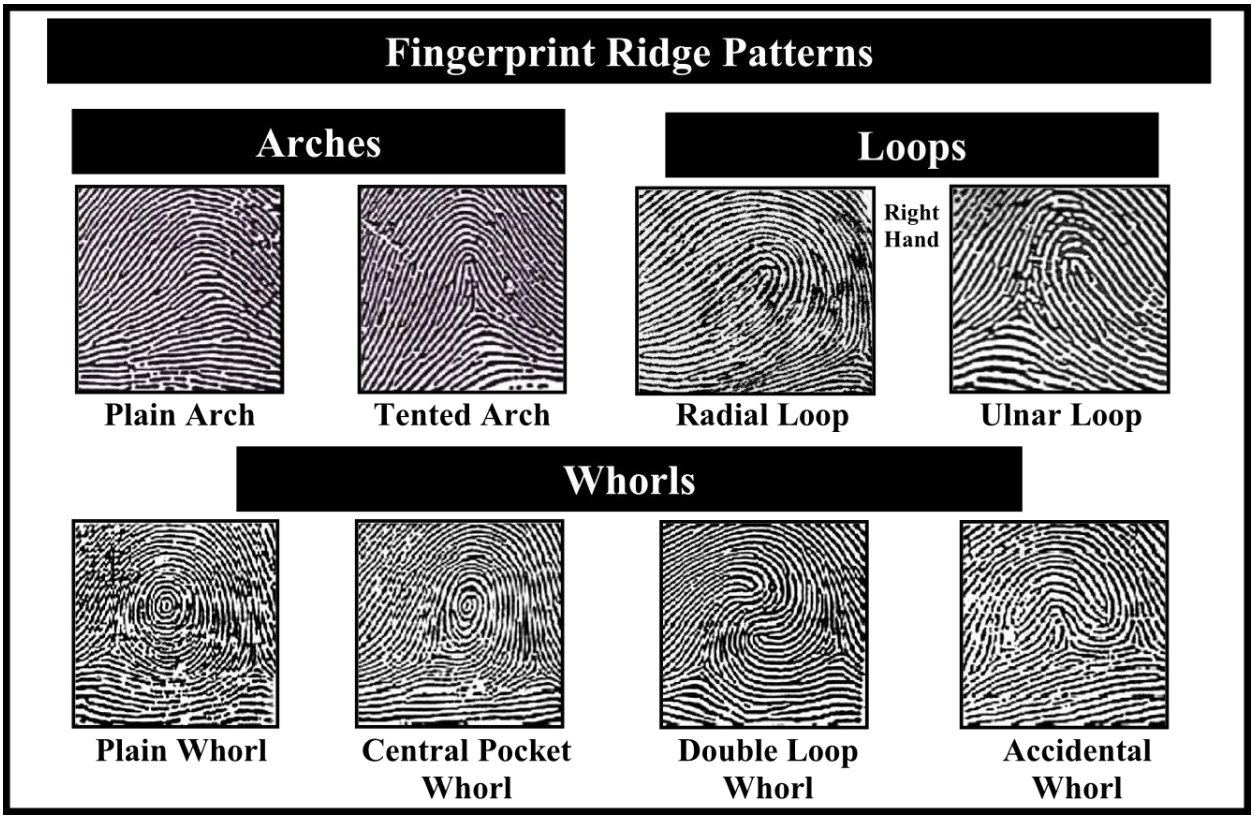
The Science of Crime Scene Investigation

"The crime": Someone plugged up the toilet and flooded the bathroom. Immediately before the flood, the hall monitor saw 2 students come out of the bathroom – Kelly King & Cary Carlyle. You have examples of the chemicals found on the scene. 3 prints were lifted from the scene and you have examples of the suspects fingerprints. We even found DNA on the paper used the plug up the toilet. You will need to identify the chemicals, the types of fingerprints, and the DNA match. You will also need to decide on the basis of the evidence which of the suspects is the most likely perpetrator.

Make sure to answer all of the italicized questions.

A. Fingerprints

Everyone's fingerprints are different. Because every person's fingerprints are unique, investigators can use fingerprints found at the scene of the crime to identify suspects later on. Here are some of the different patterns that fingerprints can take.



Hands-on experiment: Fingerprinting station

Materials:

- Fingerprint transferer (ink on a plastic membrane)
- This worksheet

Method:

1. Go to the fingerprinting station as a group
2. Position the fingerprinting ink transferer over the boxes below and press down lightly to transfer your fingerprint.

Thumb	Index Finger

Questions:

1. What pattern does your thumb fingerprint have? What about your index finger (the one closest to the thumb).
2. How do your fingerprints look compared to those of your group? Is anyone's exactly the same?

