppers
- 10ml and 25ml graduated cylinders
- 9V or less conductivity meter
- Each team may bring 5 pages two-sided of information from any source (sheet protectors are permitted).
- Calculators are Prohibited.

NOTE: Event Supervisor will not provide these items.

Supervisors will provide

- Unknowns
- Iodine Reagent (KI Solution)
- 1M HCl
- Chromatography Materials plus containers
- Wash bottle with distilled water (250 mL)
- Waste Container

Supervisors may Provide

- Microscope
- Probes
- Calculators
- Other reagents
- Differential Density materials for determining density of polymers
- Candle and matches if fibers are given

Main Focus

- Qualitative Analysis (50%) Powders, Liquids, Metals
- Polymers /Natural & Man-made substances (10%)
- Paper Chromatography (5%)
- Crime Scene Physical Evidence (10%)
- Analysis (25%)

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 powders mixed in groups of 2 & 3
- Practice identifying plastics
- Practice identifying hairs (only human, dog, cat possible)
- Practice identifying fibers (only animal, vegetable, & synthetic possible)

How to Prepare Students

- Practice doing pen chromatograms
- Practice doing juice chromatograms
- Practice identifying fingerprints
- Practice matching DNA chromatograms/electropherograms
- Practice matching shoes & tires to their tracks and make conclusions about direction and speed of travel.
- Soil composition may be given
- Analyze spatter patterns for speed & direction
- Practice Analyzing crime scene evidence

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, hair, fibers, …
- Should finish in about 30 minutes and have remaining time to analyze the crime.

