Crime Busters

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Disclaimer

- This presentation was prepared using draft rules. There may be some changes in the final copy of the Rules.
- The Rules released in September 2024 will be the official Rules and should be used for all competitions.

Safety-if in person

- Students must wear:
  - Closed shoes
  - All skin from neck to toes covered (loose fitting pants)
  - 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.

What Students May Bring

- One non-graphing calculator per student.
- One unique 8.5 X 11” sheet of paper, two sided containing information in any form from any source per team member
- A writing instrument
- Chemistry “B” lab kit

Students can bring-Chemistry B kit

- Spot plate, test tubes, rack, beakers-something to do reactions in
- Spoon/something to get powders out
- Forceps
- Hydron paper
- Magnet
- Hand lens
- Pipettes or eye droppers
- Thermometers

Chemistry B kit

- Something to stir the reagents
- Slide & cover slip
- Paper towels
- A test tube brush
- Battery conductivity meter
- Graduated Cylinders
- Erlenmeyer Flasks
- Petri Dishes
- Ruler
- Nothing Else is allowed

Supervisors will provide

- Unknowns
- Iodine Solution
- 1 M HCl
- Differential Density materials
- Chromatography Materials
- Wash bottle w/ Distilled or ROI water
- Candle and matches
- Waste Container

Supervisors may Provide

- Microscope
- Other reagents (?)

Main Focus

- Chemical Analysis
- Polymers
- 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 powders mixed in groups of 2 & 3
- Practice identifying plastics(PETE, PVC, HDPE, LDPE, PS, PP)
- Practice identifying hairs (only human, dog, cat possible)
- Practice identifying fibers (only animal, vegetable, & synthetic possible)

How to Prepare Students

- Practice doing pen chromatograms & R_f
- Practice doing juice chromatograms & R_f
- Practice identifying fingerprints
- Practice matching DNA chromatograms/electropherograms
- Practice matching shoes & tires to their tracks/soil analysis
- Spatter activity
- Practice using a waste container
- Cross train more than 1 team of 2
- Have the teams make & grade test for each other

Resources

- The National SO Website www.soinc.org

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
- 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

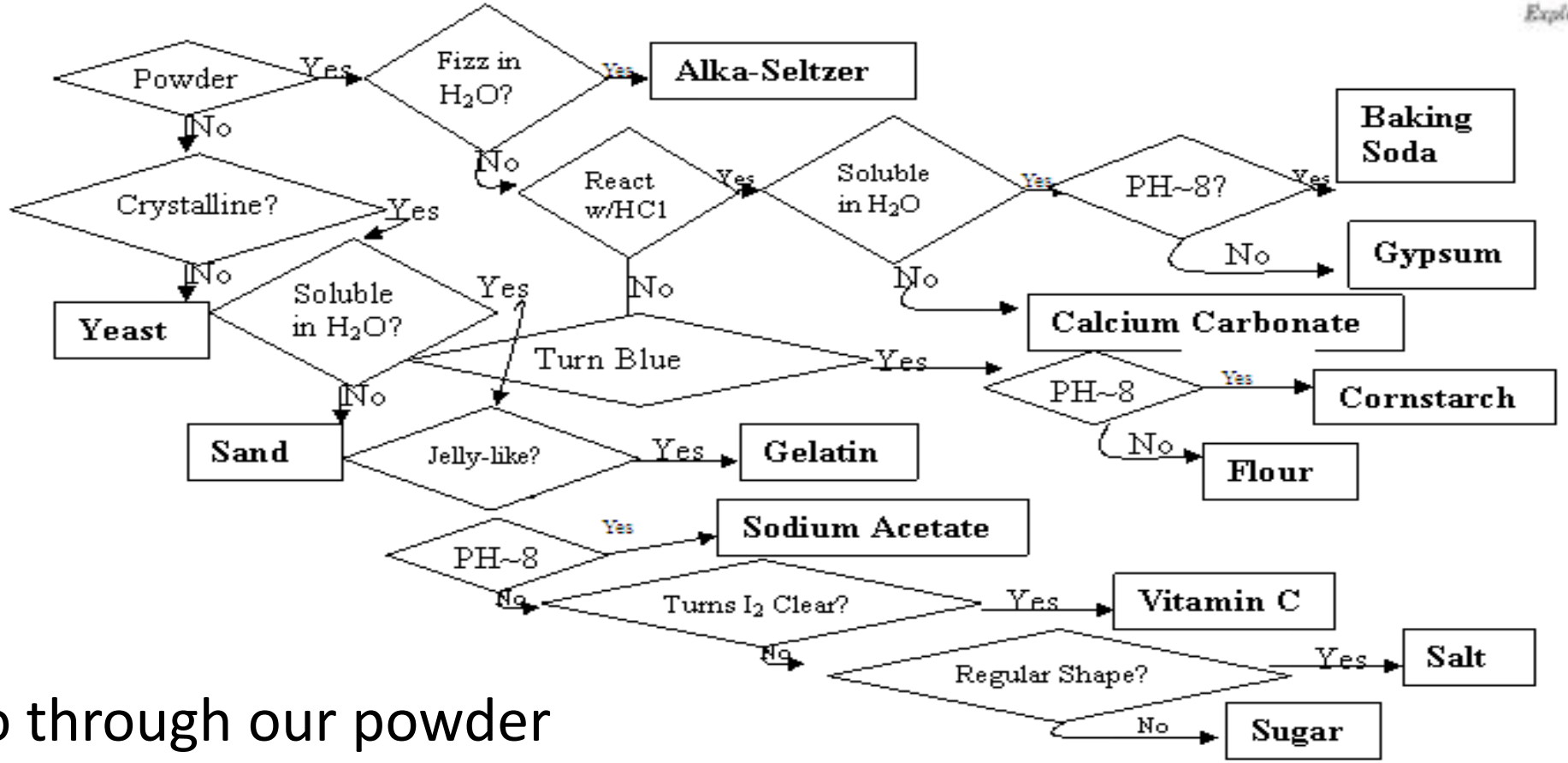
- Used to separate mixtures into components
- Uses stationary (paper) and mobile (water) phases
- Depends on affinity of molecules for the 2 phases for how fast molecule moves
- Strip or Sheet
- Draw a line ~ 2 cm from bottom in pencil
- Spot on line. Use toothpick for liquids.
- Use pencil to label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