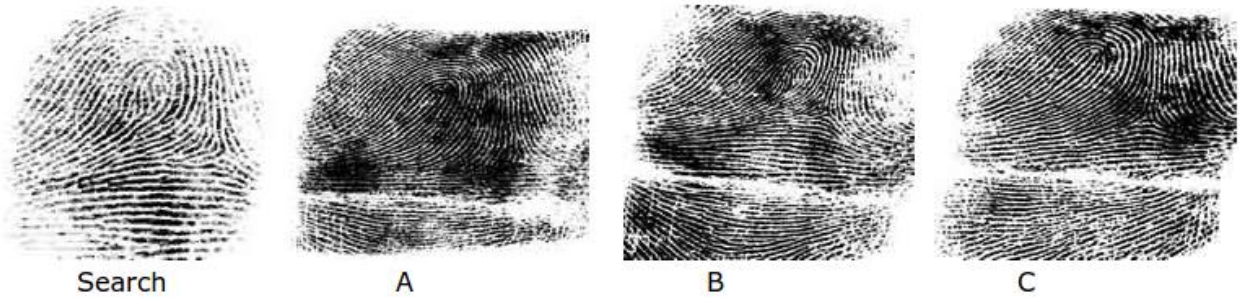
Fingerprint Matching

To figure out who did it, we're going to need to match fingerprints. Show off your pattern recognition skills by matching the fingerprint on the left with one of the fingerprints on the right. Circle the one that matches - A, B, or C.

1.

2.

3.



Unknown fingerprints found at the scene

Now lets look at the fingerprints found at the “crime scene”. We also have some fingerprints of several suspects. Which fingerprints at the crime scene match suspects prints? What does this mean? Does the fact that someone’s fingerprints were not found at the crime scene eliminate them from further consideration as a suspect? Why or why not?

Write the name of Kelly or Cary next to any fingerprints that you think match.

Kelly's fingerprint:

Cary's fingerprint:

Fingerprints found at the crime scene:

Who, if anyone, left prints at the crime scene (Kelly or Cary)? Does this mean they did it?

B. The Chemisty of Identifying Unknown Substances

When a suspect is arrested, they may have an unknown substance on them, their clothes, or their possessions. How do you think we could identify the substance? For our example, we will learn how to tell the difference between powders that look (almost) exactly the same.

Hands-on experiment: Dry chemical station

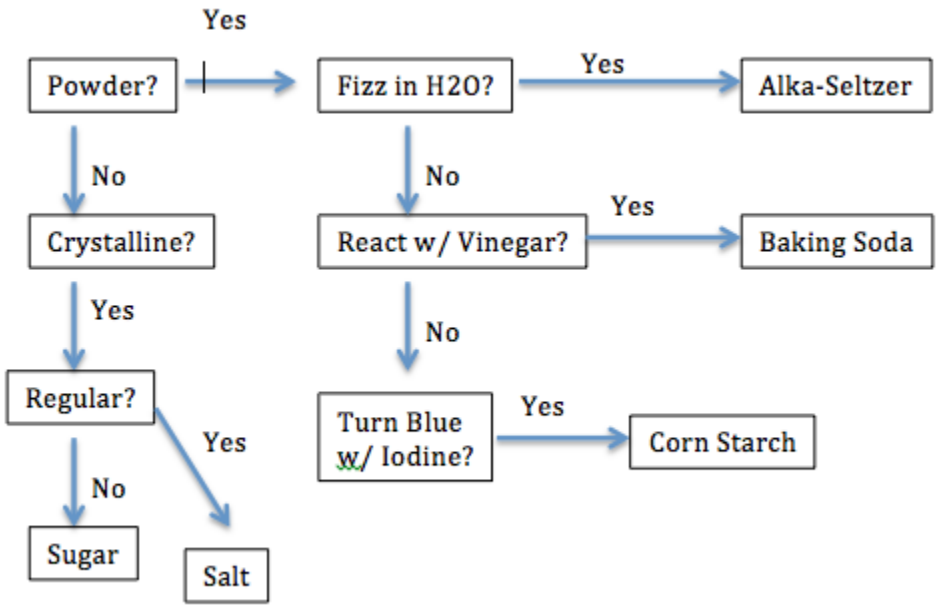
Materials

- 1 Petri dish per student
- 1 Marker
- 1 small sample (⅓ of a spoonful) of known sample of the student's choice
- 1 small sample (⅓ of a spoonful of unknown sample of the student's choice

Each student:

1. Get a petri dish and draw a line to divide it in half. Label one half "known" and the other "unknown"
2. Retrieve 1 small sample (⅓ of a spoonful) of known sample of the student's choice. Place it on the "known" side of the petri dish and write down which one it is.
3. Retrieve 1 small sample (⅓ of a spoonful) of unknown sample of the student's choice. Place it on the "unknown" side of the petri dish and write down which one it is.
4. Starting at the upper left of the diagram, test each substance in order. For example, if the substance is baking soda, you would start by classifying it as a powder ("Yes", go right), it would not fizz in water ("No", go down), it would react with acid ("Yes", go right), and be soluble in water ("Yes", go right).

Known sample: _____
Unknown sample (A, B, or C): _____



Based on the results, what is your mystery substance?

My mystery substance is: _____

Talk with the other students in your group. What other substances were found? List the identity of every unknown substance on the blanks below:

A. _____
B. _____
C. _____

Is this evidence consistent with Kelly being at the scene of the crime? What about Cary?

