

Fingerprints 101

Unit 2: Impression Evidence – Fingerprints

But first...a little history

Puzzle it Out...

- **Directions:** organize the cut up pieces into three categories try to match the forensic science pioneer with their title and description.
 - Check in with Ms. Fields
 - Copy information on your paper
- **Helpful Hints:**
 - Locard is the mac daddy of forensic science
 - There's something questionable about Mr. Osborn
 - Galton enjoys looking at whorls, loops and arches
 - I wouldn't drink anything Orfillia gave me
 - Goddard can be a little trigger happy
 - Lattes favorite letter are A, B, and O

Mathieu <u>Orfila</u> (1787-1853)	"Father of Toxicology"	Wrote about the detection of poisons & their effects on animals.
Calvin Goddard (1881 – 1954)	"Father of Ballistics"	Developed the technique to examine bullets, using a comparison microscope, to determine whether or not a particular gun fired the bullets.
Alphonse Bertillon (1853 – 1914)	"Father of Anthropometry"	Developed a system to distinguish one individual person from another based on certain body measurements.
Sir Francis Galton (1822 – 1911)	"Father of Fingerprinting"	Developed fingerprinting as a way to uniquely identify individuals.
Leone Lattes (1887 – 1954)	"Father of Blood Typing"	Discovered that blood can be grouped into different categories
Albert S. Osborn (1858 – 1946)	"Father of Questioned Documents"	Considered to be the final authority on document examination
Walter <u>McCrone</u> (1916 – 2002)	"Father of Microscopy"	Educated thousands of forensic scientists in the application of microscopic techniques
Edmond <u>Locard</u> (1877 – 1966)	"Father of the Crime Lab"	Director of the world's first forensic laboratory in Lyon, France. Pioneered the use of forensic science in practical application to criminal cases and established several important ideas that are still a part of forensic studies today.

Quick Independent Notes

Q: How did fingerprints come to be used as evidence?

- The oldest known documents showing fingerprints date from third century B.C. **China**.
- In **ancient Babylon** (dating back to 1792-1750 B.C.), fingerprints pressed into clay tablets marked contracts.
- The earliest written study (1684) is **Dr. Nehemiah's** paper describing the patterns he saw on human hands under a microscope, including the presence of ridges.
- **In 1788, Johann Mayer noted that the arrangement of skin ridges is never duplicated in two persons.** He was probably the first scientist to recognize this fact.

Q: How did fingerprints come to be used as evidence?

- Nine fingerprint patterns were described in 1823 by **Jan Evangelist Purkyn**.
- In 1856 **Sir William Herschel** began the collection of fingerprints and noted they were not altered by age.
- **Alphonse Bertillon** created a way to identify criminals that was used in 1883 to identify a repeat offender.
- In 1888, **Sir Francis Galton** and **Sir Edmund Richard Henry** developed the fingerprint classification system that is still in use in the United States.



Q: How did fingerprints come to be used as evidence?

- In 1891, Iván (Juan) Vucetich improved fingerprint collection.
- In 1896, **Sir Henry** created a system that divided fingerprints into groups.
 - Along with notations about individual characteristics, **all ten fingerprints were imprinted on a card (called a ten card).**

The image shows a standard fingerprint card (ten card) with a grid of ten individual fingerprints and two simultaneous impressions of four fingers. The card is divided into sections for personal information and fingerprint impressions.

Form Fields:

- LEAVE BLANK
- TYPE OR PRINT ALL INFORMATION IN BLACK
- LAST NAME NAM FIRST NAME MIDDLE NAME
- DATE USAGE
- NATURE OF PERSON FINGERPRINTED
- DATE ARRESTED OR RECEIVED DOA SEX RACE HGT. WGT. EYES HAIR PLACE OF BIRTH POB
- SIGNATURE OF OFFICIAL TAKING FINGERPRINTS
- YOUR NO. OCA
- FBI NO. FBI
- SID NO. SID
- SOCIAL SECURITY NO. SOC
- CLASS.
- REF.
- CAUTION

Fingerprint Impressions:

- THUMB 2. R. INDEX 3. R. MIDDLE 4. R. RING 5. R. LITTLE
- THUMB 7. L. INDEX 8. L. MIDDLE 9. L. RING 10. L. LITTLE
- LEFT FOUR FINGERS TAKEN SIMULTANEOUSLY
- L. THUMB
- RIGHT FOUR FINGERS TAKEN SIMULTANEOUSLY

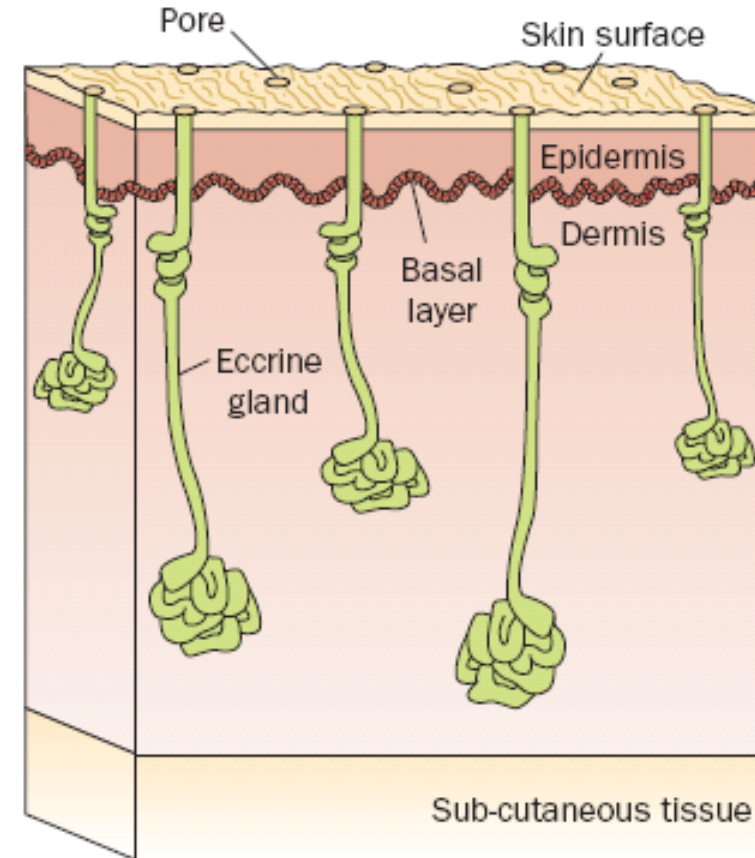
Essential Vocabulary

- **Fingerprint**
- **Ridge Pattern**

Q: How are fingerprints formed?

Q: What are Fingerprints?

- An animal's external tissue (skin) consists of (a) an inner dermis and (b) an outer epidermis.
- The creation of fingerprints occurs in the **basal layer** of the epidermis where new skin cells are produced.
 - Because the basal layer grows faster than the others, it collapses, forming intricate shapes.



Q: What are Fingerprints?

- All fingers, toes, feet, and palms are covered in small ridges.
 - These ridges are arranged in connected units called *dermal (friction) ridge*.
 - These ridges help us get or keep our grip on objects

Q: What are Fingerprints?

- The imprint of a fingerprint consists of natural secretions of the sweat glands that are present in the friction ridge of the skin and dirt from everyday activities
 - Anytime you touch something, you leave behind traces of these substances in the unique pattern of your dermal ridges.

