Introduction and History of Forensic Science

"Your Entire Being is a Matrix of Evidence Waiting to Be Left Behind…"

General Definitions

- Forensic science is the scientific study of evidence to discover the facts in a criminal or civil matter. More specifically, for our purposes:

  the science applied to solve crimes

- The term “forensic” is derived from Latin, meaning “of or before the forum.” This refers to the ancient Roman practice of resolving disputes through speech in a public forum

What is Forensic Science?

- Forensic science is the study and application of science to matters of law.

- You can use the terms forensic science and criminalistics interchangeably.

Forensic Science defined:

- Forensic Science (or Criminalistics) is the use of science & technology to enforce civil & criminal laws.

- It is vague & hard to define b/c it includes so many other areas of science.

Civil vs. Criminal Law

CIVIL LAW

- filed by a private party.
  - a corporation
  - an individual person

- Penalty: a guilty defendant pays the plaintiff for losses caused by their actions.
  - no incarceration

CRIMINAL LAW

- filed by the government

- Penalty: a guilty defendant is punished by
  - incarceration (in jail/prison)
  - fine paid to the gov't
  - execution (death penalty)

- Crimes are divided into 2 classes:
  - **misdemeanors** - less than 1 year incarceration
  - **felonies** - sentence of 1+ year

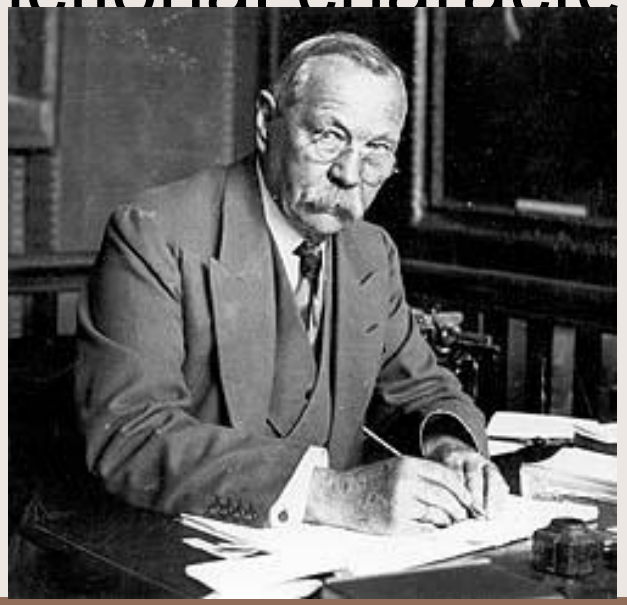
History & Development of Forensic Science

When in Rome…

- "Forensic" comes from the *Latin* word "*forensis*" meaning forum.
- During the time of the Romans, a criminal charge meant presenting the case before the public.
- Both the person accused of the crime & the accuser would give speeches based on their side of the story.
- The individual with the best argumentation would determine the outcome of the case.

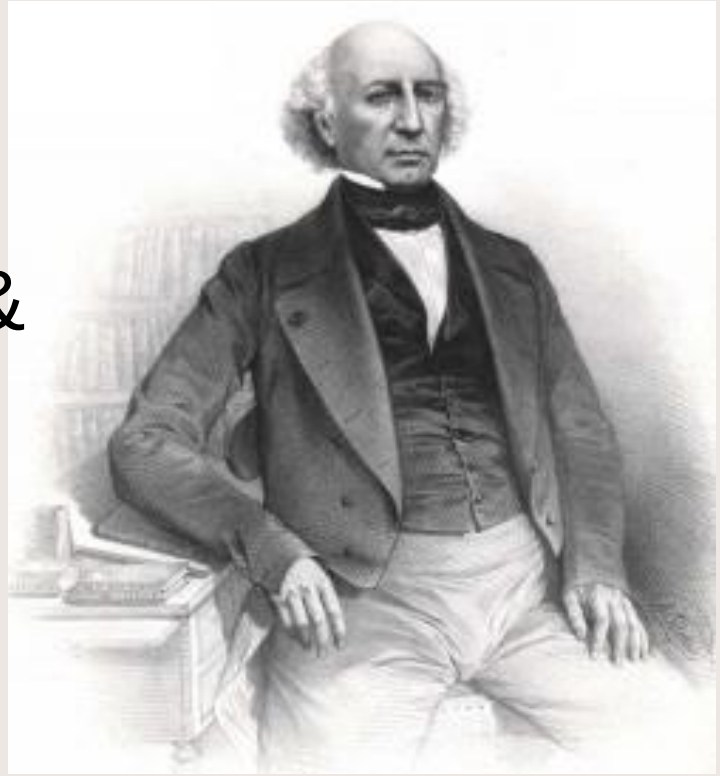
Sir Arthur Conan Doyle

- Sci-fi author in late 1800's
- Popularized scientific crime-detection methods through his fictional character 'Sherlock Holmes'.



