1. Bloodspatter

1. What can analysis of blood spatter tell an investigator?

2. There are several types of chemical reagents that can be used to detect blood. Research and list one of these reagents, and explain if there are special circumstances in which it can be used.

3. On the drop of blood below, label: parent drop, spines, satellite spatters

4. Explain the difference between passive and projected bloodstains.

2. Fingerprints

1. Why are fingerprints such an essential tool for forensic investigators?

2a. There are three basic types of fingerprints: _____, _____, _____.

2b. For each type of fingerprint, state on average what percentage of the population can be found with each of these types of prints.

3. Visual recognition of fingerprint types: write the name of the fingerprint type above each image

a. _____

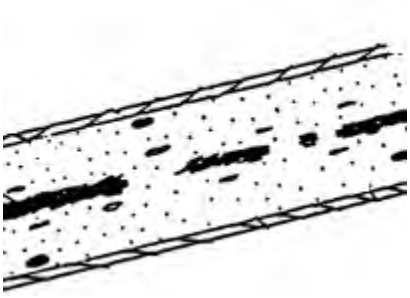
b. _____

c. _____

3. Microscopy

1a. Hair structure is composed of three different parts: _____, _____, _____.

1b. On the image of a hair shaft below, indicate the 3 parts of hair structure.



1c. Of the three parts of hair structure, the _____ is the most important when identifying human hair from a crime scene.

2. Which part of the hair must be present in order to extract DNA?

3. Textile fibers can be identified by their diameter, spinning method, as well as the source of the fiber. Discuss the difference between natural and synthetic fibers, and give an example of each.

4. Presumptive Testing for Blood

1. What is the difference between a presumptive and a confirmatory test?

2. In what situation do forensics agents use confirmatory tests, and why?

3. Give an example of a presumptive test, and what it tests for.

5. Chromatography

1a. What is the difference between a mixture and a compound?

1b. Would water be a mixture or a compound?

2a. Chromatography is the separation of a _____ (mixture or compound) into its individual components.

2b. Would it be possible to separate the components of soda using chromatography? Why or why not?

3. List two different types of chromatography.

4. Chromatography consists of a mobile phase and a stationary phase. In the chromatography experiment we'll be doing in our research class, we'll be using paper, and a liquid solvent. Identify the paper and the liquid solvent as either the mobile or the stationary phase.

Paper = _____ phase

Liquid solvent = _____ phase

6. DNA and Gel Electrophoresis

1. DNA can be found in the _____ of our cells.

2. Is every person's DNA distinct? Explain.

3. What is CODIS and how do forensic officers use it?

4. Next to each statement, write 'True' or 'False'.

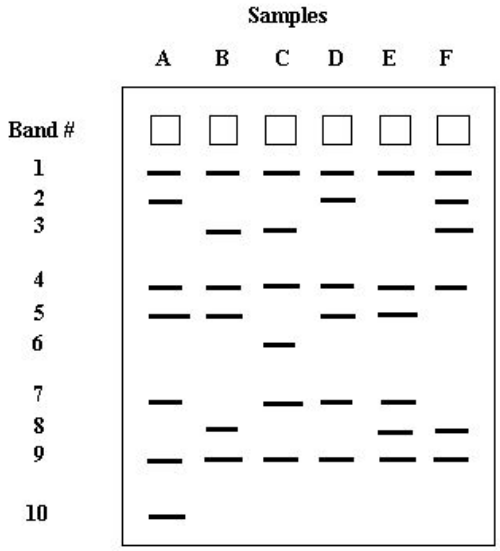
a. The DNA in a person's blood is the same as the DNA in their skin cells. _____

b. Each person's DNA is completely different. _____

c. DNA can *not* be found in saliva. _____

d. DNA can have forensic value even if it is decades old. _____

5. The DNA from several suspects was run on an electrophoresis gel. When the bands from one sample match the bands from another sample exactly, then we can say the two DNA samples came from the same person. If the bands are almost identical, but there is some small difference, then the two DNA samples could come from people who are related. Examining the gel below, what can you tell me about DNA samples 'A' and 'D'?



Lesson Title: Forensics Unit, day 2

Objectives/ SWBAT:
Recognize and catalogue clues from a crime scene. Sketch crime scene to scale.

Unit duration: 9 days (50 mins/day)

Lesson duration: 50 mins.

Aim: How to catalogue a crime scene?

Do Now: Explain what a forensic investigator should do upon arriving to a crime scene.

Materials:
Crime scene: doll/teddy as victim with the following evidence: stained shirt, trace hair fiber, torn note with writing and fingerprint, blood spatter on the ground.
Crime scene report sheets for students

Procedure:
1. On day 1, Mr. Johnston will have provided the history of the field of forensic investigation. On day 2, the lesson begins with an introductory story of the victim of the crime.

2. Students are provided with crime scene report sheets and instructed to study the scene carefully, noting any trace evidence (fibers, footprints), blood spatter, etc., and to document it in a scaled drawing.

3. Students are asked to analyze what they have observed and hypothesize how the crime occurred.

Homework:

Review the blood spatter assignment for the following day.

EVIDENCE REPORT

Date of Report:_____ Time of Report:_____ Report Submitted by:_____

Name of Victim: _____ Victim Status:_____

Location:_____

Below sketch the crime scene, including position of body and evidence.

Evidence Summary - *check all that apply*

□ latent prints	□ bitemark
□ weapon_____	□ blood
□ footwear/tiremark	□ fibers
□ toolmark	□ other trace _____

1. Describe the scene of the crime. (use back of page if needed)

_____

_____

_____

2. What appears to have happened? _____

_____

_____

3. Does the evidence indicate: homicide, suicide, accident?

_____

4. List any suspects to be brought in for questioning. _____

_____

Lesson Title: Forensics Unit, day 3

Objectives/ SWBAT:
Identify directionality and distance of blood spatter.

Lesson duration: 50 mins.

Aim: How does blood spatter help to recreate a crime?

Do Now: Review the definition of parent drop, spines and satellite drops.

Materials:
Ring stands, ring clamps
dropper bottles containing diluted red food coloring
paper, rulers
computer, projector

Procedure:
1. View a brief powerpoint reviewing blood spatter terminology and patterns.
2. Adjust the ring clamp on the ring stand to a height of 10cm using the ruler. Place the dropper bottle with diluted food coloring into the ring, and set a piece of paper below. Allow one drop to fall, and measure the maximum width of the spines.
3. Adjust the ring clamp to a height of 20cm and repeat the above steps using a fresh portion of paper.
4. Adjust the ring clamp to a height of 30cm and repeat the above steps using a fresh portion of paper. Analyze how height affects spatter.
5. With the ring clamp still at 30cm, and holding the paper at 45 degree angle, analyze how the spatter is affected.
6. Using a fresh piece of paper, aligned to the edge of the desk, have a student walk while releasing drops from the bottle at a steady height. Analyze what directionality does to spatter.
7. Repeat step 6 with different walking speeds. Analyze what velocity does to spatter.
8. Go to the mock crime scene and analyze the blood spatter. What does the spatter indicate about the point of origin of the blood? From what direction was the impact? Was it high velocity?

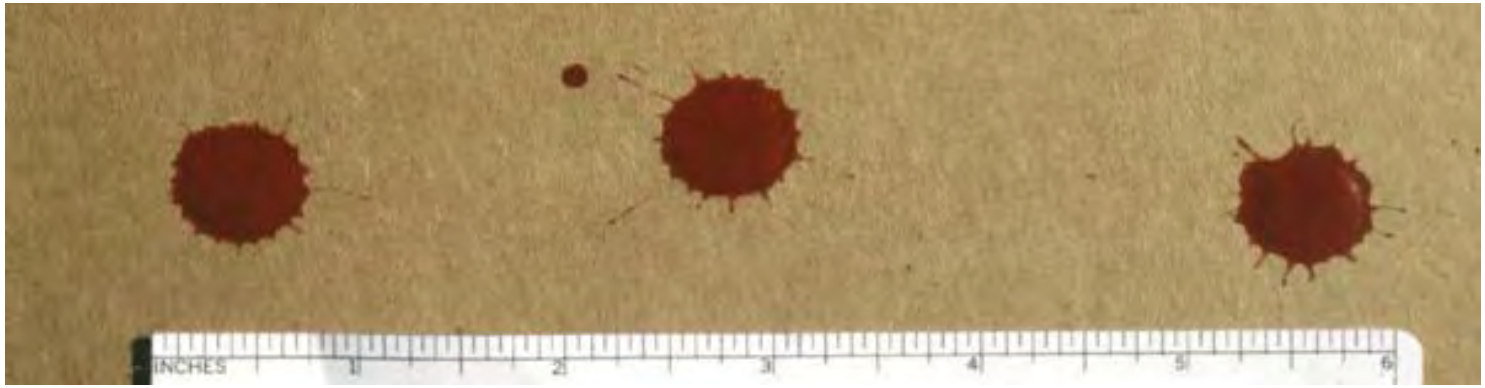
Homework:

Review the fingerprinting assignment for the following class.


Bloodstain Science

What can an investigator learn from the analysis of a blood spatter?