Q: What are Fingerprints?

3 fundamental principles:

1. A fingerprint is an individual characteristic; no two people have been found with the exact same fingerprint pattern.

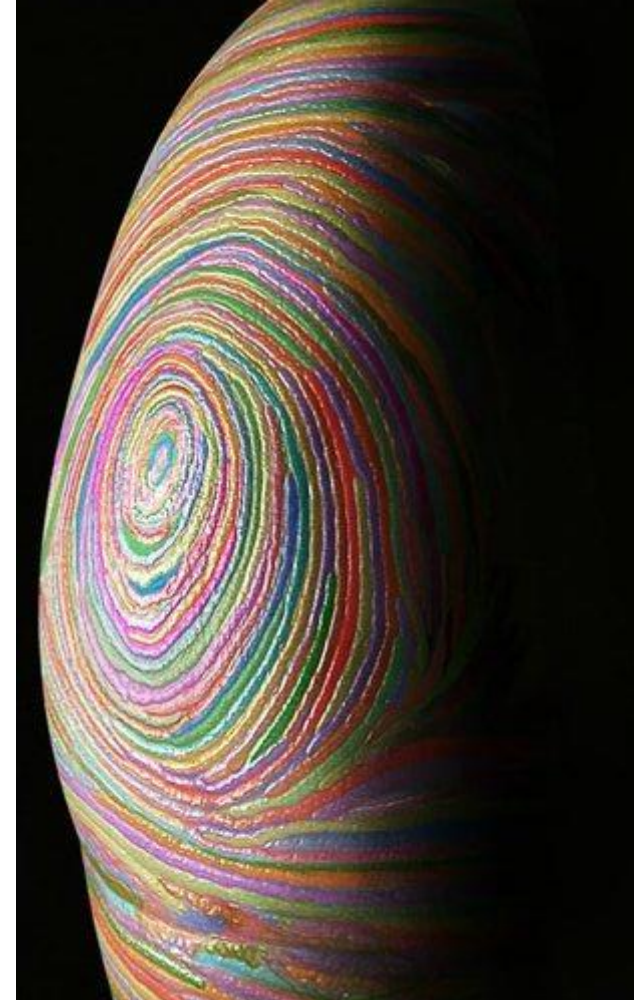


Q: What are Fingerprints?

3 fundamental principles:

2. A fingerprint pattern will remain unchanged for the life of an individual;

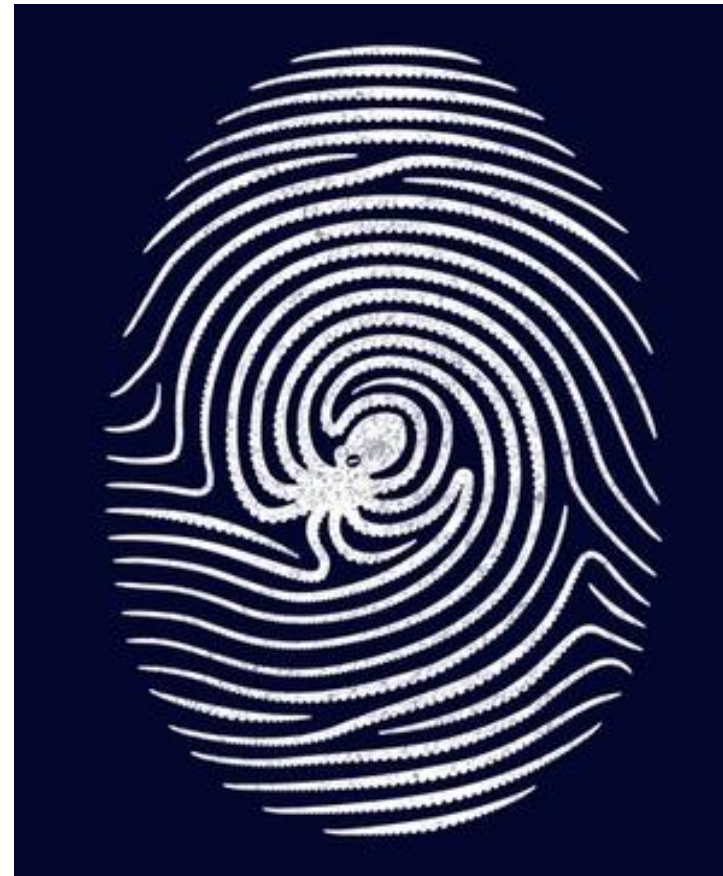
- the print itself can change due to permanent scars and skin diseases.



Q: What are Fingerprints?

3 fundamental principles:

3. Fingerprints have general characteristic ridge patterns that allow them to be systematically identified.



Fingerprint Classification

Unit 2: Sticky Fingers

Essential Vocabulary

Arch, Core, Delta, Loop, Whorl

Did You Know?

Dactyloscopy is the classification of fingerprints.

Police investigators are experts in collecting “dactylograms”, otherwise known as fingerprints.

Q: How are fingerprints classified?

There are 3 specific classes for all fingerprints based upon their visual pattern: arches, loops, and whorls.

Each group is divided into smaller groups as seen in the lists below.

Arch

Plain arch
Tented arch

Loop

Radial Loop
Ulnar loop

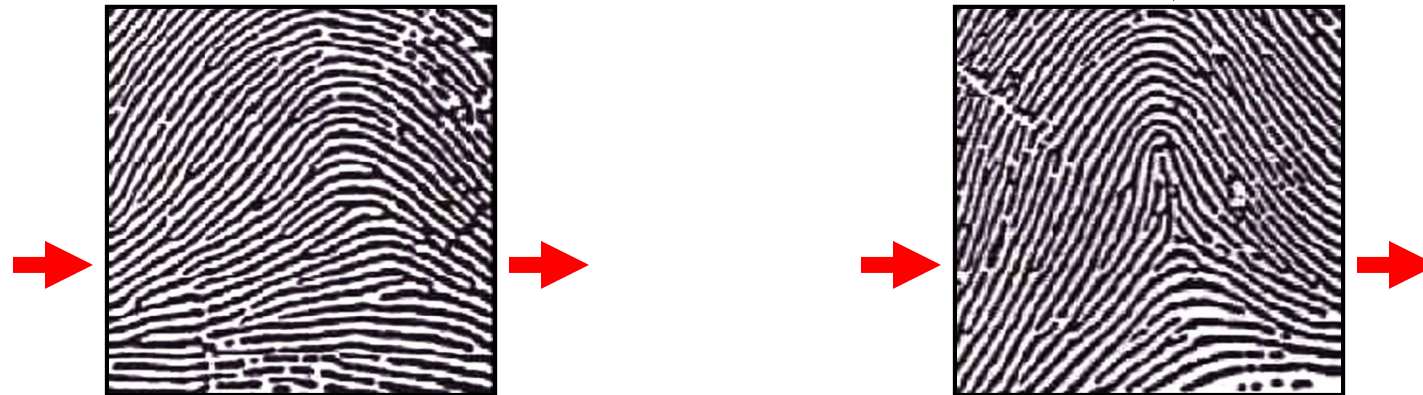
Whorl

Plain whorl
Central pocket whorl
Double loop whorl
Accidental

Q:

Arches

Arches are the **simplest type** of fingerprints that are **formed by ridges that enter on one side of the print and exit on the other**. No deltas are present.