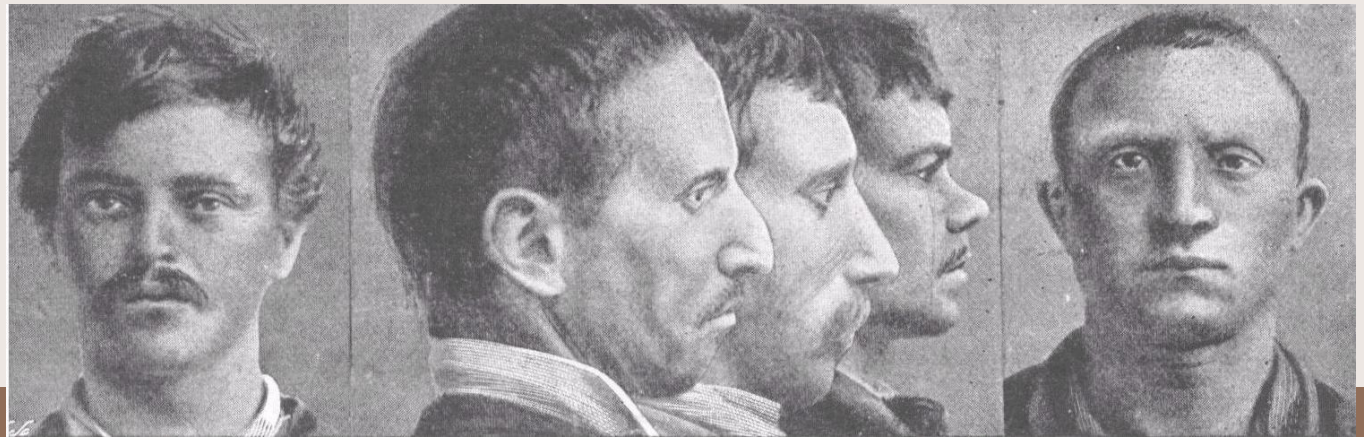
Mathieu Orfila
(1787-1853)

- "Father of Toxicology"
- Wrote about the detection of poisons & their effects on animals.

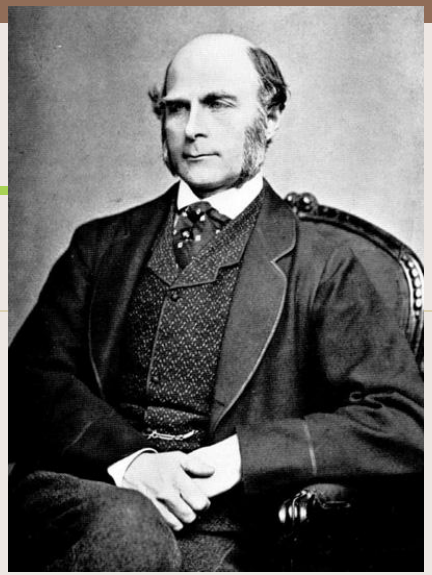


Alphonse Bertillo
(1853-1914)

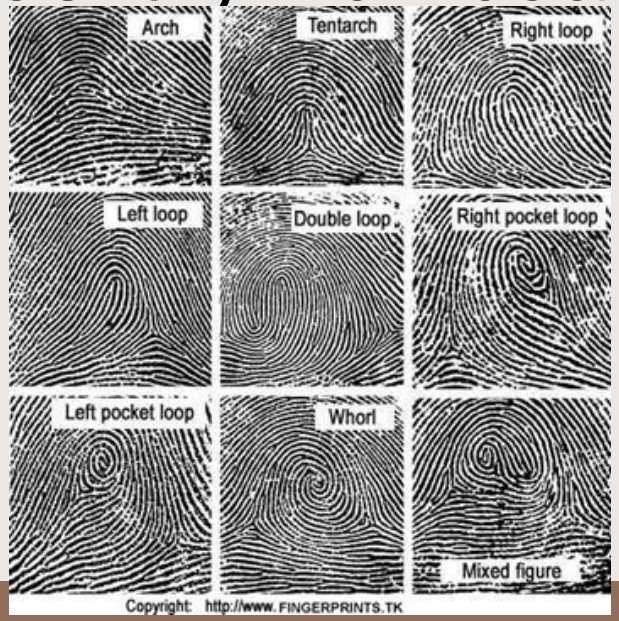
- "Father of Anthropometry"
- Developed a system to distinguish one individual person from another based on certain body measurements.



Francis Galto
(1822-1911)



- "Father of Fingerprinting"
- Developed fingerprinting as a way to uniquely identify individuals.



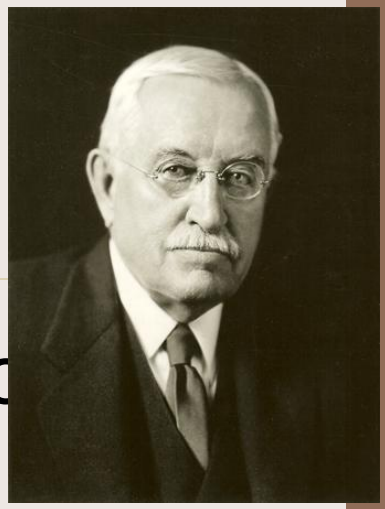
Leone Lattes
(1887-1954)

- "Father of Bloodstain Identification"
- He developed a procedure for determining the blood type (A, B, AB, or O) of a dried blood stain.