- Type and velocity of weapon
- Number of blows
- Handedness of assailant (right or left-handed)
- Position and movements of the victim and assailant during and after the attack
- Which wounds were inflicted first
- Type of injuries
- How long ago the crime was committed
- Whether death was immediate or delayed



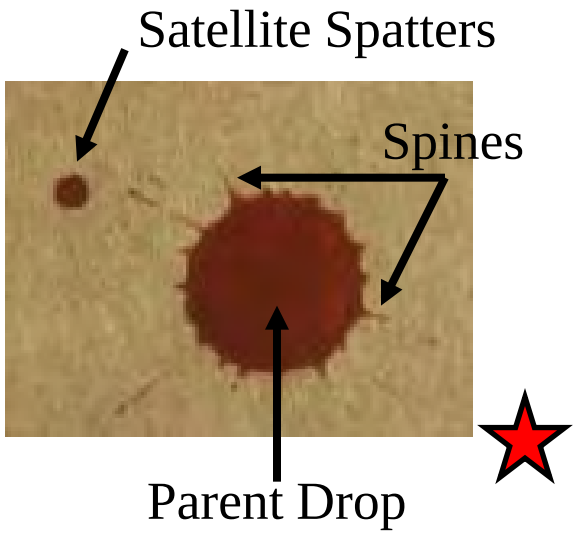
Bloodstain Pattern Analysis Terms

- **Spatter** – Bloodstains created from the application of force.

- **Parent Drop**

- **Satellite Spatters** – Small drops of blood that break of from the parent spatter.

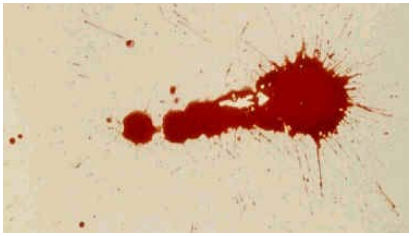
- **Spines** – The pointed edges of a drop. Why might they be important?



Types of Bloodstain Patterns

- **Passive Bloodstains**
  - Patterns created from the force of **gravity**
  - Ex. drop, series of drops, blood pools, etc.

- **Projected Bloodstains**
  - Patterns that occur when a **force** is applied to the source of the blood
  - Ex. impact spatters, cast-off, arterial spurting, expiratory blood blown out of the nose, mouth, or wound.



- **Transfer or Contact Bloodstains**
  - These patterns are created when a wet, bloody object comes in **contact** with a target surface.

Images from http://www.bloodspatter.com/BPATutorial.htm

Exercise 1: Single Droplets

How does distance from a surface affect the size of droplets and spines?

• Fold the paper in three, and label one section 10cm, the next 20cm, and the last 30cm.

•Adjust the ring clamp to the height of 10cm above the desk surface. Place the dropper bottle in the clamp, and place the paper sectioned labeled 10cm, below. Allow 3 drops to fall in that area.

•Repeat this process for the last two heights of 20cm, 30cm.

• For each height group, calculate the average drop diameter, and length of spines

Exercise 1 Questions

Use your results to answer these questions.

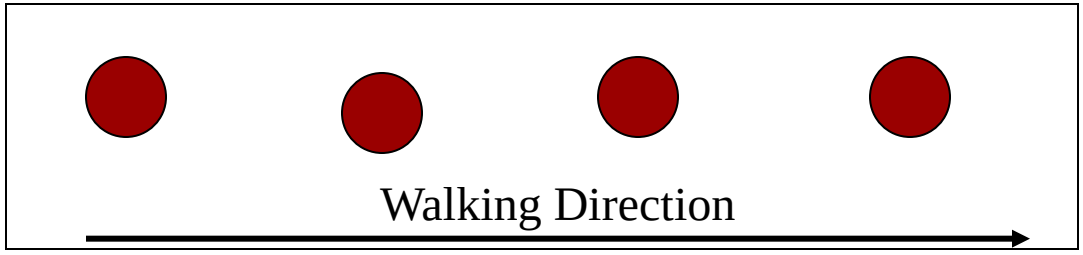
What did you notice about the diameter of the parent droplets as you increased the height of the drop?

How do the spines compare from the different heights?

Exercise 2: Motion Droplets

How does motion affect the size and shape of the droplets and spines?

- Use tape to secure a piece of paper to the desk top.
- Hold your hand at a steady height above the paper.
- Start off walking at a **SLOW WALKING RATE** along the paper from one end to the other and GENTLY squeeze the bottle as you walk so that blood is released ONE DROP at a time. Be sure that all the drops land on your paper strip.
- Repeat this procedure using a **NORMAL WALKING RATE** and a **FAST WALKING RATE**.



Exercise 2 Questions

Use your results to answer these questions.

Draw a sketch of the droplets showing the size, shape, and/or distance between them at each speed in the chart below.

Walking Rate	Sketch of Droplets (Shape/Distance)
Slow	
Normal	
Fast	

What did you notice about the shape of the droplets as you increased your walking speed?

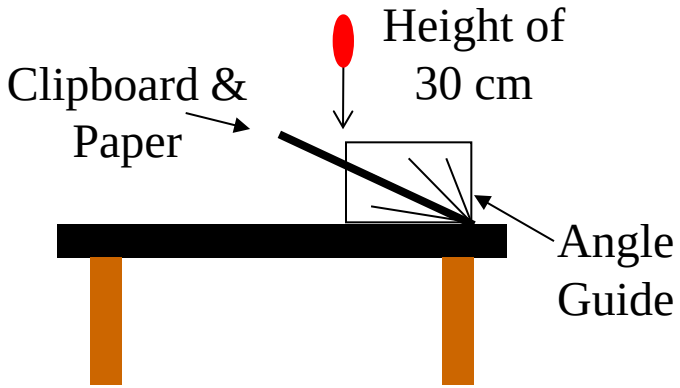
What did you notice about the spines as you increased your walking speed?

What did you notice about the distance between the droplets as you increased your walking speed?

Exercise 3: Angle of Impact

How does angle affect the blood stain pattern?

- Adjust the ring clamp to a height of 30cm.
- Each group is assigned an angle: **15º, 30º, 45º, 60º, or 75º**.
- Place the first piece of paper on the clip board and **align the clipboard with the angle guide**.
- GENTLY squeeze the bottle so that ONE drop of blood is released and lands on the paper. **Repeat two more times** at this angle.
- Compare the various angle results from the different groups.



Exercise 3 Questions

Use your results to answer the question.

What did you notice about the shape of the droplets as you increased the angle of the paper?

Lesson Title: Forensics Unit, day 4

Lesson Goals: To utilize fingerprints to identify people.

Objectives/ SWBAT:
Identify 3 basic fingerprint groups. Properly take a fingerprint. Compare fingerprints for matches.

Lesson duration: 50 mins.

Aim: How can we identify a perpetrator using fingerprints?

Do Now: List the 3 main types of fingerprint, and state which one you find on your right pointer finger.

Materials:
Ink pads, paper
Fingerprint matching exercise sheets
Computer, projector

Procedure:
1. View a brief powerpoint covering the three types of fingerprints.
2. Demonstrate how to properly take a fingerprint. Allow students to work in pairs to practice fingerprinting eachother.
3. Distribute fingerprint matching exercise and challenge students to match the pairs of prints.
4. Collect a fingerprint from the mock crime scene and identify the type.

Homework:

Compare the fingerprint from the crime scene to the four suspect teachers' prints.

Fingerprints

3 Fingerprint Principles

- No two people have the **exact** same fingerprints.
- A fingerprint pattern will remain **unchanged** for the **life** of an individual.
- Fingerprints have characteristics that allow them to be systematically identified.

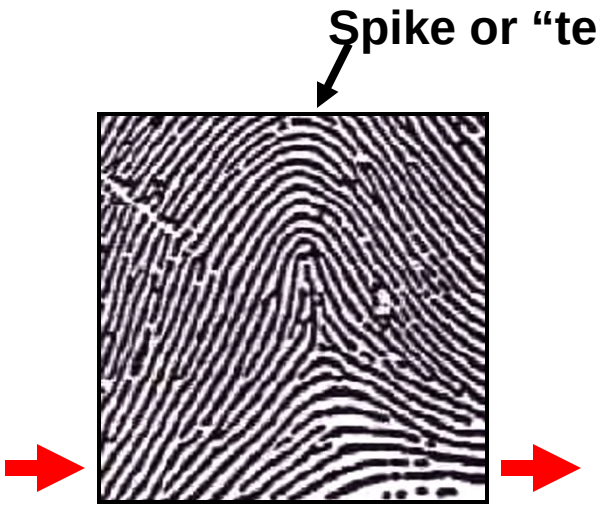
Fingerprint Classes

There are 3 specific classes of fingerprints

Arch	**Loop**	**Whorl**
Percentage of Population with each Class:		
5%	60%	35%

Arches

Plain Arch
Ridges enter on one side and exit on the other side.



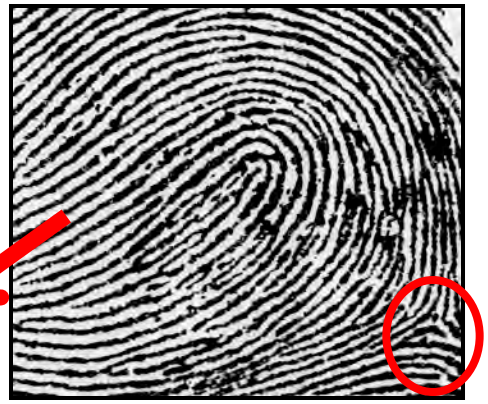
Tented Arches
Similar to the plain arch, but has a spike in the center.

Loops

Ulnar Loop (Right Thumb)

Loop opens toward right or the ulna bone.

Delta



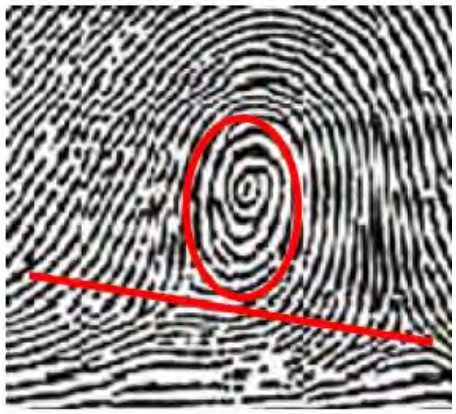
Radial Loop (Right Thumb)

Loop opens toward the left or the radial bone.