Plain Arch

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

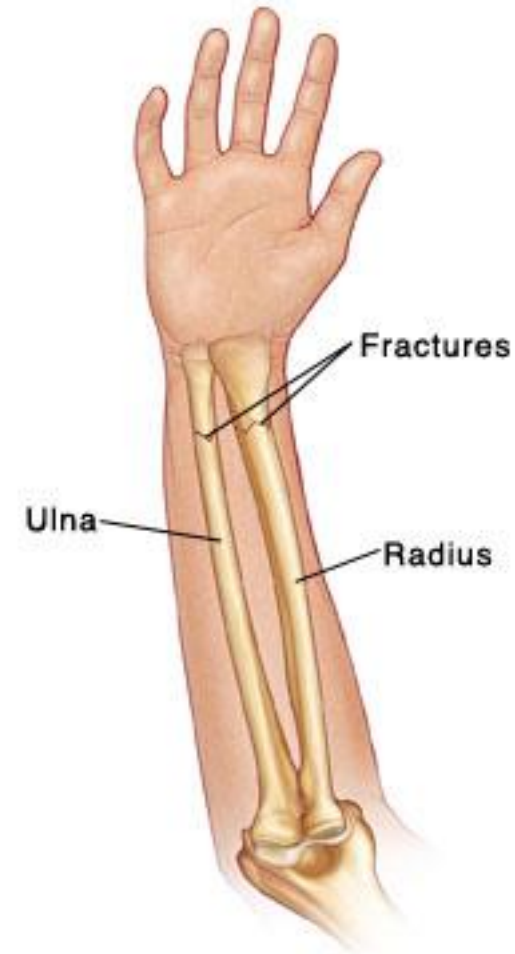
Tented Arches

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

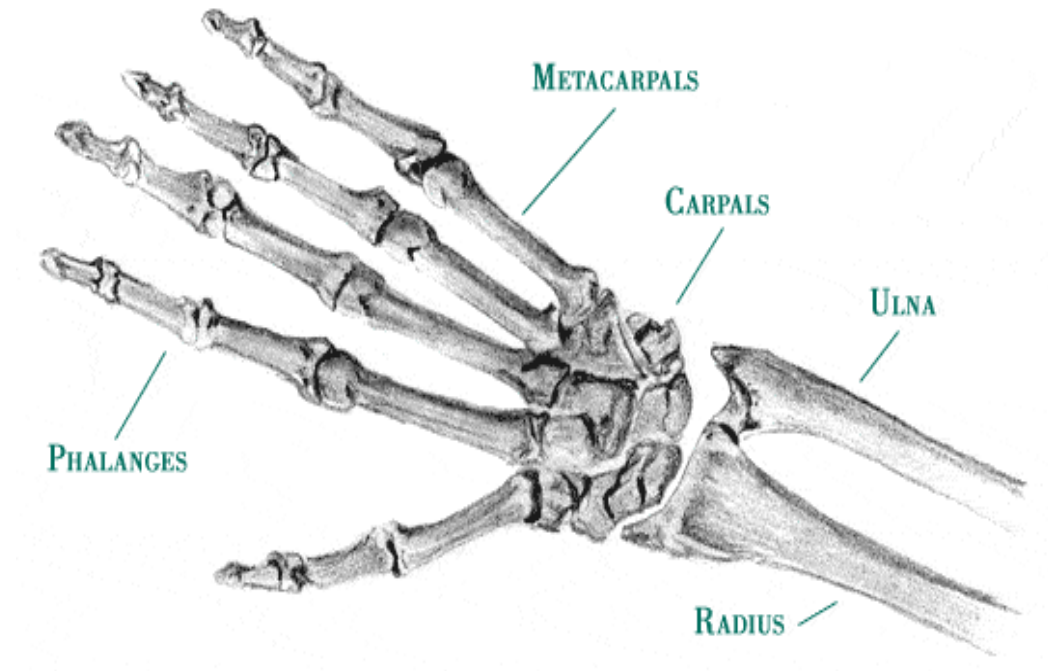
Q:

Loops

- Loops must have **one delta and one or more ridges that enter and leave on the same side.**
- These patterns are named for their positions related to the radius and ulna bones.



Hand and Wrist Bones

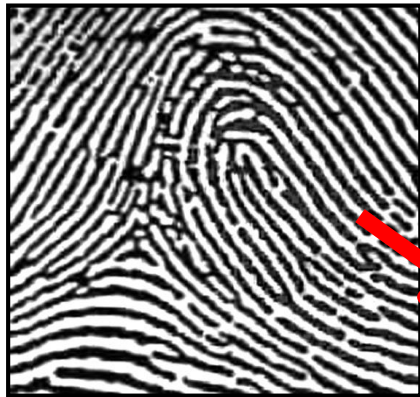


Ulna=pinky side

Think about what way your hand is facing to leave a print...

Q: How are fingerprints classified?

On the left hand, a loop that opens to the left would be an ulnar loop, while one that opens to the right would be a radial loop.



Radial Loop (Right Thumb)

Loop opens toward right or the ulna bone.



Delta



Ulnar Loop (Right Thumb)

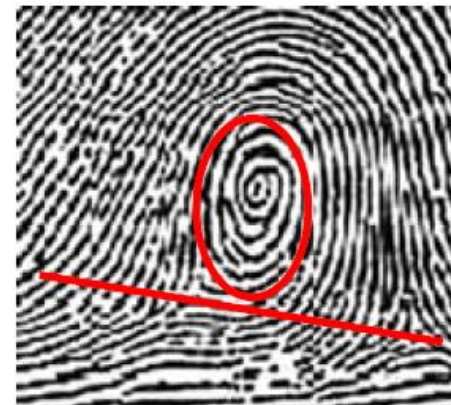
Loop opens toward the left or the radial bone.

Q: How are fingerprints classified?

Whorls

Whorls have **at least one ridge that makes (or tends to make) a complete circuit**. They also have **at least two deltas**. If a print has more than two deltas, it is most likely an accidental.

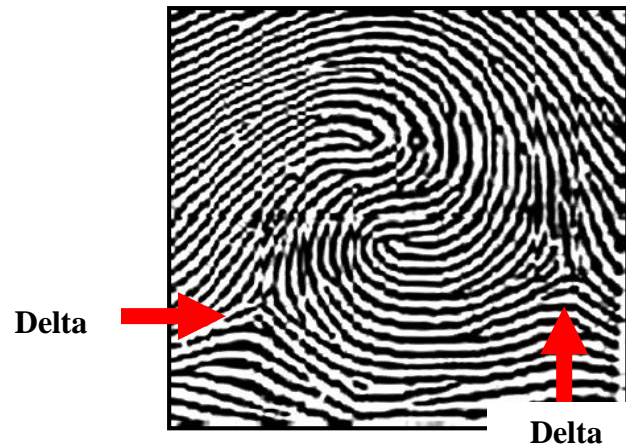
Plain
Whorl



Central
Pocket
Whorl

Q:

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** (not including the plain arch), or does not clearly fall under any of the other categories.

Identify each fingerprint pattern.