Retention Factors (R_f)

- Take the paper out of the water
- 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
- <u>Divide distance molecule moved by distance solvent moved to find R_f</u>

Powder Analysis

- Need well thought out and practiced dichotomous scheme.

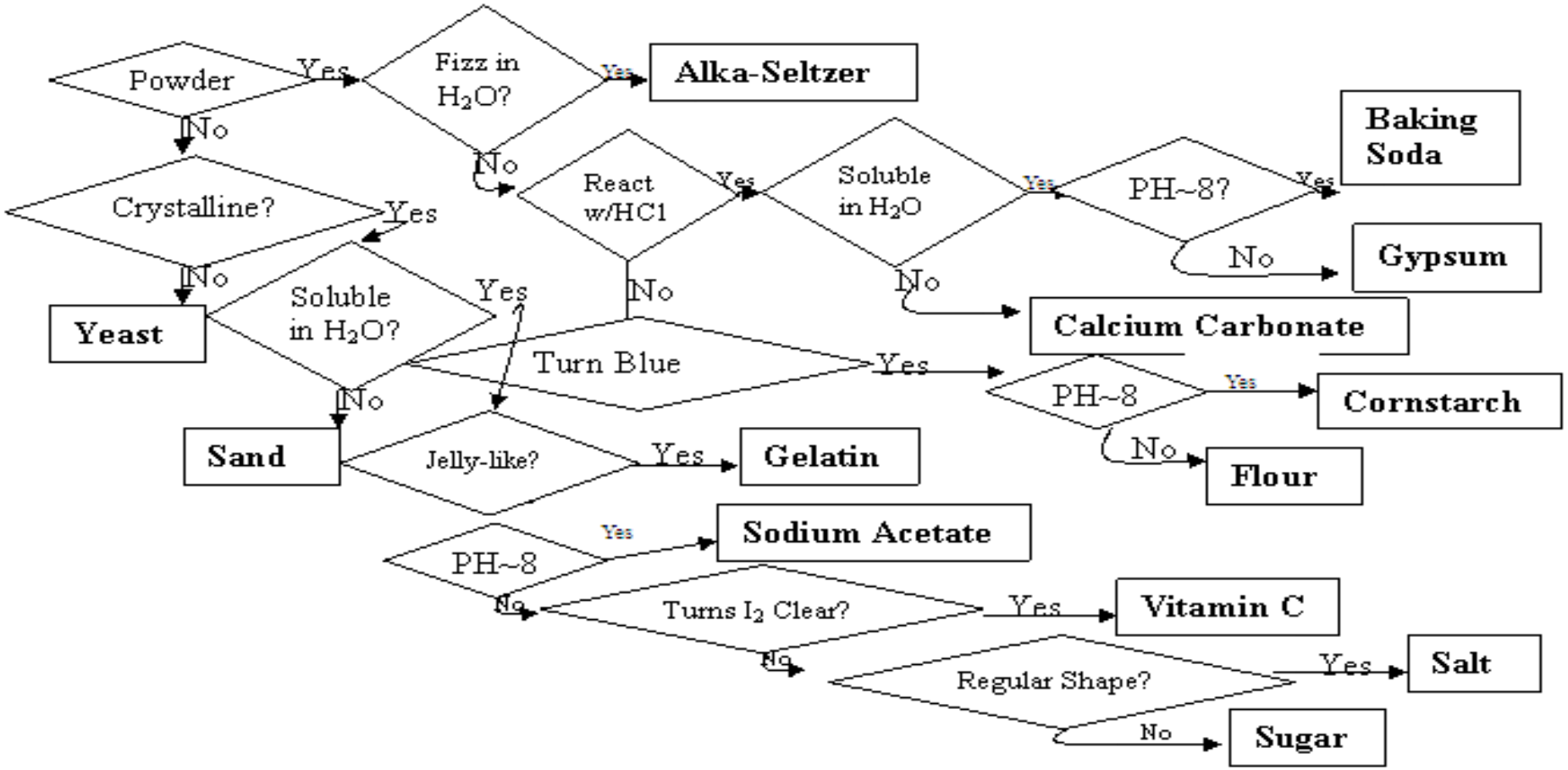


- Let's go through our powder
- Liquid Analysis

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.
- Lets try our mixed powder and see what is in it using the dichotomous key