Whorls

- have at least two deltas

Plain Whorl

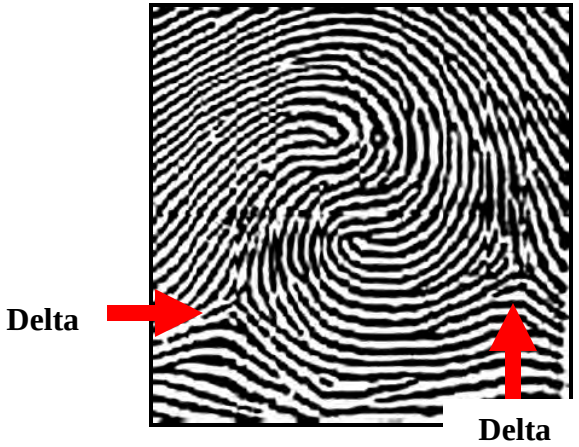


Central Pocket Whorl

Draw a line between the two deltas in the plain and central pocket whorls. If some of the curved ridges touch the line, it is a plain whorl. If none of the center core touches the line, it is a central pocket whorl.

Whorls – Part 2

Double Loop Whorl



Double loop whorls are made up of any two loops combined into one print.

Accidental Whorl

Accidental whorls contain two or more patterns and does not clearly fall under any of the other categories.

Identify each fingerprint pattern.

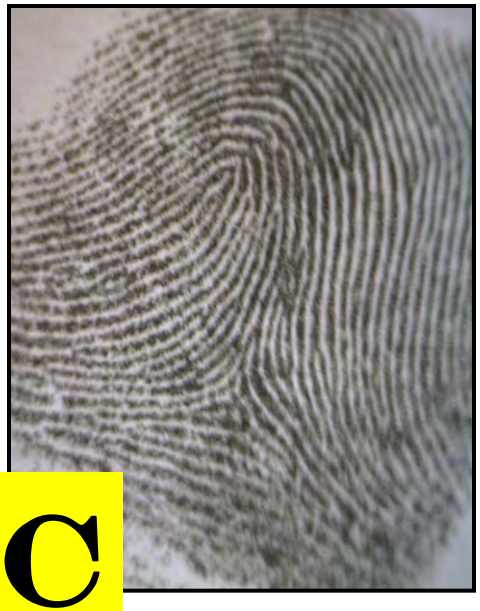
A

Left Hand

?

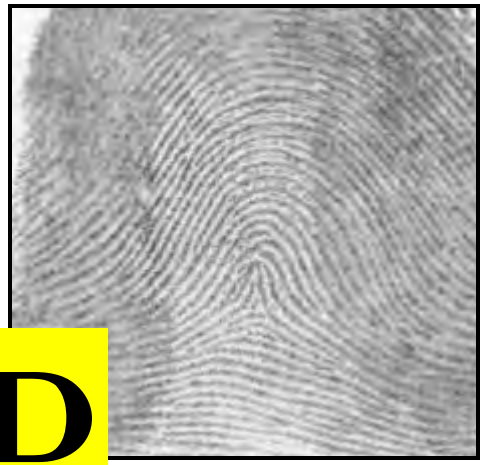
B

Right Hand



C

Right Hand



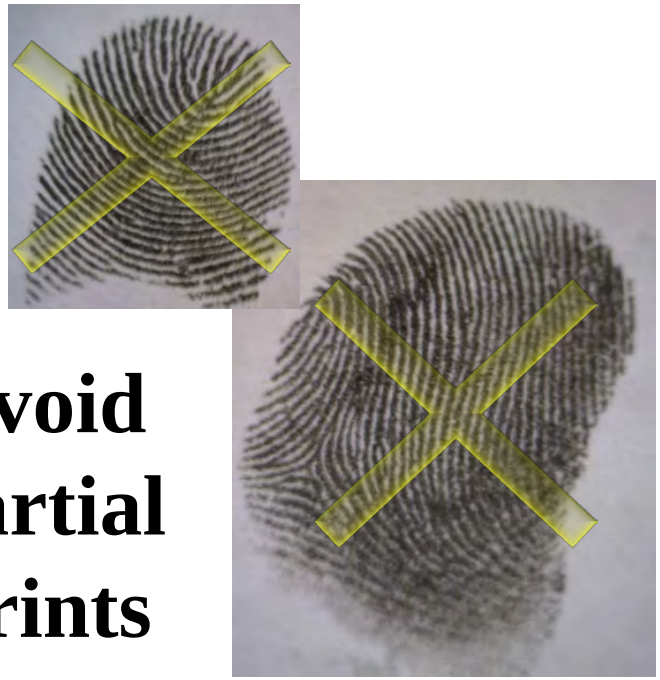
D

Right Hand

E

Left Hand

It’s time to make some prints!



Avoid Partial Prints

GOOD PRINT

Get as much of the top part of your finger as possible!

Directions

1st – Roll the “pad” portion of your thumb over the ink pad from the left side of your thumb to the right. You do not have to push down really hard!

2nd – Roll the “pad” portion of your thumb from the left side of your thumb to the right on your paper to make a thumbprint.

3rd – Use your notes and a magnifying lens to help you figure out what type of pattern is found in each of your fingerprints.

4th – Identify the print from the crime scene.

Lesson Title: Forensics Unit, day 5

Objectives/ SWBAT:
Use a microscope to differentiate between a human hair or a fiber. Distinguish human hairs of various colors through the microscope.

Lesson duration: 50 mins.

Aim: How can we conduct microscopic hair and fiber analysis?

Do Now: Review the 3 main parts of a hair strand.

Materials:
Microscopes
Prepared slides with hair fibers, set up on demo-scopes
Blank slides, coverslips, vaseline, toothpicks
Computer, projector

Procedure:
1. View a brief powerpoint demonstrating the parts of a hair strand and how different types of fiber and hair would appear through a microscope. Discuss how synthetic and natural fibers are different in appearance.
2. Students will pass before the demo scopes, each set-up with a different hair sample, and take notes of the characteristics that distinguish the various types.
3. The students will collect the hair/fiber found at the crime scene and prepare a slide with the sample. They will examine the sample microscopically and identify characteristics of the source.
4. Time-permitting, students can prepare slides of their own hair.

Homework:

Review information on presumptive testing for tomorrow's lesson.

Hairs & Fibers

http://media.popularmechanics.com/images/PMX0706FORENSICSHairSmall.jpg

Biology of Hair

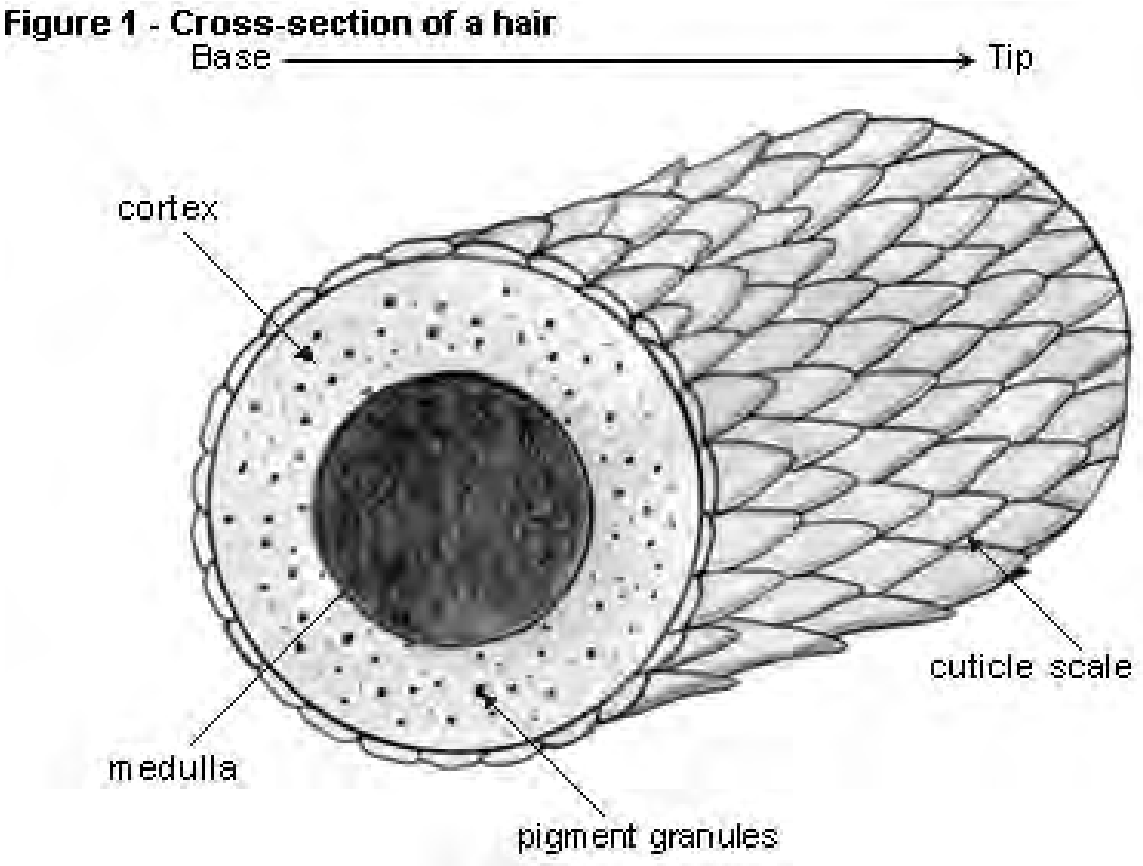
Hair is composed of the protein **keratin**, which is also the primary component of finger and toe nails.