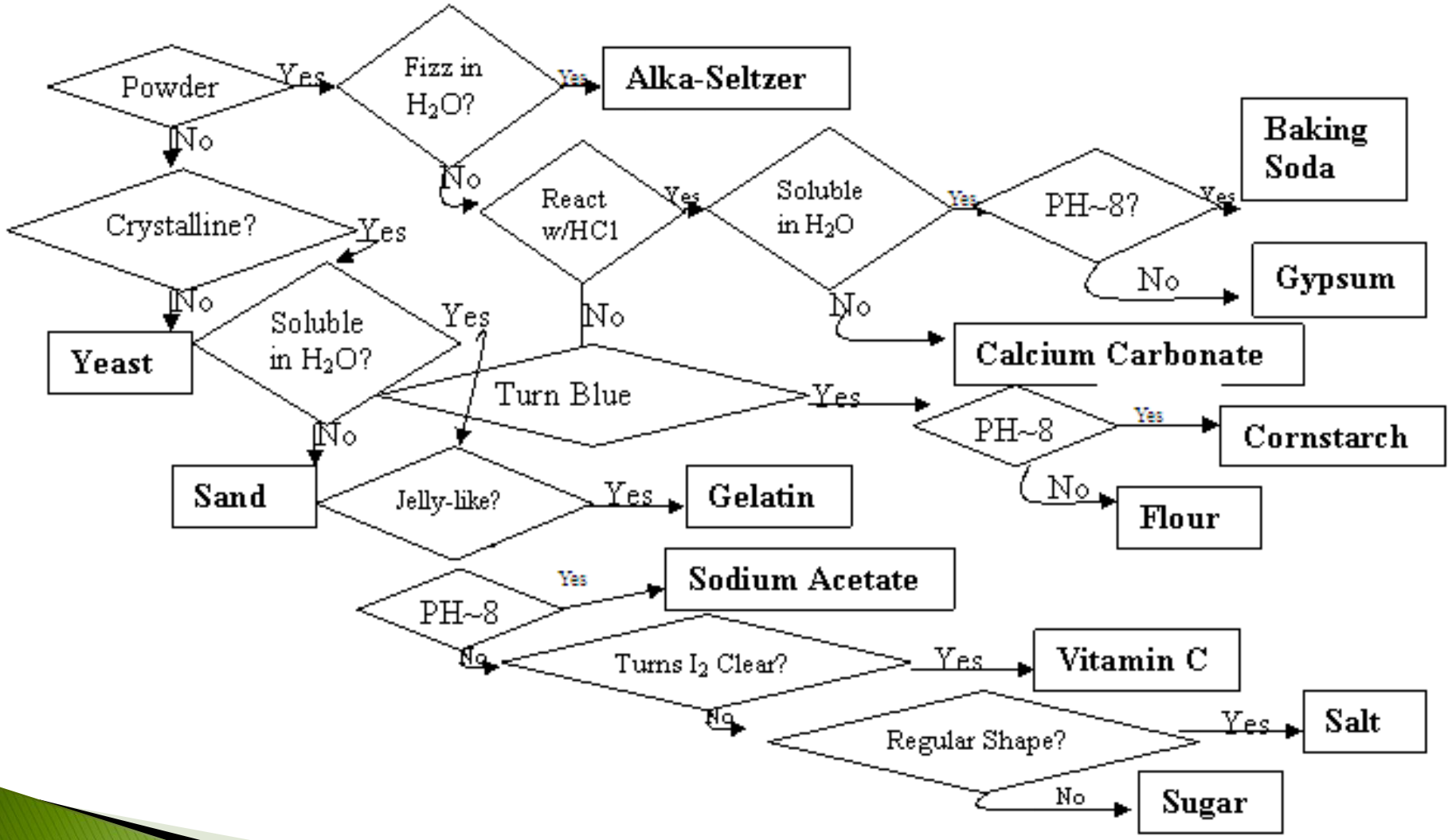
Solids, Liquids, Metal Analysis

- Need well thought out and practiced dichotomous scheme
- Make a key and practice it
- Find a published key
- Make sure both team members can analysis all powders