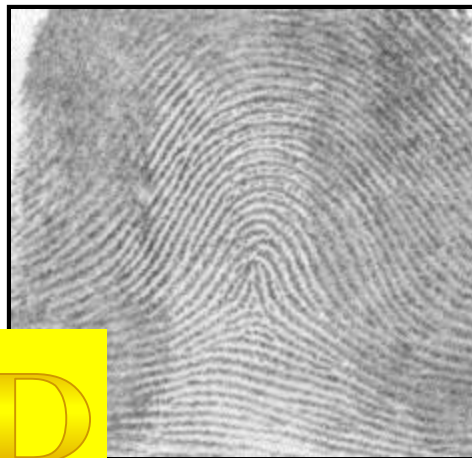
A

Left Hand



B

Right Hand



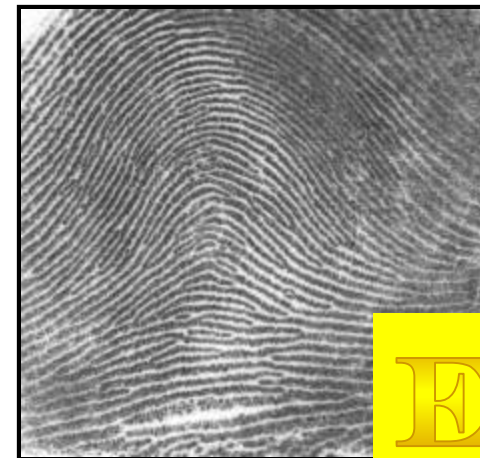
D

Right Hand



C

Right Hand



E

Left Hand

Ridgeology

A Closer Look at Fingerprints



Yesterday we learned...

- Fingerprints can be classified into three main categories and 8 subcategories
 - Loops, whorls and arches
- **Within each category more specific distinctions can be made**

Q: What is Ridgeology?

- **Ridgeology**: The study of the uniqueness of friction **ridge** structures and their use for personal **identification**.
- The uniqueness of a fingerprint can be determined by
 - The **pattern** of ridges and valleys
 - The **minutiae** points (points where the ridge structure changes)

Essential Vocabulary

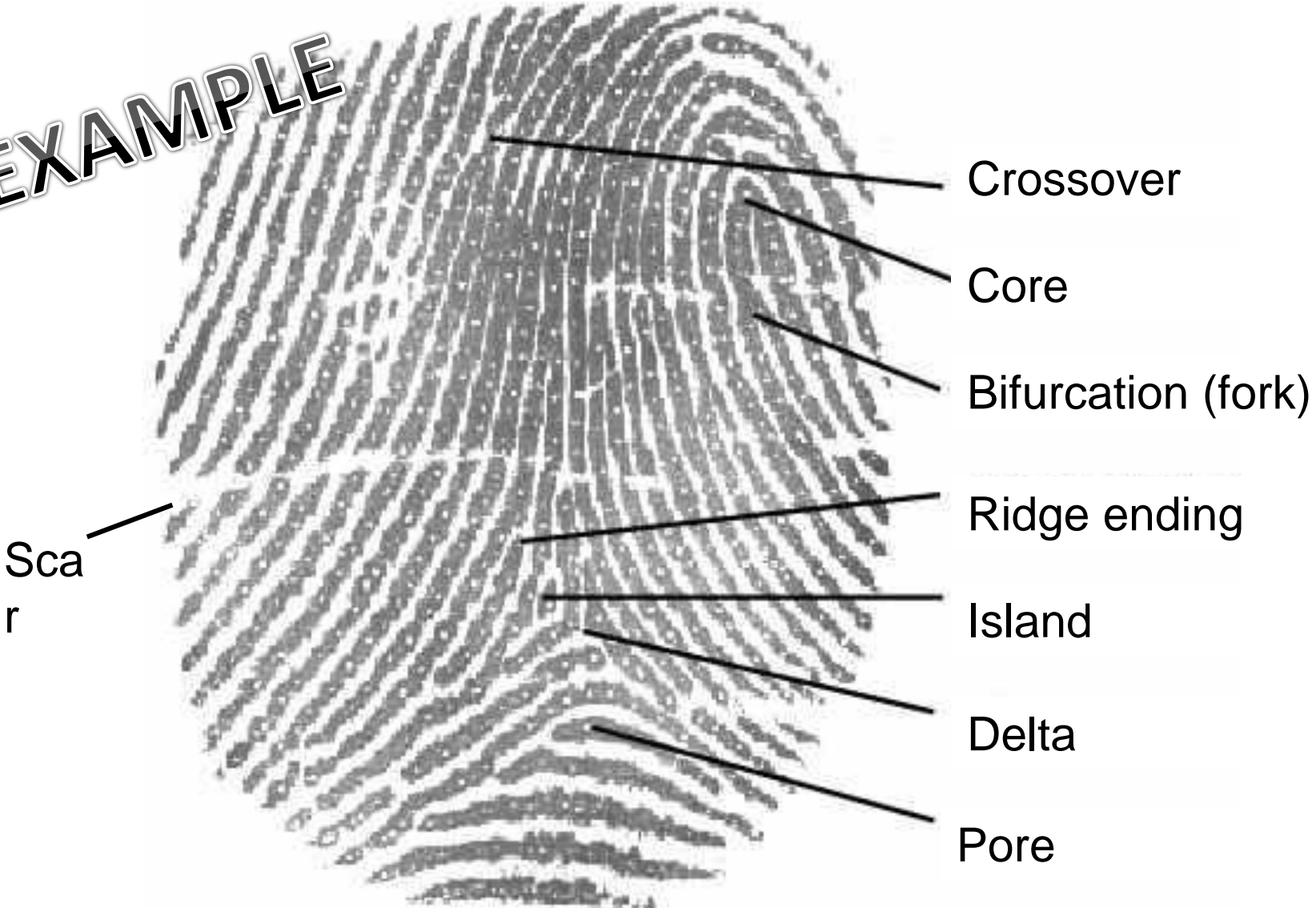
- **Points of Similarity:** where minutiae on two different fingerprint impressions meet
- **Points of Dissimilarity:** where minutiae do not meet these criteria
- **Points of Identification:** when sufficient minutiae are located in the same sequence and an identification is assumed

Q: What is Ridgeology?

- When minutiae on two different prints match, these are called **points of similarity** or **points of identification**.
- At this point there is **no international standard** for the number of points of identification required for a match between two fingerprints.
 - The United Kingdom requires a minimum **sixteen** points while Australia requires **twelve**.
 - **The US requires twelve**

Ridge Characteristics

EXAMPLE



Q: So how do we match 'em?

- Fingerprints can be compared to each other by examining the minutiae to determine whether:
 - **The same minutiae are present** (eg. a bifurcation);
 - **The minutiae flow in the same direction** (eg. the bifurcation is on a ridge running horizontally and the two divided ridges are to the right of the bifurcation)
 - **The minutiae occupy the same relative positions to each other** (eg. the bifurcation is separated from an enclosure below it by six intervening ridges).



Fingerprint Inquiry #3

1. Slightly blow up a large balloon or half inflate a large balloon.
2. Ink both of your thumbs and carefully roll over either side of the balloon. Fully inflate the balloon and examine your thumbprint.
3. Identify your thumb pattern as a loop, whorl, or arch.
4. Identify and label 8 **different** minutiae in one of your prints. Record your findings in your notes
5. Switch balloons with a classmate; identify and label 8 **different** minutiae in their other print. Record findings in your notes.