Hair color is mostly the result of **pigments**.

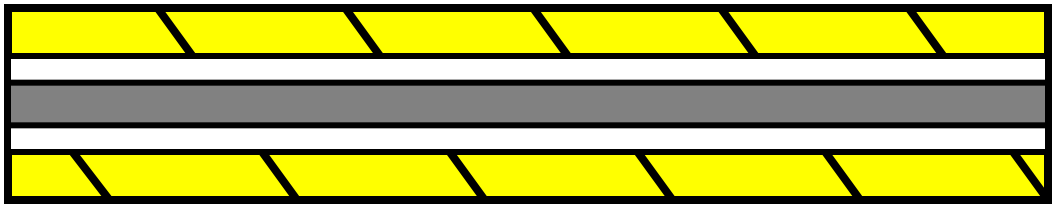
Hair **texture** (curly or straight) is influenced by **genes**. The physical appearance can be affected by intentional **alteration** (heat curling, perms, straightening, etc.).

Hair Structure

Hair is composed of three principal parts: cortex, medulla, and cuticle



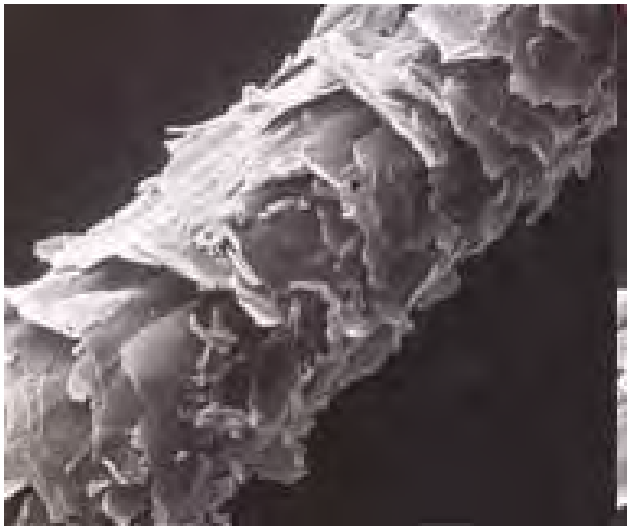
Hair Structure



Cuticle

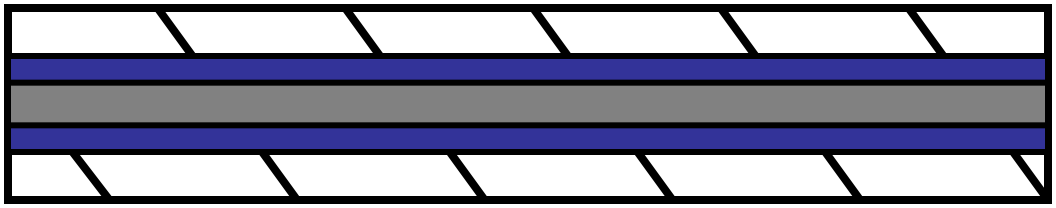
Scales vary in:

- How many there are per centimeter,
- How much they overlap,
- Their overall shape, and
- How much they protrude from the surface

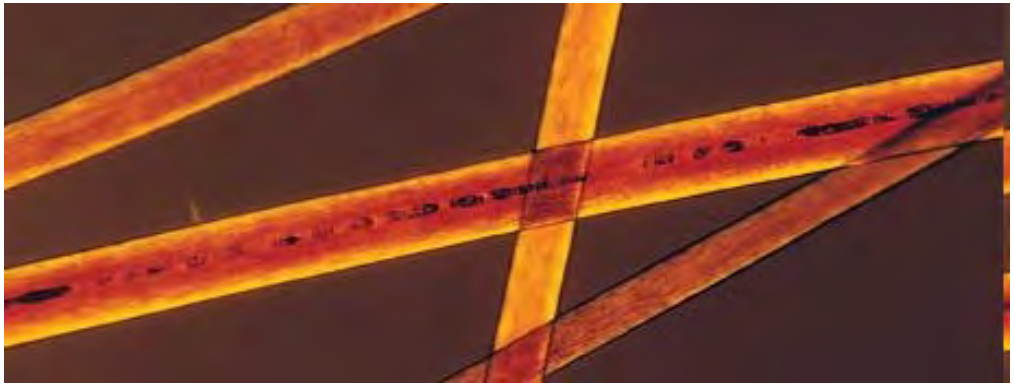


Cuticle characteristics may distinguish between hairs of different **species** but rarely between different **people**.

Hair Structure



Cortex

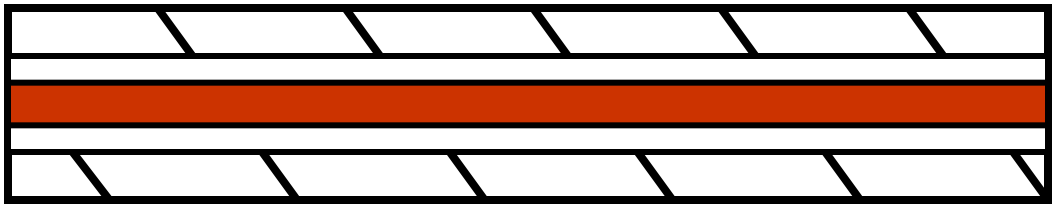


The cortex varies in:

- **Thickness**
- **Texture (curly, straight)**
- **Color**

• The cortex is the most important component in determining from which individual a **human** hair may have come.

Hair Structure



Medulla

The medulla may vary in:

- **Thickness**
- **Continuity**
- **Opacity**

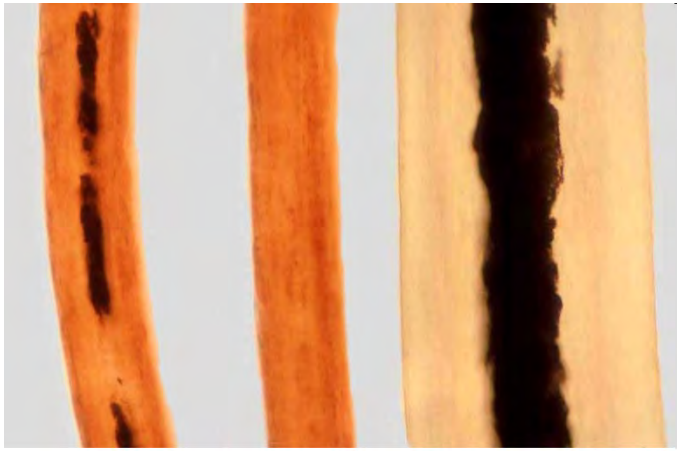
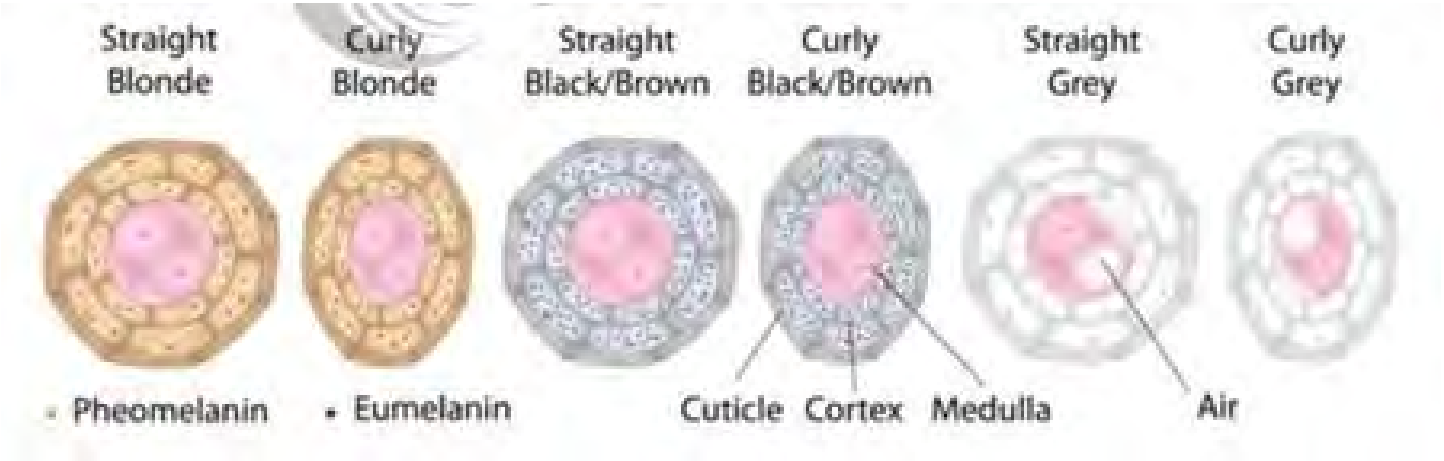


Figure 3. Light micrographs of three human hairs. The left example illustrates dark hair with a typical fragmentary medulla. The middle hair is blond and has no medulla. The right coarser hair is white with a continuous medulla.

The medulla can distinguish between hairs of different **species**, but not different **people**.

Hair Texture



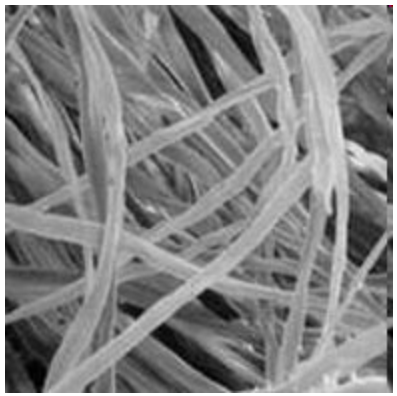
Straight hair has a round shaft, while curly hair has an oval shaft.