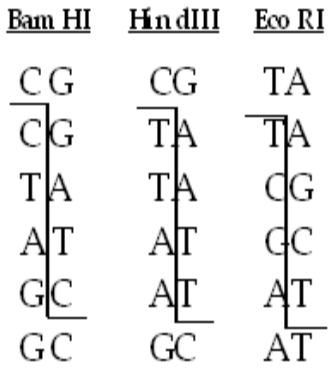
C. Genetic Analysis of DNA (do this last!)

DNA testing is a lot like dusting for fingerprints, because everyone's DNA is unique. In fact, the method used to identify someone based on their DNA is called DNA fingerprinting.

DNA fingerprinting relies on the fact that the DNA code is universal for all living things and that there are differences between individuals within that code. Because human DNA is very similar to every other human's DNA, DNA fingerprinting primarily focuses on the areas of the genetic code that vary greatly amongst individuals. Scientists use special enzymes (proteins) to cut DNA that match a specific sequence. They then pull the DNA through a gel similar to jello that separates the pieces by size.

1. Choose one of the enzymes: BamHI, HindIII or EcoRI, identify and label the sites where it would cut the DNA sequence provided. Draw the cut site on the sample.
2. Record the number of cuts, the number of fragments and the length of each fragment created by each of the three enzymes. NOTE: To count fragment lengths, only count the number of bases on the longest side of the DNA strand.
3. Using the data collected, draw the banding patterns that would result if these fragments were run on an electrophoresis gel.

Enzymes: DNA Sample



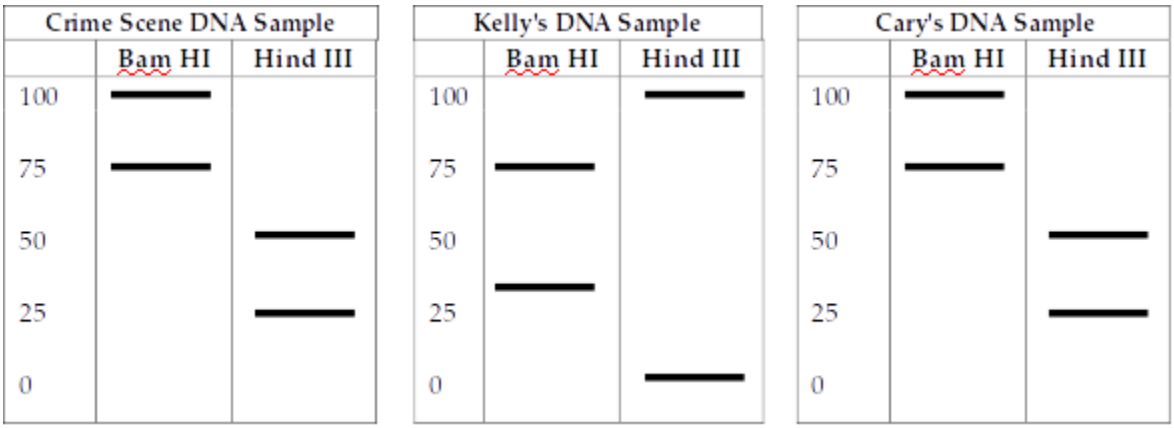
(lines show where the DNA gets cut)

1	2	3	4	5	6
T A	G C	T A	T A	G C	T A
G C	A T	T A	T A	T A	T A
G C	G C	C G	C G	A T	C G
G C	A T	G C	G C	T A	G C
C G	T A	A T	T A	T A	A T
C G	T A	A T	C G	C G	A T
T A	C G	G C	C G	G C	C G
A T	T A	G C	T A	A T	G C
G C	T A	T A	T A	A T	G C
G C	A T	A T	A T	C G	G C
C G	A T	C G	A T	T A	G C
A T	G C	A T	G C	C G	C G
C G	T A	C G	C G	C G	C G
A T	C G	C G	T A	T A	C G
T A	A T	T A	T A	T A	T A
T A	A T	A T	T A	A T	A T
C G	G C	G C	T A	A T	G C
G C	C G	G C	A T	G C	G C
A T	A T	C G	A T	A T	A T
A T	G C	T A	A T	A T	C G
G C	G C	C G	T A	T A	C G

Enzyme	# cuts	# fragments	lengths
BamHI			
HindIII			
EcoRI			

Hands-on experiment: done at your desk

We found DNA on the paper used to clog the toilet. We tested a part of the DNA that often gives us different results when we cut it with enzymes. Below is the results of cutting our DNA and pulling it through the gel. The numbers on the left tell us the size of the bands.



Whose DNA matches the DNA found at the crime scene? Who do you think committed the crime?

Putting it all together

We have different pieces of evidence for who was at the crime scene (and in what way).

Whose fingerprints were at the crime scene?

Whose clothes had substances that matched those at the crime scene?

Whose DNA matches that found on the toilet paper?

Who do you think did it? Why do you think so? Which evidence do you think is better and why do you think so?