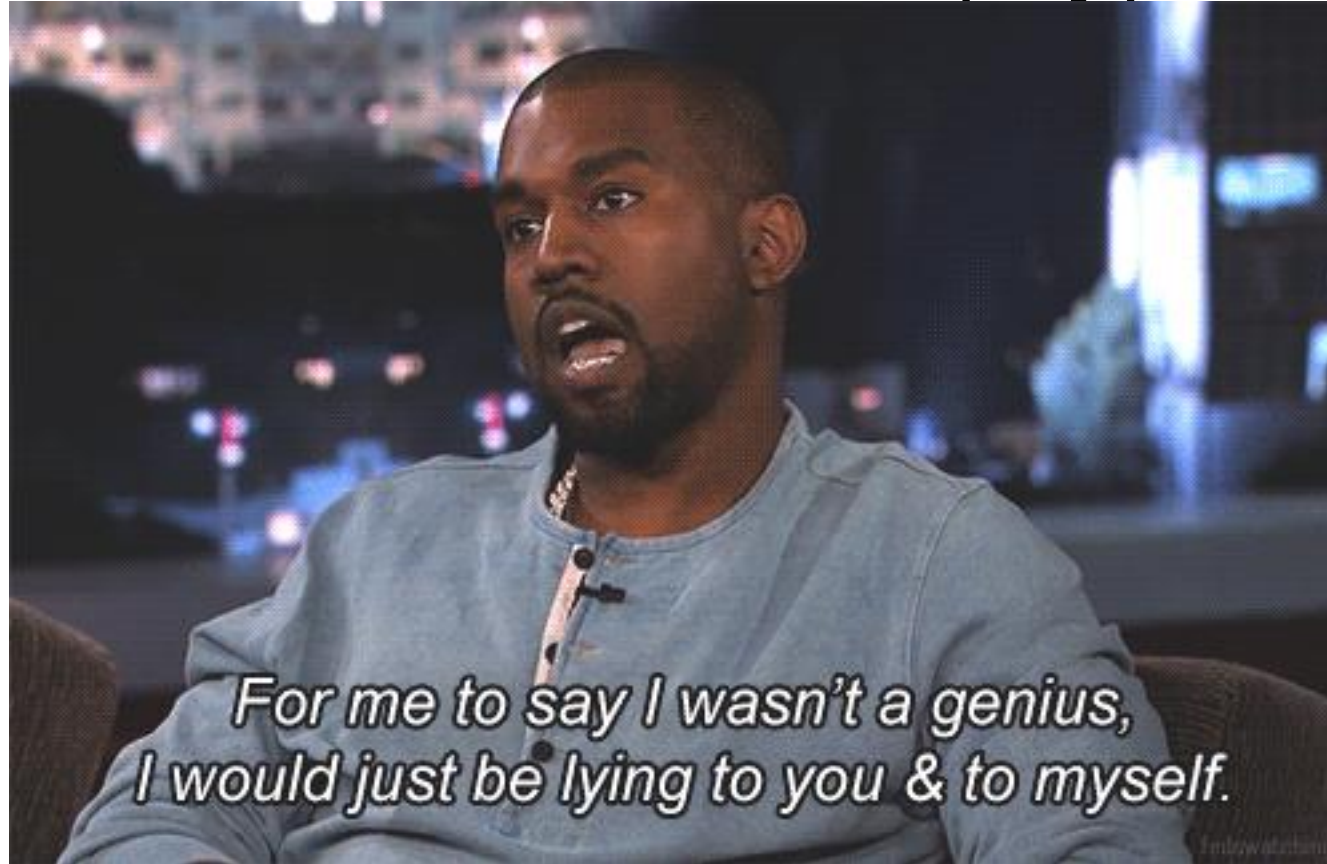
Friday | February 19, 2016

1. What are minutiae? List and draw three types.
2. What are the three fundamental principles of fingerprints?
3. What percentage of the population has whorls? Loops? Arches?
4. What are the two different kinds of loops? How can we distinguish between the two?
5. Classify the following prints (right thumbs)



SATWOTD

Pretentious (adj.)



Making claim to or creating an appearance of (often undeserved) importance or distinction

Agenda

- Warm Up/SATWOTD
 - Turn 'em in 😊
- U2: Sticky Fingers
 - Work Time
 - U2 Quiz
 - Forensic Files

Weekly Outlook:

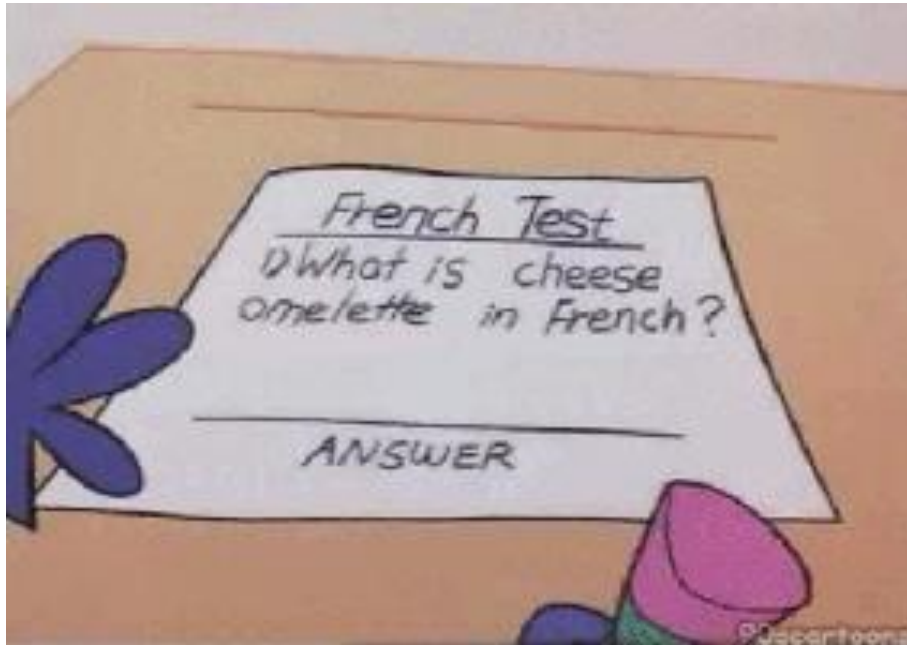
- ~~Monday: Cold Day~~
- ~~Tuesday: Intro to fingerprinting~~
- ~~Wednesday: Classification~~
- ~~Thursday: Ridegology~~
- Friday: Quiz

Work Time

- Use this time to prepare for your quiz!
 - Things that should be turned in: U2 Introduction, Sticky Fingers Activity, pink fingerprinting practice (**new****)