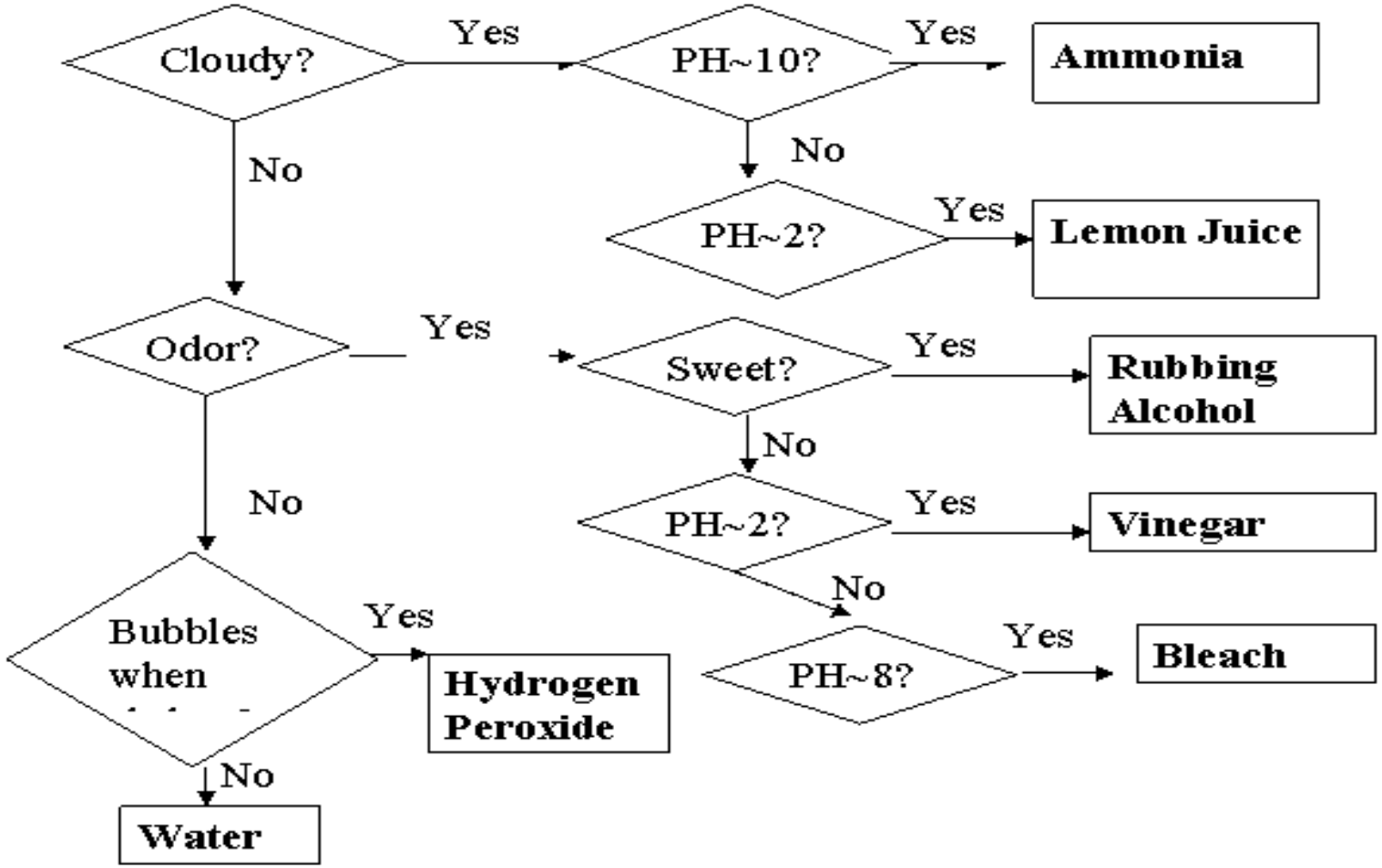
Mixed Powder Analysis

- Can have 2 or 3 of the “*” powders mixed.
- Students have to be told which powders are mixed and how many powders are mixed.
- Practice mixing the powders to determine which are included in the mixture.

