<u>Warmup</u>: *Read the case study about the murder of Laci Peterson on* ***page 610***. *Then answer these questions:*

1.10: Physical Evidence

SFS1- Recognize and classify various types of evidence in relation to the definition and scope of Forensic Science:

b. Distinguish and categorize physical and trace evidence (e.g. ballistics, drugs, fibers, fingerprints, glass, hair, metal, lip prints, soil, and toxins).

1/26/17

Part I: Common Types of Physical Evidence

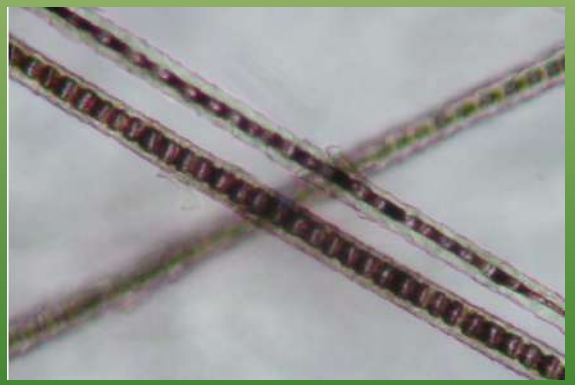
- blood, semen, and saliva
- documents
- drugs
- explosives
- fibers
- fingerprints
- firearms/ammunition
- glass
- hair
- impressions
- organs/physiological fluids
- paint
- petroleum products
- plastic bags
- plastic/rubber/other polymers
- powder residues
- serial numbers
- soil and minerals
- tool marks
- vehicle lights
- wood/other vegetative matter

You will **research** and **produce a product** on one of these types of physical evidence later on today.

Part II: The Examination of Physical Evidence

- **identification** = the process of determining of the physical or chemical identity of a substance (with as near absolute certainty as existing analytical techniques will permit)
  - for example, the crime laboratory is frequently asked to identify:
    - the chemical composition of an **illicit-drug** preparation that may contain heroin, cocaine, barbiturates, etc.

    - **gasoline** in residues recovered from the debris of a fire
    - the nature of **explosive** residues—for example, dynamite or TNT
    - blood, semen, hair, or wood = test for **species origin** (dog/cat/human, pine/cherry)



- blood, semen, hair, or wood = test for **species origin** (dog/cat/human, pine/cherry)
- each of these requests requires the analysis and ultimate identification of a **specific physical or chemical substance** to the exclusion of all other possible substances

- the process of identification first requires the adoption of **testing procedures** that give characteristic results for specific standard materials
  - once these test results have been established, they may be permanently recorded and **used repeatedly** to prove the identity of suspect materials
    - for example, to be certain that a particular suspect powder is heroin, the test results on the powder must be **identical** to those that have been previously obtained from a **known** heroin sample

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- second, identification requires that the **number** and **type** of tests needed to identify a substance be sufficient to **exclude** all other substances.
  - test results must be **comprehensive** enough to exclude all other substances from consideration
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- ultimately, the conclusion will have to be substantiated beyond any reasonable doubt in a court of law (meaning **the jury ultimately decides the significance of the evidence**)
- **comparison** = the process of ascertaining whether two or more object have a common origin
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  - a suspect may be placed at a particular location by noting similarities between a **hair** found at the crime scene and hairs removed from a suspect's head
  - a **paint chip** found on a hit-and-run victim's garment may be compared with paint removed from a vehicle suspected of being involved
- forensic comparison is actually a two-step procedure:
  - first, combinations of select properties are chosen from the **suspect** and the **standard/reference specimen** for comparison to try to improve the ultimate evidential value of the conclusion
  - second, the forensic scientist must draw a **conclusion** about the origins of the specimens

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  - if one or more of the properties selected for comparison **do not agree**, the analyst will conclude that the specimens are **not the same** and hence could **not** have originated from the same source
  - on the other hand, what if all the properties do **match** and the specimens are considered to be **indistinguishable**? Did they come from the same source? Not necessarily so.
- to comprehend the evidential value of a comparison, one must appreciate the role that **probability** has in ascertaining the origins of two or more specimens
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  - hence, the probability of the event (heads) occurring is **50 in 100**, or **50%**
  - in other words, probability **defines the odds** at which a certain event will occur

SELF-CHECK QUESTIONS!