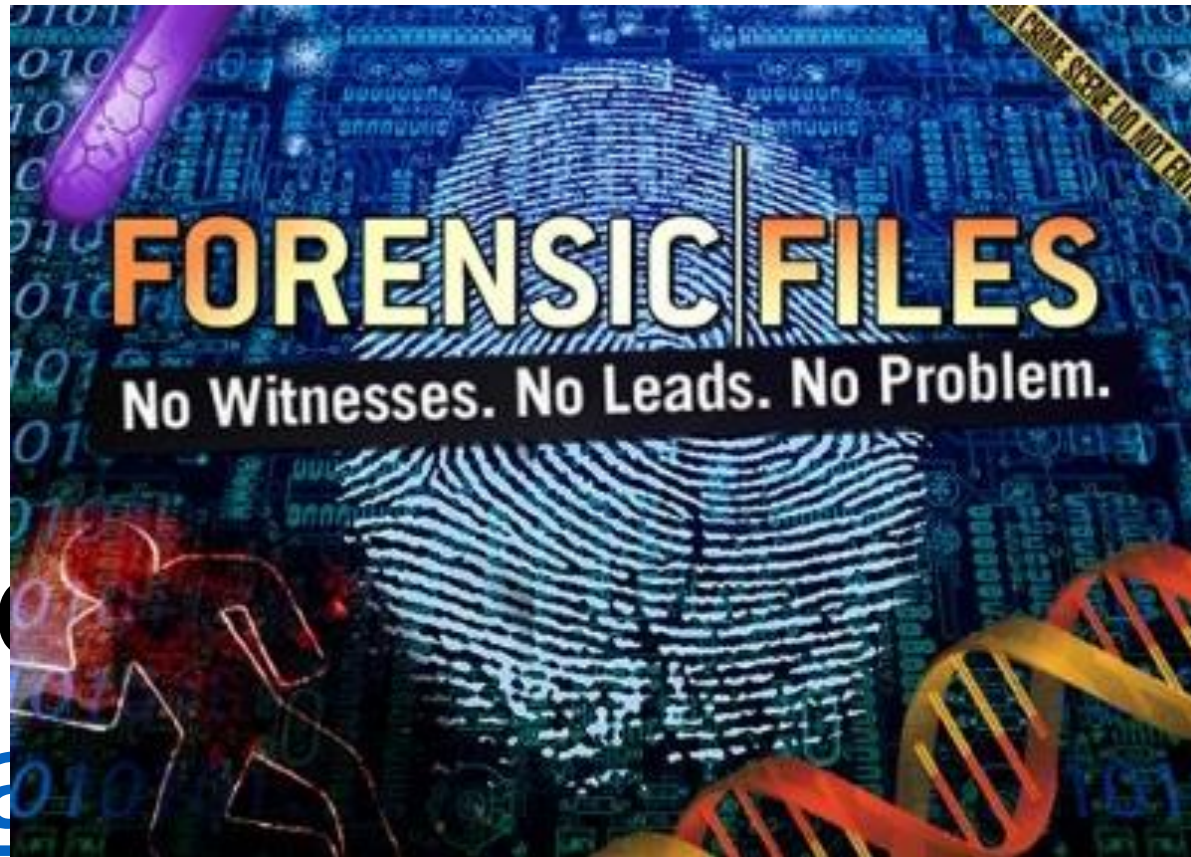
Quizzy Quiz



Bonus:

- Who is the founding father of fingerprinting?
- What is the technical name of fingerprinting?
- How many points of similarity are required in the US before they can become points of identification?

Forensic Salesman



S. 8, Ep. 33

#MysteryMonday | February 22, 2016

Grab new warm up

1. Put your returned work in your binder
2. Riddles are on your lab bench (yellow)

Happy solving!



#MysteryMonday | February 22, 2016

Solutions

1. How did the man know where the murder scene was?
2. If he killed himself, he couldn't have wound the tape back
3. Bill is the suspect, if read upside down the numbers read "Bill is boss. He sells oil."
4. The mail isn't delivered on Sunday

Bumptious (adj.)



Although Kanye is a musical genius, his self-assertive or proud to an **bumptious** nature causes some people irritating degree to dislike him.

Agenda

- Warm Up/SATWOTD
- U2: Sticky Fingers
 - Quiz Results
 - Sticky Fingers pt. 2
 - Developing Prints

Weekly Outlook:

- Monday: Developing Prints
- Tuesday:
- Wednesday:
- Thursday:
- Friday:

Quiz Results

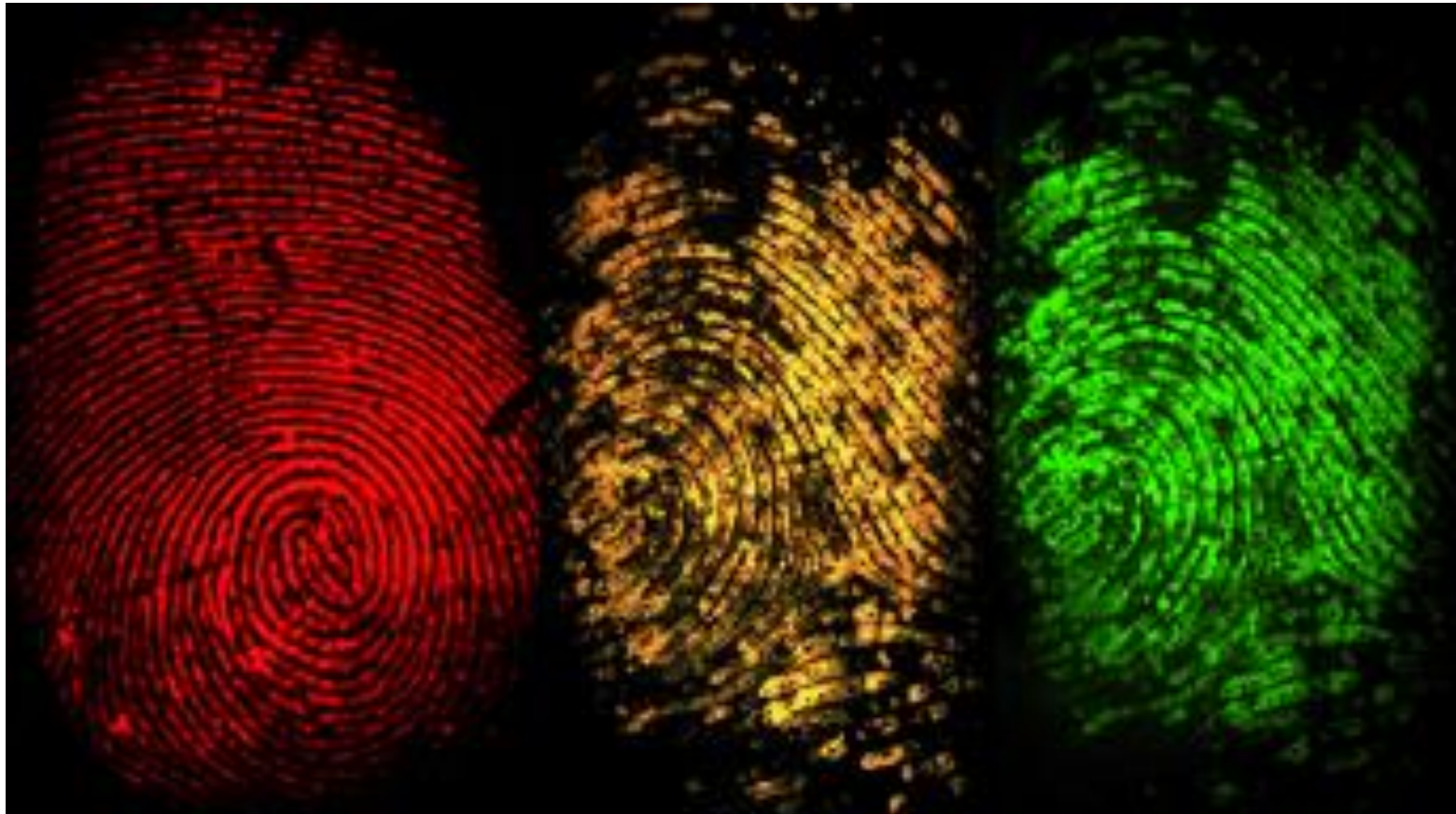


82.7%

Lets Review: Sticky Fingers pt. 2

- Three weeks ago a local bakery was robbed at gunpoint. The thief wore a mask, so even when the police found a suspect the bakery owner couldn't make a positive ID. However, as the CSI processing the scene, you collected several fingerprints from various parts of the bakery. The police have identified a suspect, but he says he's never been to that bakery.
- **Your task:** determine if the suspect's fingerprints match any of those recovered at the scene of the crime.