Fiber Evidence

A **fiber** is a textile material that has a **length** many times greater than its **diameter**.

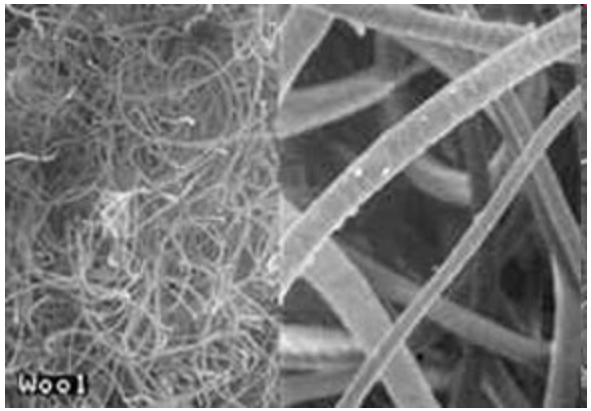
The **type** and **length** of fiber used, the type of **spinning** method can be used to identify a fiber from a crime scene.

Natural Fibers



Cotton = most common plant fiber

Wool = most common animal fiber



Synthetic Fibers

More than half of all fibers used in textile production are **synthetic** or **man-made**.

Nylon, rayon, and polyester are all examples of synthetic fibers.

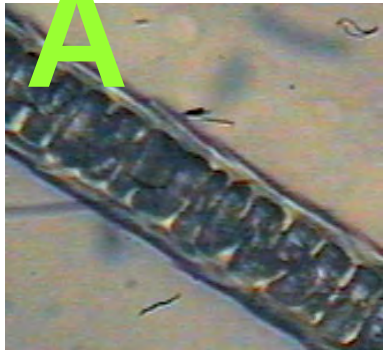
Cross-section of a man-made fiber

Fibers under a microscope

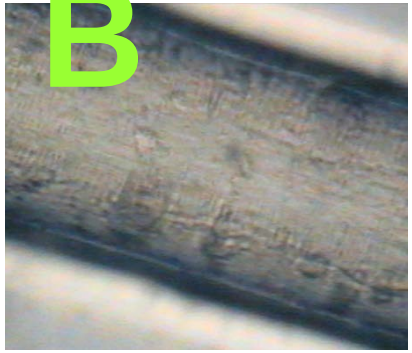

It's time to examine
some hairs and fibers!

Types of Animal Hairs

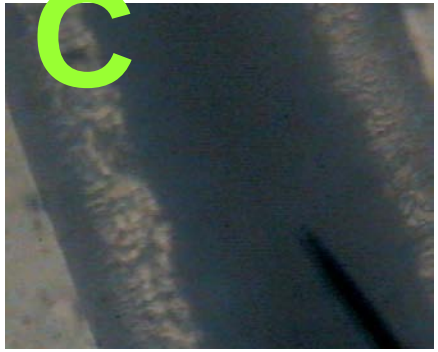
Cat



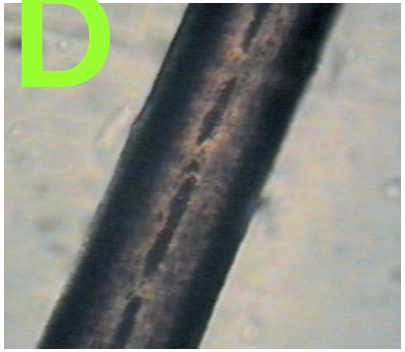
Horse

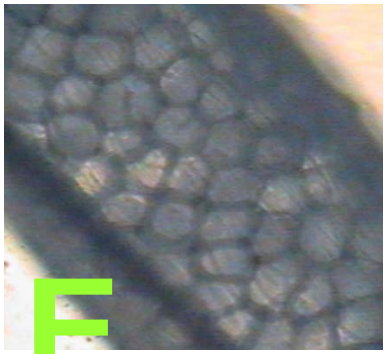


Pig

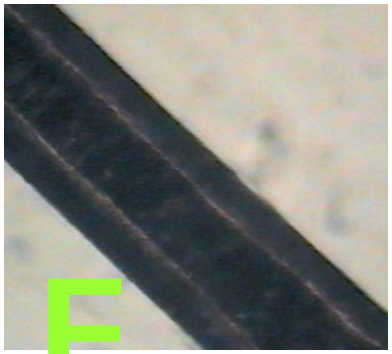


Human



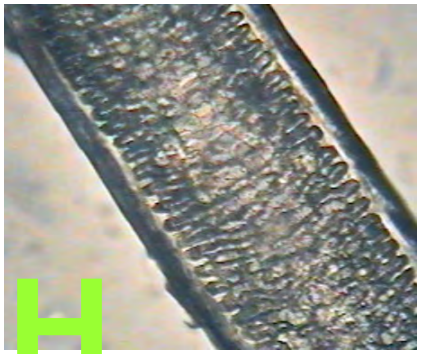


Deer

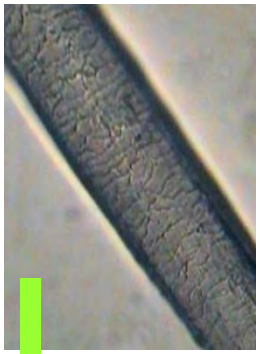


Dog

Rabbit



Rat



Human

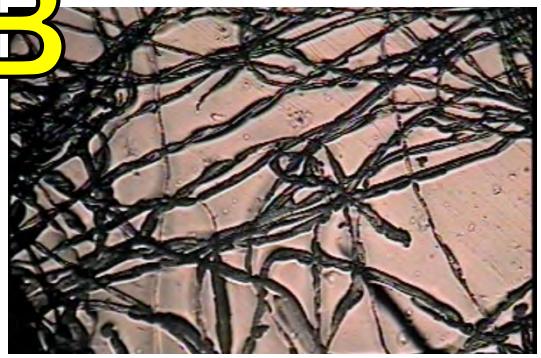
Types of Fibers

A

Acrylic Yarn

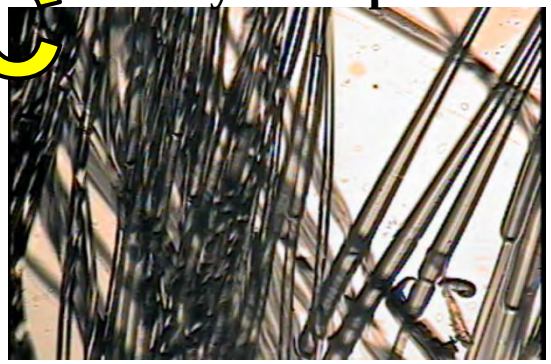
B

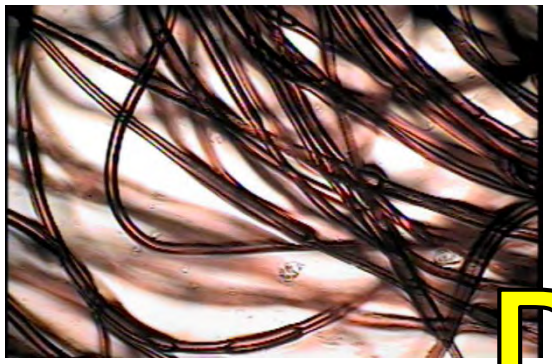
Cotton Yarn



C

Nylon Rope



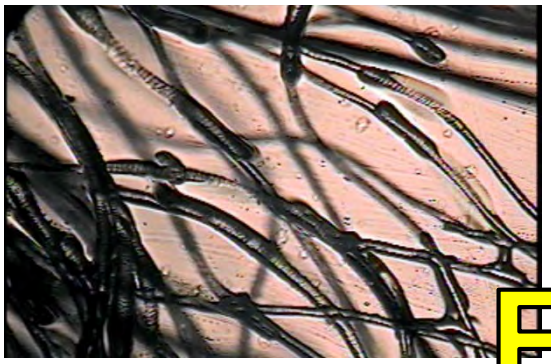


D

Polyester Yarn

E

Rayon Rope



F

Wool Yarn

Lesson Title: Forensics Unit, day 6

Objectives/ SWBAT:
Define what a presumptive test is, and the appropriate time for application. Use the Kastle-Meyer test to detect blood.

Lesson duration: 30 mins.

Aim: How can we use a presumptive test to detect blood?

Do Now: Define 'presumptive test'.

Materials:
Kastle-Meyer reagent, hydrogen peroxide, ethanol
Pipets, cotton swabs, scissors
Cloth swatches with blood stain

Procedure:
1. Review on board the definition of a presumptive test, and why it's important to forensic investigators.
2. Demonstrate how the carry out the Kastle-Meyer test. Students will be given blood-soaked cloth swatches to practice the test.
3. From the mock crime scene, students will cut samples of the victim's shirt to test for blood.
4. Using cotton swabs, students will take samples from the ground to test for blood.

Homework:

Review information on chromatography for next week's lesson.

Chromatography

Applications in Forensic Science

Mixtures & Compounds

Mixture – Two or more substances that are mixed together, but not chemically combined.

Examples of mixtures ...

Bowl of cereal – mixture of cereal and milk

Kool-Aid – mixture of water, sugar, and flavor crystals

Compounds – Two or more elements that are chemically combined.

Examples of compounds ...

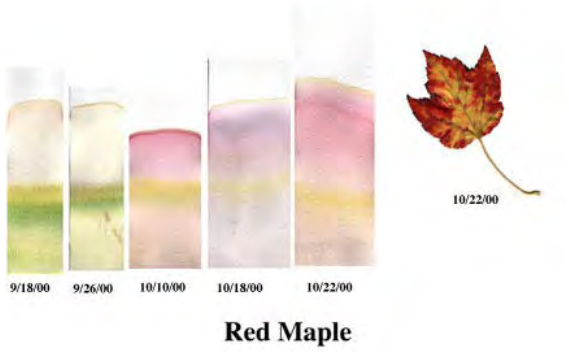
Salt –Sodium and chlorine combined chemically

Water –Hydrogen and oxygen combined chemically

What is chromatography?