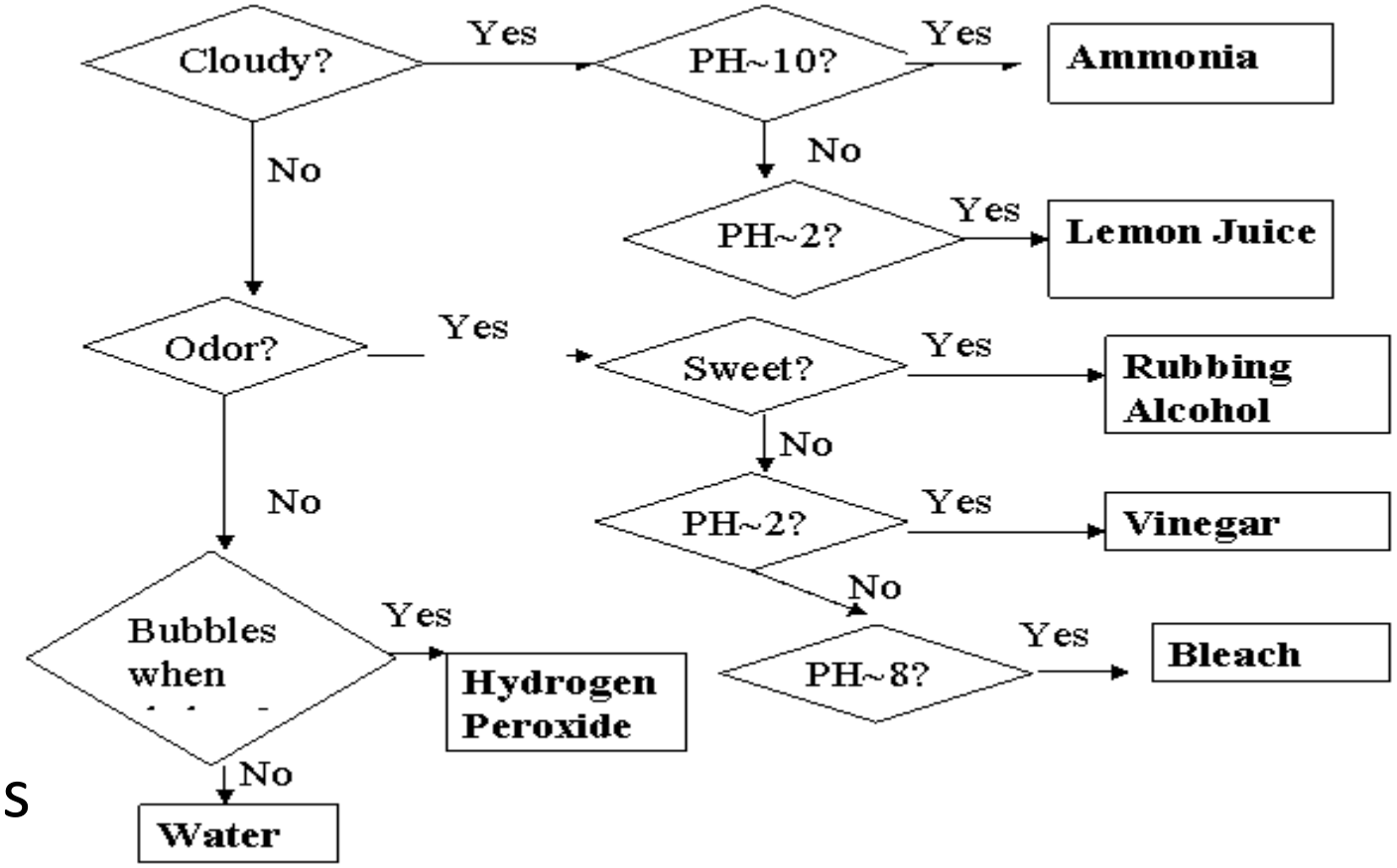
Mixed Powder Analysis



- How To Prepare Students