Developing Prints



Essential Vocabulary

- Latent Fingerprint
- Patent Fingerprint
- Plastic Fingerprint
- Ten Card

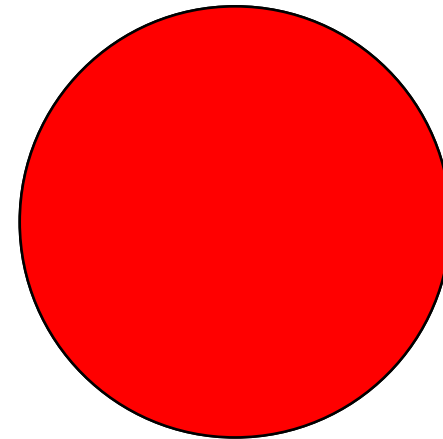
Latent Print



“Book Work”

- Let’s practice a skill that we will all need in our pursuit of a higher education: **taking useful notes from a text**
 - To get some practice, I have given you some guiding questions.
 - Please be thorough, we will be using these for our activities over the next few days

20 minutes



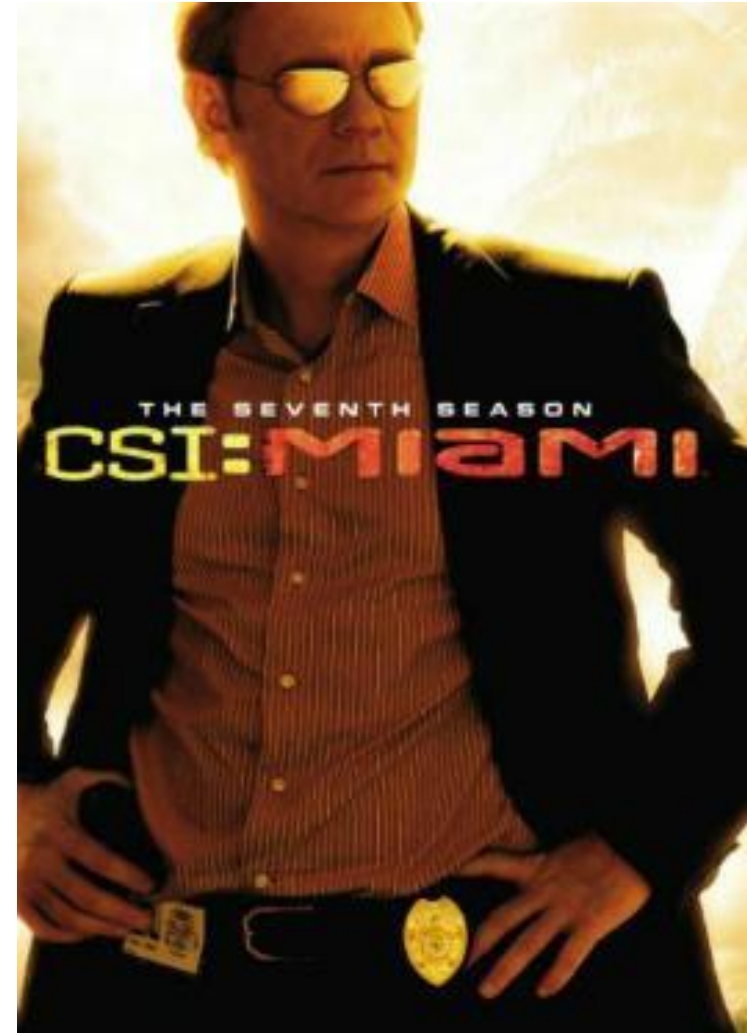
I Spy....

- We're going to watch an episode of **CSI Miami**
 - Take notes like we did last time.
 - Pay special attention to the use of fingerprints

CSI: Miami

“Power Trip”

S. 7, Ep. 9



Hmm....

- Can fingerprints be altered or disguised?
- How reliable is fingerprinting as a means of identification?
- How are fingerprints analyzed?
- How are **latent** prints collected?

Forensic Files: [Touch of Evil](#)

Tuesday | February 23, 2016

- Define the following terms in your own words: visible prints, plastic prints, latent prints
- On what type of surface would you use the dust and lift method?
- What is AFIS?

Q: What are the different **types of fingerprints?**

✦ **Visible Prints**

✦ made after coming in contact with colored material such as blood, paint, grease, or ink.

✦ **Plastic Prints**

✦ ridge impressions left on a soft material such as putty, wax, soap, or dust.

Q: What are the different **types** of fingerprints?

- **Latent Prints** = Invisible prints
 - Impressions caused by the transfer of body perspiration or oils present on the finger to the surface of an object.
 - Latent prints **must be developed** or made visible

ACTWOTD

Frugal (adj.)



Sparing or economical with regard
to money or food

Agenda

- Warm Up/SATWOTD
 - U2: Sticky Fingers
 - Development Review
 - Lyle and Louise
 - Introduction
 - Pre-lab
- Weekly Outlook:**
- ~~Monday: Developing Prints~~
 - Tuesday: Developing Prints
 - Wednesday: Lab
 - Thursday: Review
 - Friday: U2 Exam

Let's Review

Q: What are the different **types of fingerprints?**

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Q: How can we develop latent prints?

Dusting

- **Appropriate Surface:**
 - Ridged/non-porous such as glass, plastic, or metal
- **Theory:**
 - Dust will adhere to sweat & oils left behind