Chromatography a laboratory technique for the separation of mixtures into its individual components.

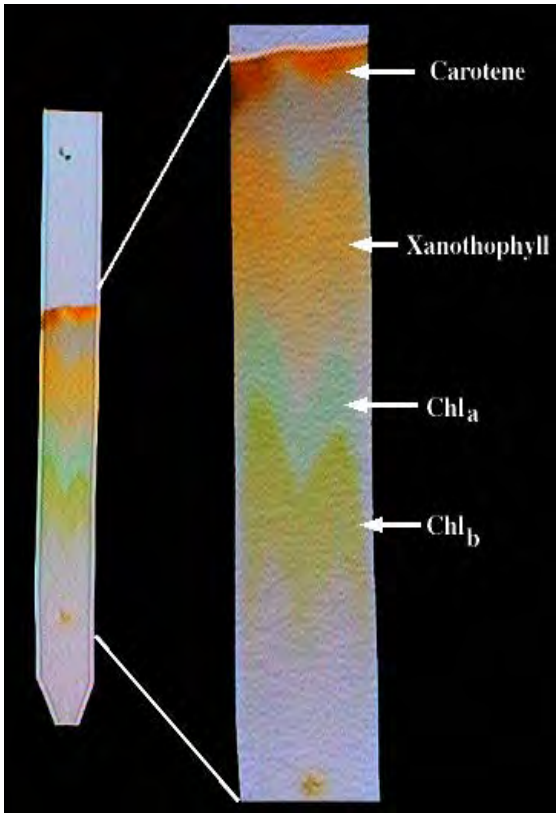
We can use chromatography to separate the components of **inks** and **dyes**.



http://members.shaw.ca/vict/chemistry_test3.htm

Paper Chromatography

Paper Chromatography
Can be used to separate the components of inks, dyes, plant pigments, make-up, and many other substances

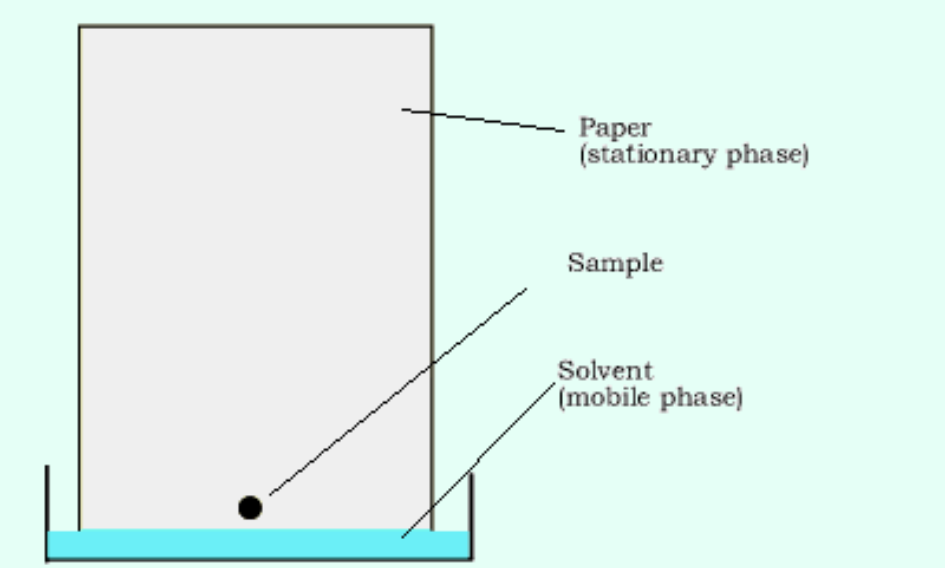


Mobile and Stationary Phases

Mobile Phase:
The liquid in which the mixture is dissolved

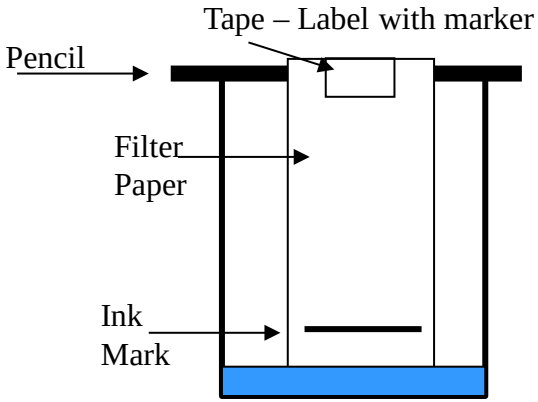
Stationary Phase:
The solid which the mobile phase passes through.

The mobile phase passes through the stationary phase, causing the parts of the mixture to separate.



Paper Chromatography Lab

- Obtain the supplies you'll need.
  - 1 large beaker
  - Chromatography solution
  - filter paper
  - pens for testing
  - tape
  - Pencil (to attach to the top of the filter paper)



- Choose one of the testing pens and draw a thick line near the bottom of the filter paper - about ¼ inch from the bottom. Make sure to label which pen is in each position.
- Attach the filter paper to the pencil with tape, and lay across the top of the beaker so that the bottom of the paper just touches the beaker bottom.
- Pour a small amount of chromatography solvent into the beaker and then hang the paper strip in the cup. Make sure the ink line does not touch the solvent – only the bottom of the filter paper.
- Allow the solvent to move up the paper for 5 minutes and then remove the paper from the beaker. Hang it on the side of the table to dry.

Lesson Title: Forensics Unit, day 7.

Objectives/ SWBAT:
Understand the basic principles of chromatography. Distinguish between compounds and mixtures. Utilize chromatography to identify an ink sample.

Lesson duration: 50 mins.

Aim: How can we use a chromatography to identify an ink sample?

Do Now: Define 'compound' and give an example.

Materials:
Chromatography paper, chromatography solvent
Scotch tape
1/group: 250mL beaker, pencil, scissors
Chemical hood (watch glass for top of beaker)
Computer, projector

Procedure:
1. Show a brief powerpoint on chromatography.
2. Discuss the difference between mixtures and compounds, and explain why chromatography can only separate mixtures.
3. Demonstrate the set-up: have students fold the chromatography paper in four, and cut along the folds. Apply an ink sample of the four different teacher's pens to the tips of the paper strips. Attach the paper length-wise to a pencil with tape, and suspend over the 250mL beaker. Cut a sample from the note at the mock crime scene, and tape onto the rest. Add chromatography solvent in the chemical hood (fumes).
4. Compare the chromatography mobile phase to match identities.

Homework:

Review information on gel electrophoresis for next lesson.

Lesson Title: Forensics Unit, day 8

Objectives/ SWBAT:
Understand the basic characteristics of DNA. Understand how gel electrophoresis separates DNA samples. Understand how to read a gel to match up DNA samples.

Lesson duration: 50 mins.

Aim: How can we use gel electrophoresis to compare DNA samples?

Do Now: Is the DNA in your liver cells identical to the DNA in your skin cells? Why, or why not?

Materials:
Agarose gels (poured), electrophoresis boxes, DNA samples, pipets
Computer, projector

Procedure:
1. Demo the loading of the ladder, then allow students to pipet their DNA samples, plus loading dye into the wells.
2. While waiting for the electrophoresis to occur, show a brief powerpoint on DNA structure and gel electrophoresis.
3. Use pre-prepped Demo for results. Have students compare lanes for match.

Homework:

Begin report on forensics unit.

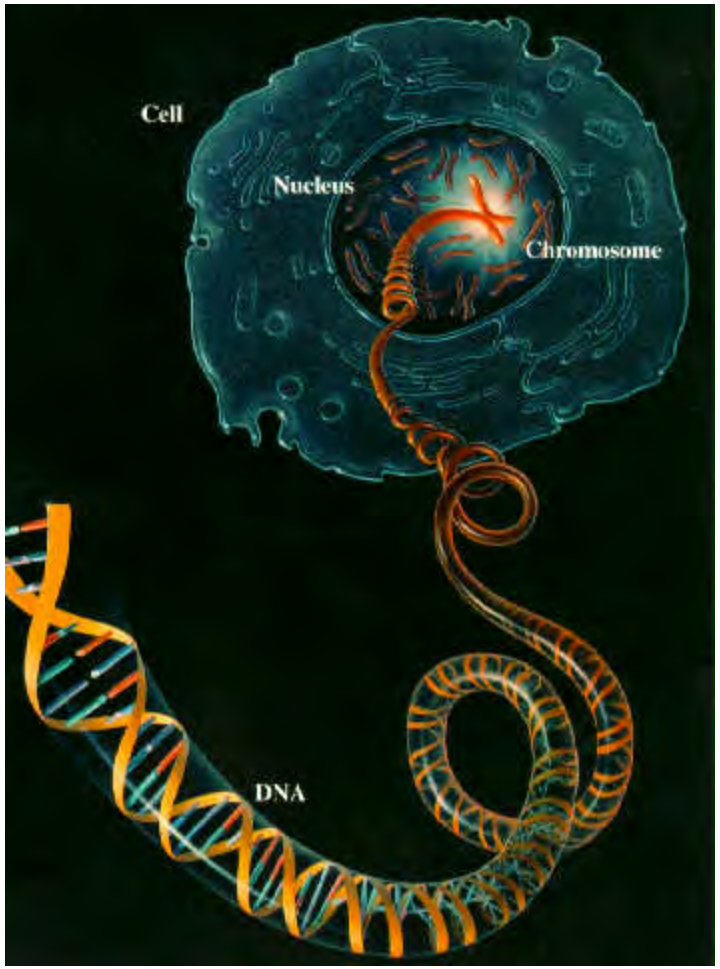
Tomorrow: final day of unit: unit analysis and determination of cause of death.