Liquid Analysis

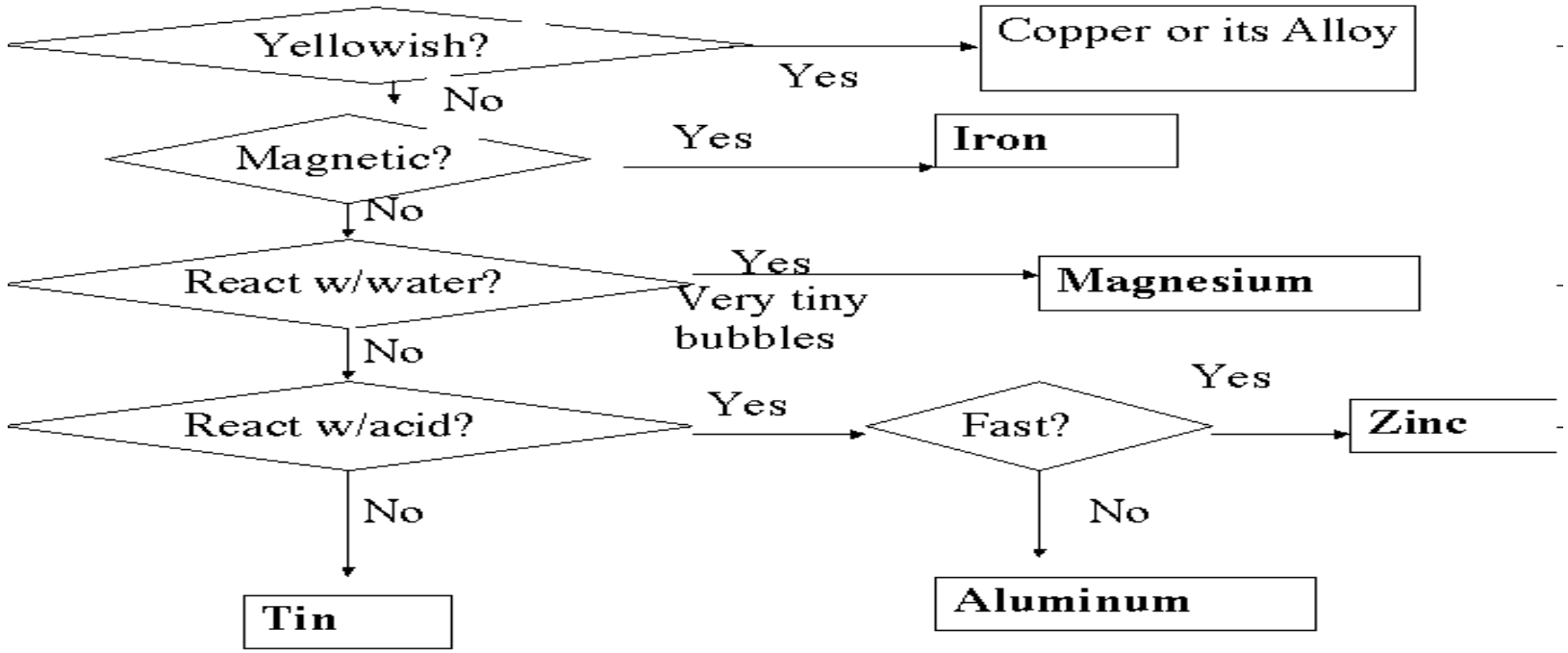
- Also need practiced dichotomous scheme