1. Cover Surface With Dust

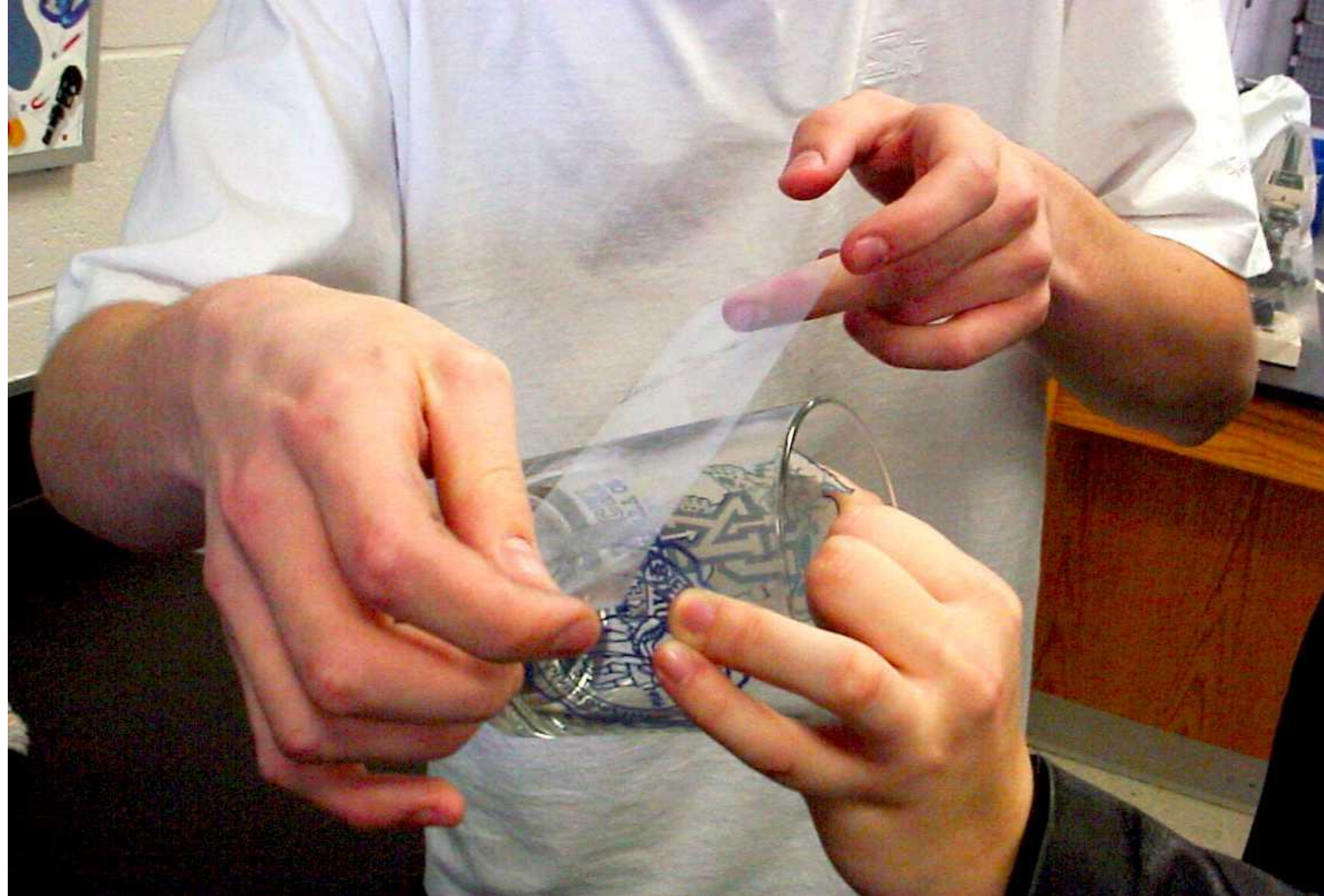


2. Remove Excess Dust



Brush or Blow

3. Use Tape to Lift the Print



4. Place Print on a Card



Q: How can we develop latent prints?

- Other methods:
 - Fuming
 - Iodine/super glue
 - Ninhydrin
 - Silver Nitrate
 - Cyanoacrylate Vapor

Let's piece it all together

Q: How can we develop latent prints?

- Cyanoacrylate is super glue and will make you sneeze
- Iodine is the same color as a grizzly bear
- Wear gloves and don't be salty with AgNO_3
- You need a special light to see Silver Nitrate
- Wait a day to see protein with Ninhydrin
- Use fuming when something is unpainted

Chemical	Uses	Application	Safety	Chemical Reaction	Latent Print
Ninhydrin	Paper	Object dipped or sprayed in Ninhydrin Wait 24 hours	Do not inhale or get on your skin	Reacts with amino acids (proteins) found in sweat	Purple-blue print
Cyanoacrylate Vapor	Household items: plastic, metal, glass, and skin	Heat sample in a vapor tent	Do not inhale or get on your skin: irritant to mucous membranes	Reacts with amino acids	White print
Silver Nitrate	Wood Styrofoam	Object dipped or sprayed in Silver Nitrate	Wear gloves to avoid contact with skin	Chloride from salt in perspiration on the print combines with silver nitrate to form silver chloride	Black or reddish brown print under UV light
Iodine Fuming	Paper Cardboard Unpainted surfaces	In a vapor tent, heat solid iodine crystals	Toxic to inhale or ingest	Iodine combines with carbohydrates in latent print	Brownish print (fades quickly) must be photographed or sprayed with a solution of starch

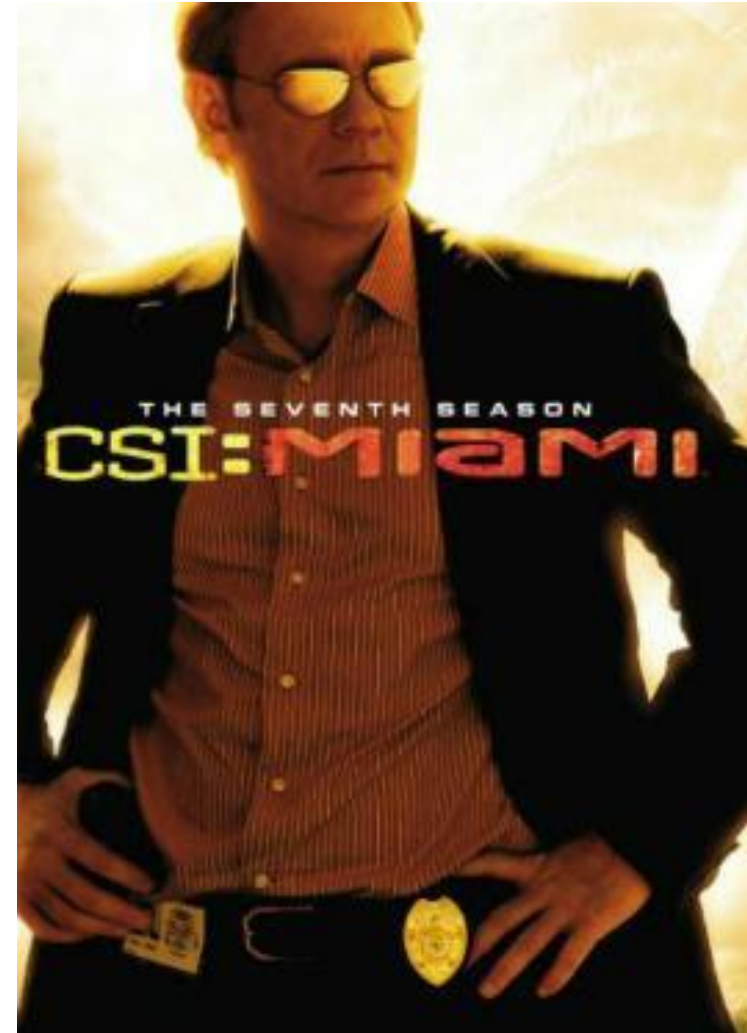
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CSI: Miami

“Power Trip”

S. 7, Ep. 9



Forensics Factoid



The koala is one of the few mammals (other than primates) that has fingerprints.

In fact, koala fingerprints are remarkably similar to human fingerprints; even with an electron microscope, it can be quite difficult to distinguish between the two.

Agenda

- Warm Up/SATWOTD
- U2: Sticky Fingers
 - Review Work Time
 - CSI Miami

Weekly Outlook:

- ~~Monday: Developing Prints~~
- ~~Tuesday: Developing Prints~~
- Wednesday: Review
- Thursday: Lab Day
- Friday: U2 Exam

Work Time.

Review Sheet | Extra Practice Worksheet



This is time to get your work done.
Quietly and semi-independently