DNA Evidence

How is DNA used to solve crimes?

What is DNA?

DNA stands for **deoxyribonucleic acid** and contains **genetic information.** It is found on **chromosomes** located in the nucleus of our cells.



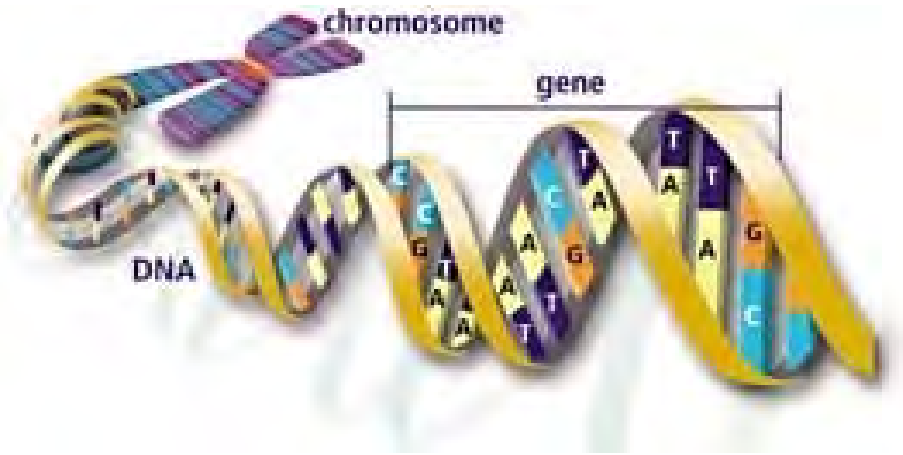
What makes up DNA?

- The sides DNA are made up of **sugar (deoxyribose)** and **phosphate molecules**.

- The rungs in the middle are made up of pairs of **nitrogen bases**.

- The order of the bases determines the **genetic code**.

Double Helix



DNA Image: http://science.howstuffworks.com/genetic-science/dna-evidence.htm

How is DNA used as evidence?

•Each person's DNA is **different** from other people (except identical twins).

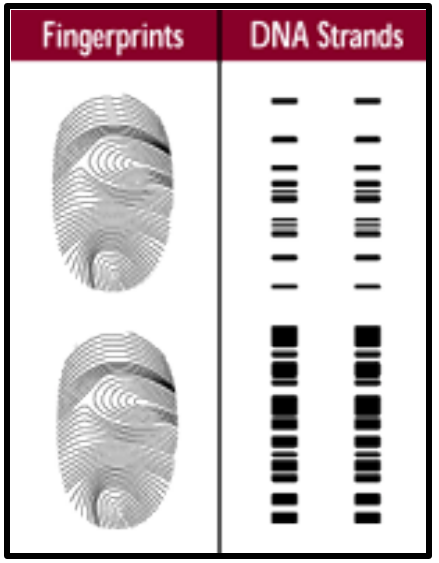
•How Can DNA be used?

•To link a suspect to the evidence

• Identify a victim

•Link crime scenes to scenes across the nation

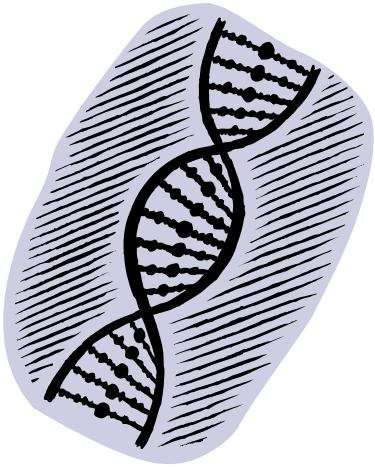
•Link a suspect to a weapon



What is CODIS?

CODIS stands for **COmbined DNA Index System**, which is an electronic database of DNA profiles that can identify suspects.

Did you know?
Each human cell contains three billion DNA base pairs. Our unique DNA amounts to 0.1%



DNA information : http://www.dna.gov/audiences/investigators/know/

True or False?

Which statements below are true?

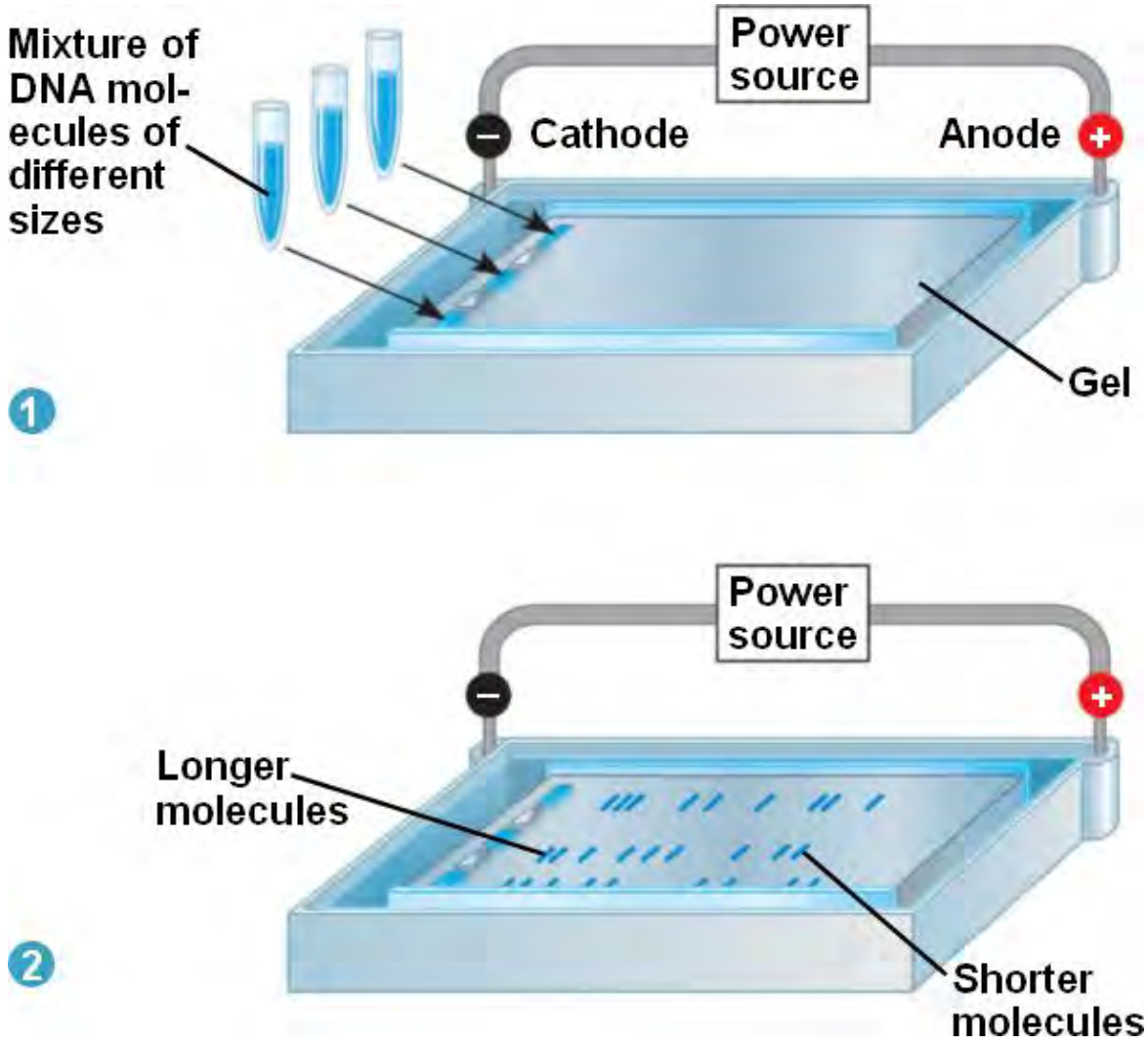
1. The DNA in a man's blood is the same as the DNA in his skin cells and saliva.

2. Each person's DNA is different from every other individual's.

3. DNA can be found in all the cells in our bodies except the white blood cells.

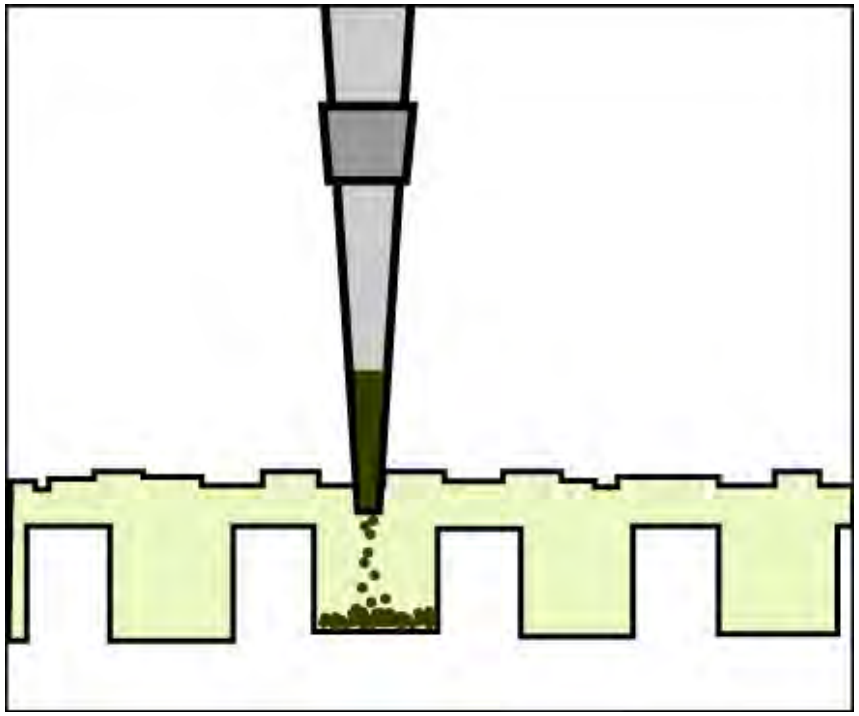
4. DNA can have forensic value even if it is decades old.