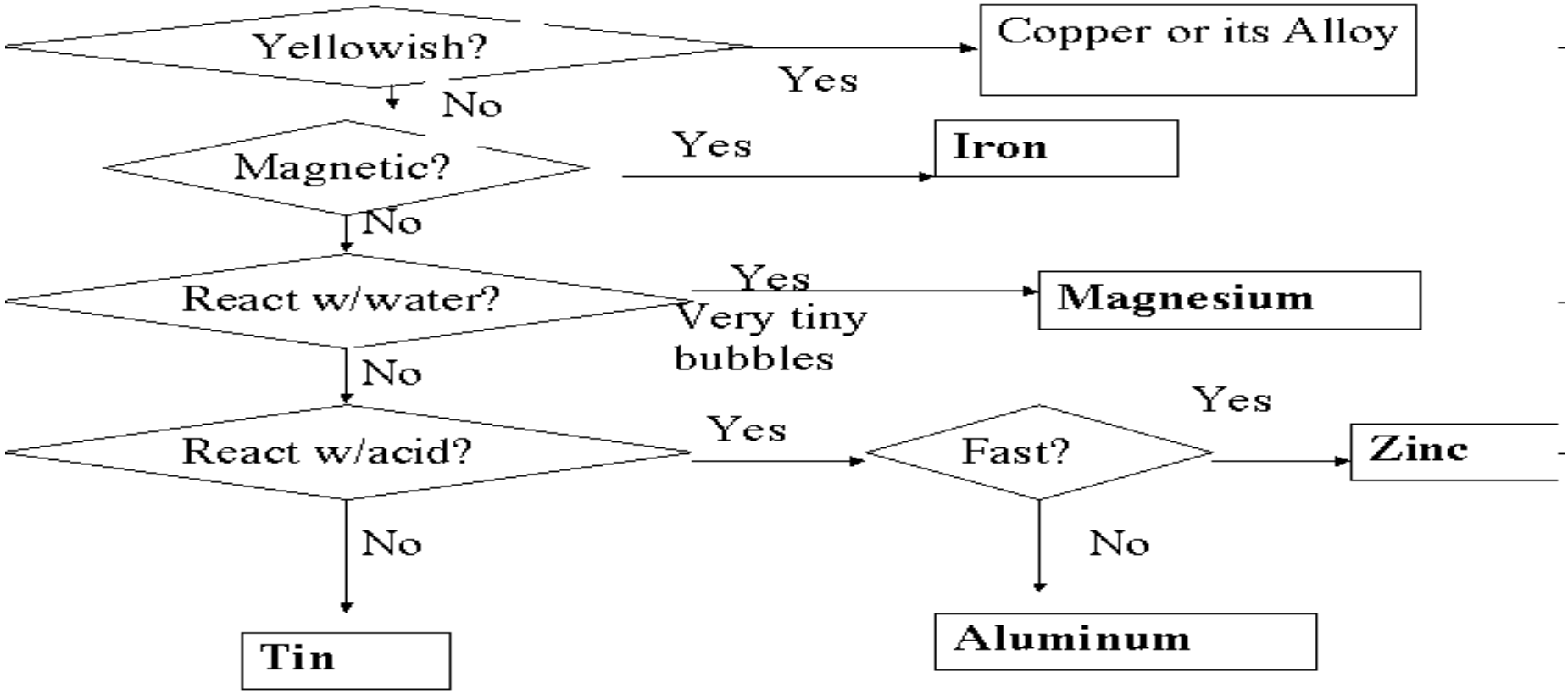
Powder Analysis

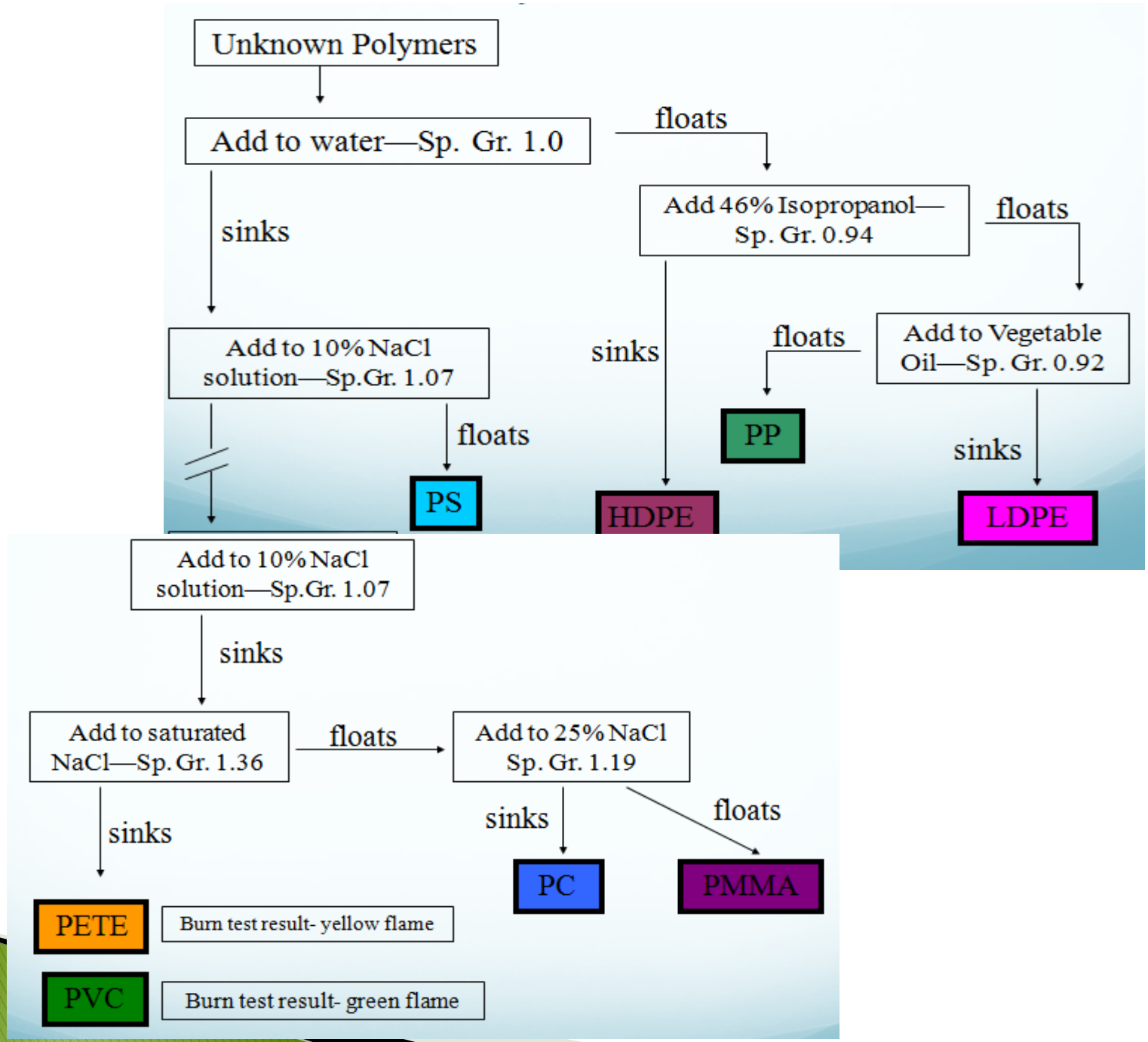


Liquid Analysis



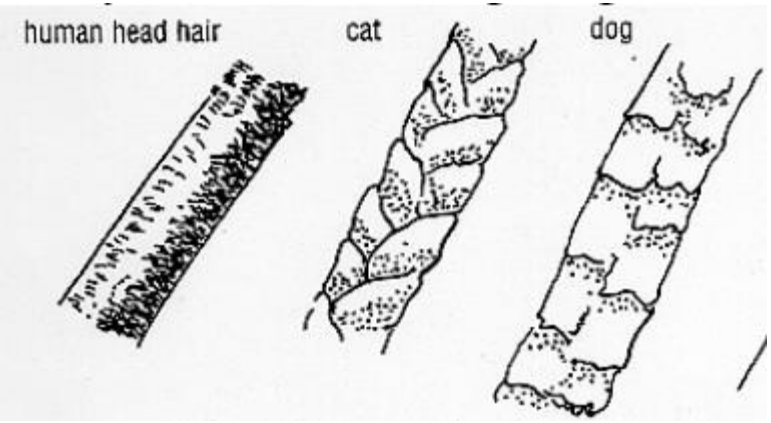
Metal Analysis




Unknown Polymers
Add to water—Sp. Gr. 1.0
floats
sinks
Add 46% Isopropanol—
Sp. Gr. 0.94
floats
Add to 10% NaCl
solution—Sp.Gr. 1.07
sinks
floats
floats
Add to Vegetable
Oil—Sp. Gr. 0.92
PS
PP
HDPE
sinks
LDPE
Add to 10% NaCl
solution—Sp.Gr. 1.07
sinks
Add to saturated
NaCl—Sp. Gr. 1.36
floats
Add to 25% NaCl
Sp. Gr. 1.19
sinks
floats
sinks
PC
PMMA
PETE
Burn test result- yellow flame
PVC
Burn test result- green flame

Hair Analysis

- Only allowed to use Human, Dog, and Cat
- Best identified by looking at microscope.
- Human hair thickest, no distinct cuticle
- Cat hair thinnest, distinct palm tree or braided cuticle.
- Dog hair in between thickness and in between cuticle.



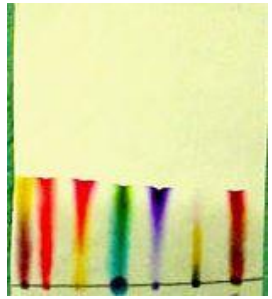