True or False: In a ~~comparison~~ test, the goal is to identify a specific physical or chemical substance to the exclusion of all other possible substances.

False

(should read identification)

True or False: A paint chip found on a hit-and-run victim's garment may be compared with paint removed from ~~any vehicle of the same make and model.~~

False

(from the suspect's vehicle)

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Part III: Individual vs. Class Characteristics

- evidence that can be associated with a common source with an extremely high degree of probability is said to possess **individual characteristics**—examples include:
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- evidence that can be associated with a common source with an extremely high degree of probability is said to possess **individual characteristics**. Examples include:
  - **ridge** characteristics of fingerprints
  - random **striation** markings on bullets or tool marks
  - irregular and random **wear patterns** in tire or footwear impressions
  - **handwriting** characteristics
  - **irregular edges** of broken objects that can be fit together like a jigsaw puzzle
  - **sequentially** made plastic bags that can be matched by striation marks running across the bags

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- in all of these cases, it is **not** possible to state with **mathematical exactness** the probability that specimens are of common origin—it can only be concluded that this probability is **so high** as to defy mathematical calculations or human comprehension
  - for example, the probability of two individuals having the same fingerprints is one out of $\mathbf{1 \times 10^{60}}$, or 1 followed by **sixty** zeros. (1,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000)
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- this probability is so small as to **exclude** the possibility of any two individuals having the same fingerprints (only 7 billion people alive today, or 7×10^9 people)
- this contention is also supported by the **experience** of fingerprint examiners who, after classifying millions of prints over the past hundred years, have never found any two to be exactly alike

- evidence is said to possess **class characteristics** when it can be associated only with a group and never with a single source
- probability is a determining factor—for example:
  - if we compare two **one-layer** automobile paint chips of a similar color, their chance of originating from the same car is not nearly as great as when we compare two paint chips having **seven similar layers** of paint, not all of which were part of the car's original color.

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  - the **one-layer** paint chips will have **class** characteristics and could only be associated at best with **one car model** (which may number in the thousands)

  - the **seven-layer** paint chips may be judged to have **individual** characteristics and to have a high probability of originating from **one specific car**

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  - suppose that two blood specimens are compared and both are found to be of human origin, **type A** (the frequency of occurrence in the population of type A blood is **26%**)
  - however, if **other blood factors** are also determined and are found to compare, the probability that the two blood samples originated from a common source increases
  - thus, if you use a series of blood factors that occur independently of each other, you can calculate the **overall frequency** of occurrence of the blood in a population using the **product rule**
    - for example, in the O.J. Simpson case, a bloodstain located at the crime scene was found to contain a number of factors that compared to O.J.'s blood (see table)

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Blood Factors	Frequency
A	26%
EsD	85%
PGM 2+2–	2%

- the **product** of all the frequencies shown in the table determines the probability that any one individual possesses such a combination of blood factors
- applying the product rule, 0.26 × 0.85 × 0.02 equals 0.0044. or **0.44%**, or **1 in 200** people who would be expected to have this particular combination of blood factors
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- as we will learn later on, the product rule is used to determine the frequency of occurrence of **DNA profiles** typically determined from blood and other biological materials.
- importantly, modern DNA technology provides enough factors to allow an analyst to **individualize** blood, semen, and other biological materials down to **a single person**.

SELF-CHECK QUESTIONS!

Can we say with 100% accuracy that the blood belonged to O.J.?

No, this evidence only has class characteristics

Define "product rule."

Formula for determining the frequency at which a combination of separate characteristics occurs in the population by using the product of each characteristics probability

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INDIVIDUAL CHARACTERISTICS	CLASS CHARACTERISTICS
bullets recovered from a body	a single-layer paint chip
DNA profile	carpet fibers
fingerprints	dog hair
headlight fragments that fit together	new and unused shoes
human bite marks on skin	non-fired bullets
multi-layer paint chip	screwdriver tip width
shoeprints with wear patterns	soil samples

Poster guidelines:

1. **title** (name of class of evidence)
2. **illustration/picture** of evidence (must be in color)
3. written and/or illustrated **examples**:
    1. at least one example of your type of evidence exhibiting an **individual** characteristic
    2. at least one example of your type of evidence exhibiting a **class** characteristic