Gel Electrophoresis



Gel Electrophoresis separates DNA fragments by length.

Gel Electrophoresis



Supplies:

Agarose gel

Electrophoresis box & power source

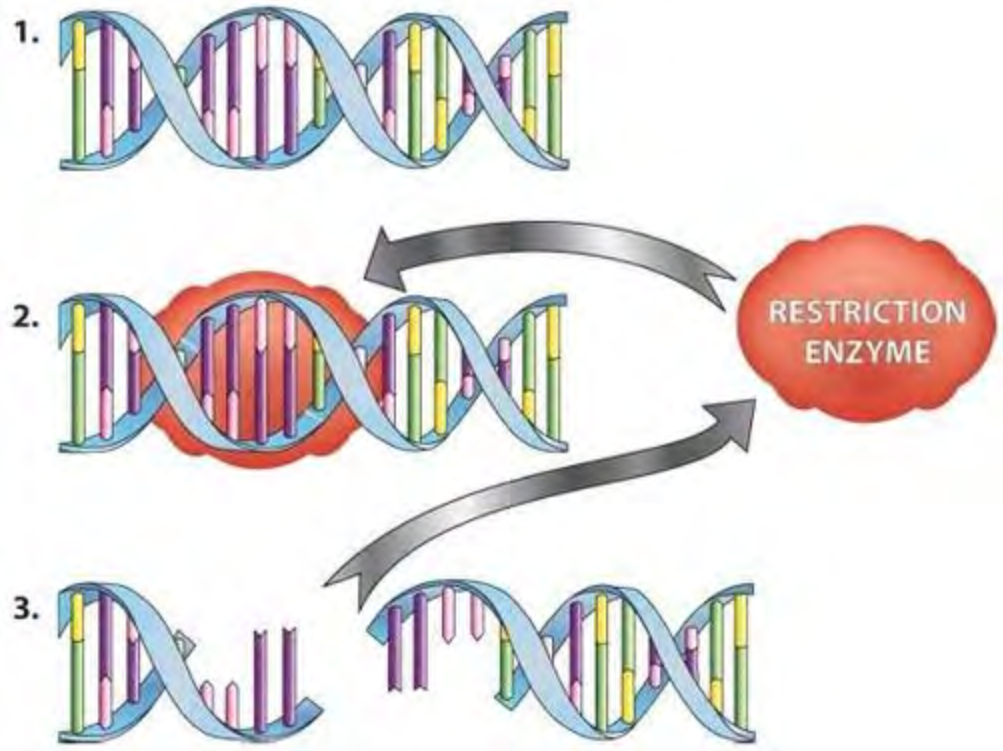
TAE buffer

Loading buffer

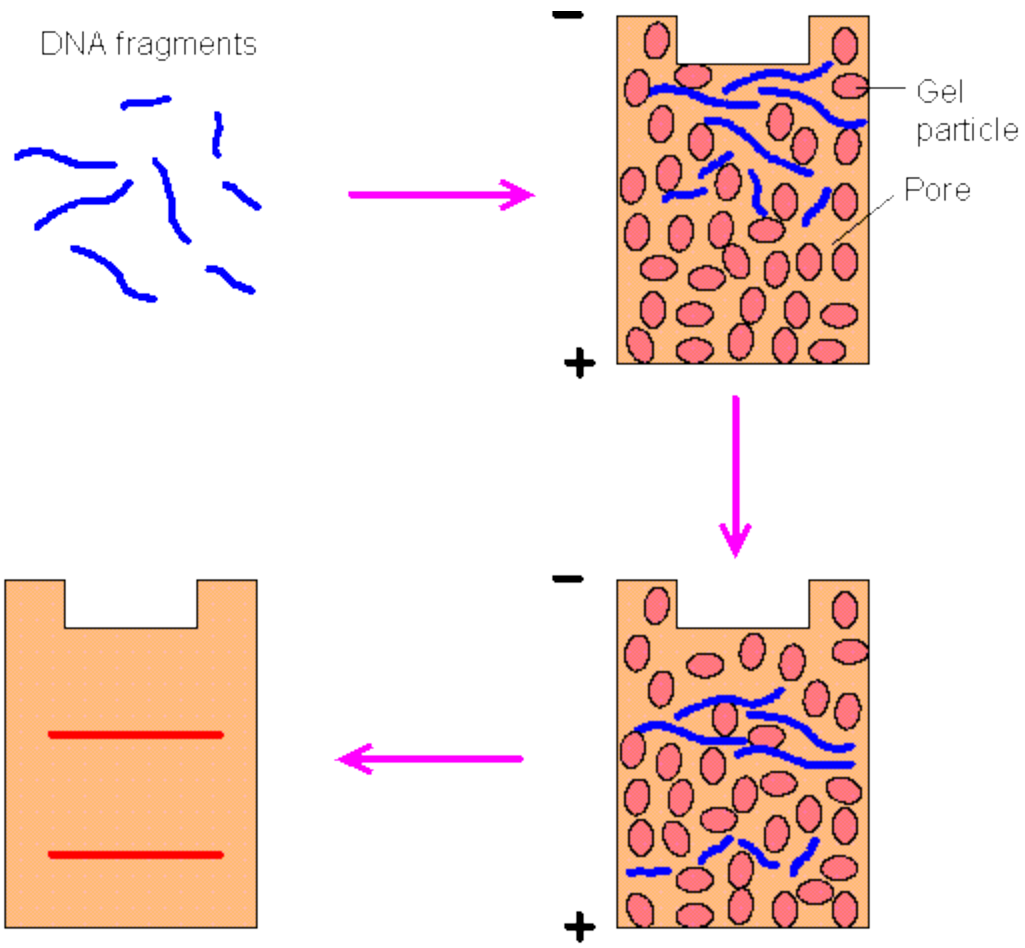
DNA sources

Pipets

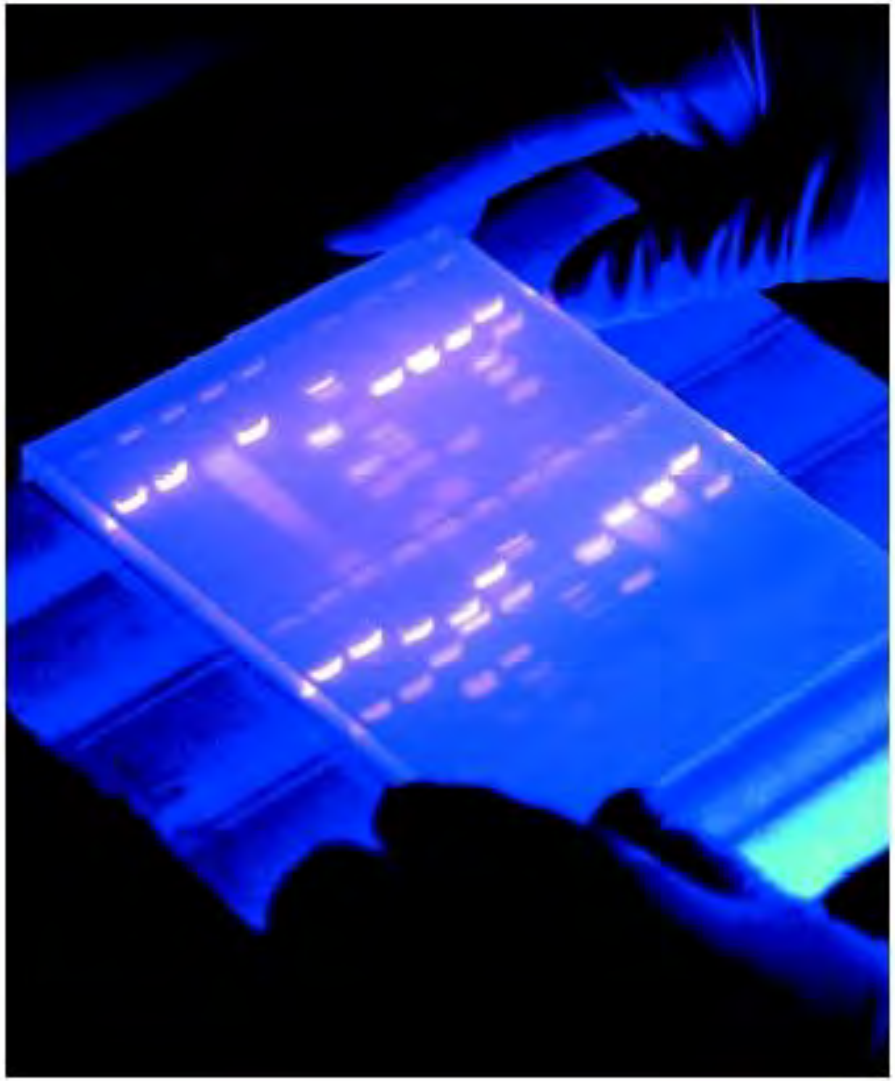
Cutting the DNA



DNA Fragment Separation



Visualizing the Gel



Final Product: Photo