Fiber Analysis

- Only need to know the difference between animal, vegetable, and synthetic fibers

- Easiest to identify with burn test
  - Animal fiber shrivels in heat, wool smells like burning hair (wool, silk)
  - Vegetable fiber burns (cotton, linen)
  - Synthetic fibers melt (nylon, polyester)

Chromatography

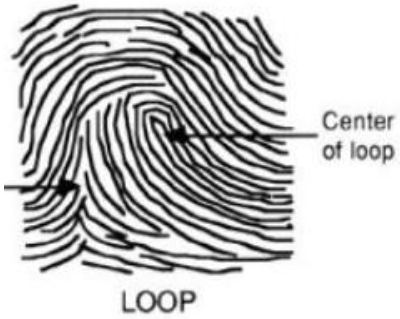
- Used to separate mixtures into components
- Uses stationary (paper) and mobile (water) phases
- Strip of Chromatography paper or use Coffee Filter
- Draw a line ~ 2 cm from bottom in pencil
- Spot on line. Use toothpick for liquids.
- Use pencil to label at top above spot.
- Put bottom only of paper in water
- Wait until water moves up ~ 3/4ths of paper.



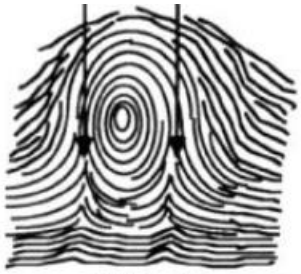
Fingerprints

- Only need to know Whorl, Loop, and Arch
  - Arch- hill-no deltas
  - Loop – around the lake -1 delta
  - Whorl-target-2 deltas