- Lets see what our liquid is

Metal Analysis

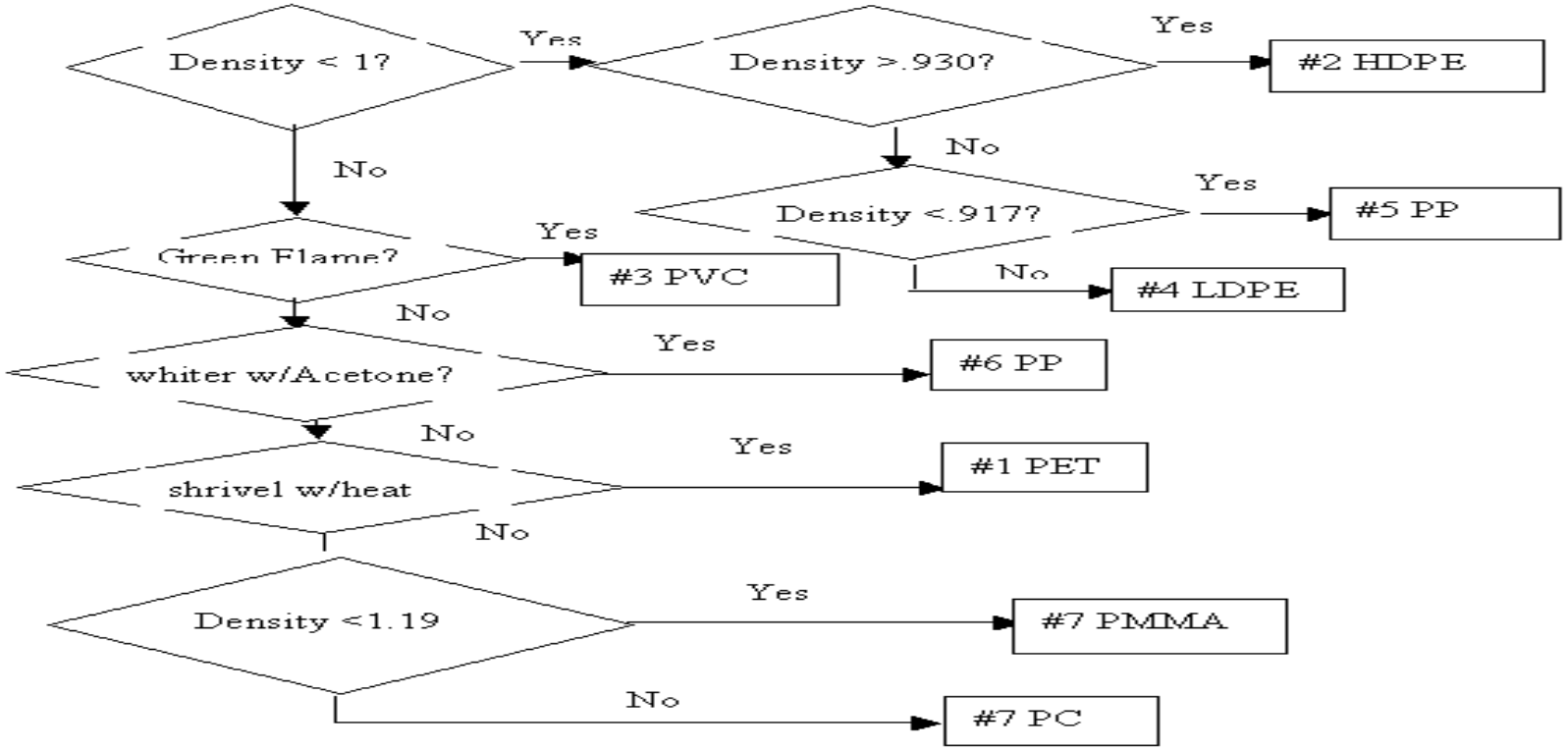
- Again, need practiced dichotomous scheme



- Let us see what our metal is [How To Prepare Students]

Plastics

- A good dichotomous scheme needed here too.

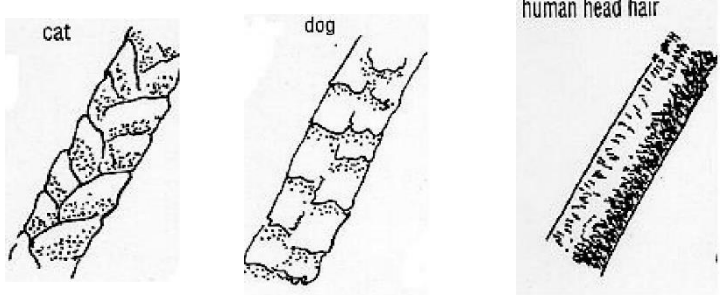


- So what is our plastic? How To Prepare Students

Fiber Analysis

- Only need to know the difference between animal, vegetable, and synthetic fibers
- Easiest to identify with burn test
  - Animal shrivel in heat
  - Vegetable burn
  - Synthetic melt.
- So what is our fiber?How to Prepare Students

Hair Analysis

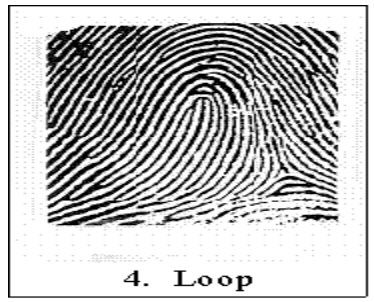


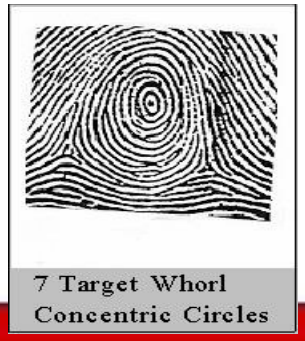
- Only allowed to use Human, Dog, and Cat
- Best identified by looking at microscope.
- Human hair thickest, no distinct cuticle
- Cat hair thinnest, distinct palm tree or braided cuticle.
- Dog hair in between thickness and in between cuticle.
- What type of hair was found at scene?
- How To Prepare Students

Fingerprints

- Only need to know Whorl, Loop, and Arch
  - Arch- hill-no deltas
  - Loop – around the lake -1 delta
  - Whorl-target-2 deltas
- What type of fingerprint?
- How to Prepare Students

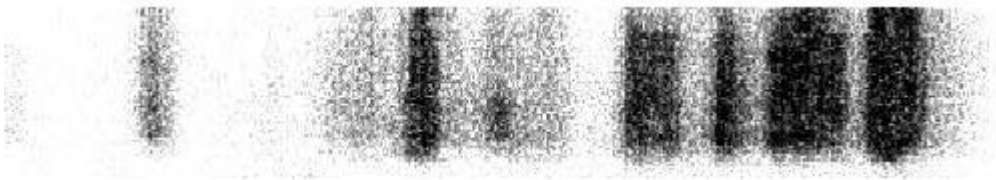
5. Simple Arch


4. Loop


7 Target Whorl
Concentric Circles

DNA

- Pretty picture matching
- Easy to make electropherograms
  - Make rectangle with drawing program
  - Use spray tool to spray in different width, density lines at various distances.



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

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?

Spatters

- NOT MEASURING ANGLES
- Should know if strait drop or angle
- Should know if spatter is high or low
- 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.

Solve Crime

- Now we will put all of the evidence together to solve the crime.
- It is the preponderance of evidence that is being looked for
- Please remember that the perpetrator may be one of the suspects, more than one suspect, all of the suspects, or none of the suspects.
- The event is won or lost on the basis of the analysis