ARCH



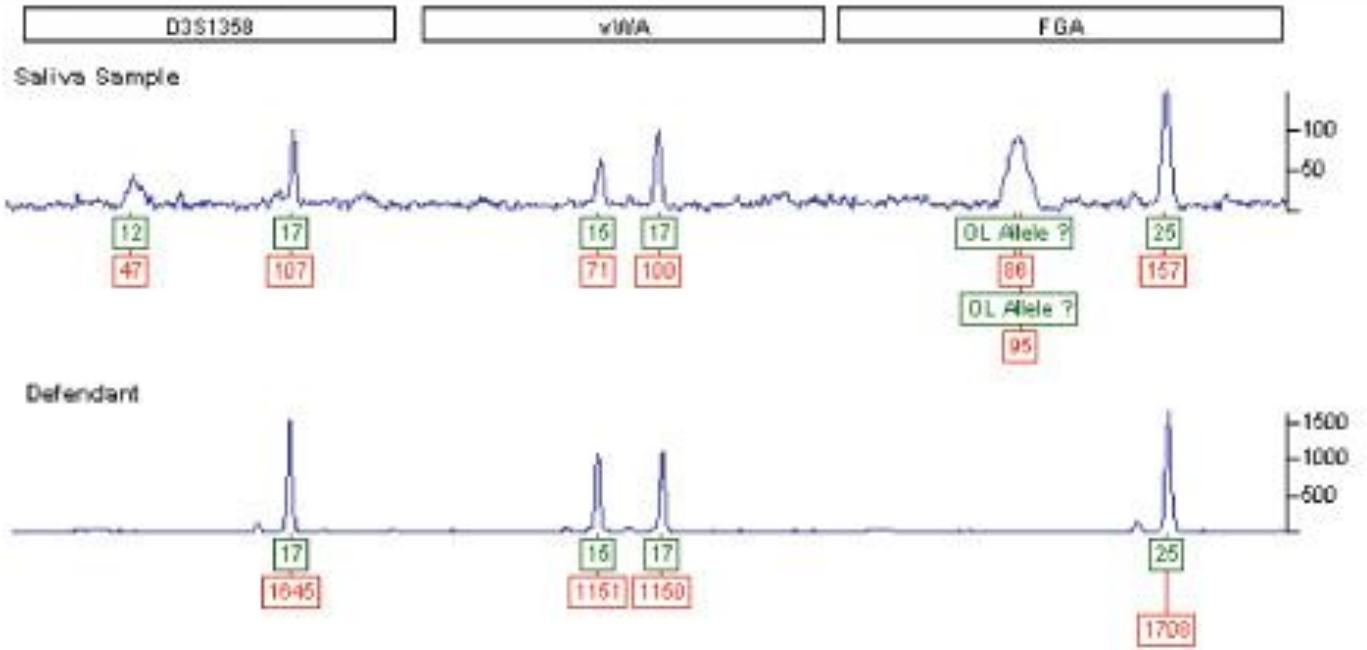
LOOP


WHORL

DNA

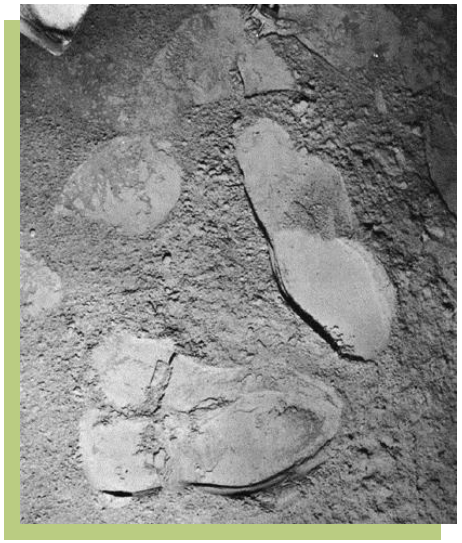
FIGURE 3: ELECTROPHEROGRAMS OF DEFENDANT AND A "SALIVA SAMPLE" FROM AN EVIDENCE SWAB

Electropherograms showing a DNA profile for the D3, vWA and FGA loci for two samples. Top sample is from a swab of a woman's breast that the defendant is said to have licked. Bottom sample is the defendant's profile. Boxes below the peaks label the name of the alleles seen while boxes below indicate their heights in RFUs



Tracks

- Bike tracks
  - Use a cookie sheet filled with sand,
  - Take a picture of tire, run through sand, and take a picture of track.
- For footprints
  - Photograph bottom of shoe
  - Stomp in cookie sheet of flour
  - Stomp on black construction paper
  - Photograph paper



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

Spatters

- NOT MEASURING ANGLES
- Should know if strait drop or angle
- Should know if spatter is high or low impact
- Start with red finger paint, then mix in blue and green until correct shade
- Then dilute with water slowly until proper consistency.
- Students should put in eye dropper and drop straight down at 1 cm, 10 cm. 20 cm, etc.

Solve Crime

- Now we will put all of the evidence together to solve the crime.
- Please remember that the perpetrator may be one of the suspects, more than one suspect, all of the suspects, or none of the suspects.
- Include positives as well as who can be ruled out
- Use all your information
- BE SURE TO LEAVE ENOUGH TIME FOR THE ANALYSIS.

RESOURCES

- The National SO Website
- https://www.soinc.org/crime-busters-b

- Crime Buster Resources
- https://scioly.org/wiki/index.php/Crime_Busters