Calvin Goddard
(1891-1955)

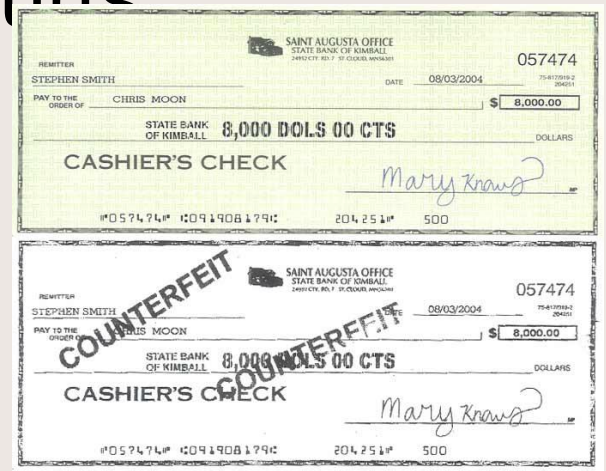
- "Father of Ballistics"
- Developed the technique to examine bullets, using a comparison microscope, to determine whether or not a particular gun fired the bullets.

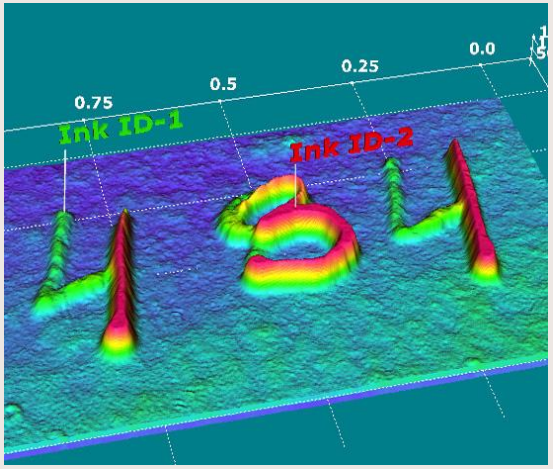
Albert Osborn
(1858-1946)



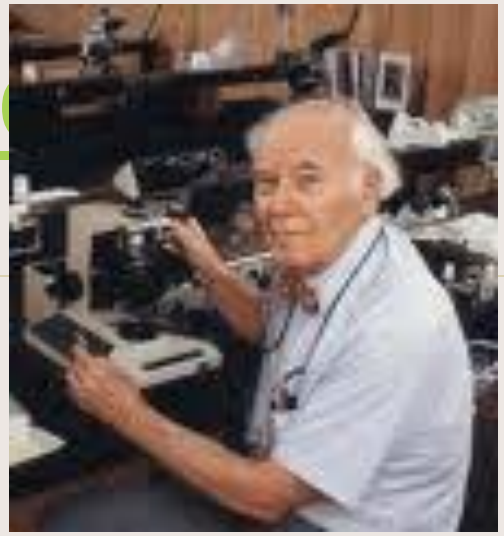
- "Father of Document Examinatio

- His work led to the acceptance of documents as scientific evidence by the courts



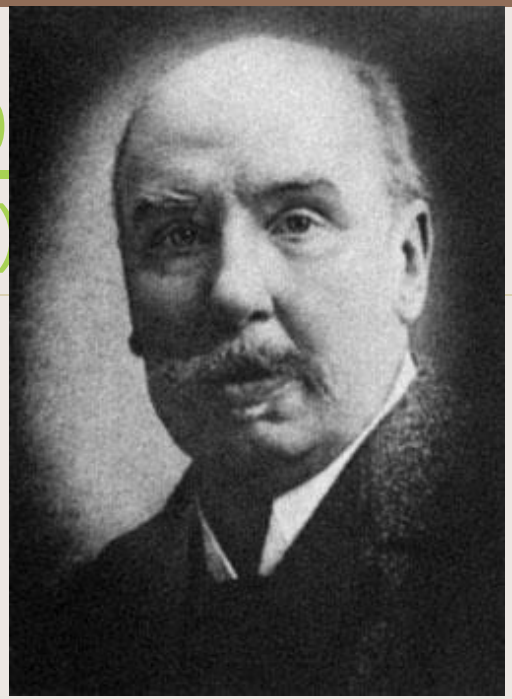


Walter McCr
(1916-2002)



- "Father of Microscopic Forensics"
- He developed & applied his microscope techniques to examine evidence in countless court cases.

Hans Gro
(1847-1915)



- “Father of Forensic Publications”
- Wrote the book on applying all the different science disciplines to the field of criminal investigation.

Edmond Loca
(1877-1966)

- "Father of the Crime Lab"
- In 1910, he started the 1st crime lab in an attic of a police station.
- With few tools, he quickly became known world-wide to forensic scientists & criminal investigators & eventually founded the *Institute of Criminalistics* in France.
- His most important contribution was the "**Locard's Exchange Principle**"

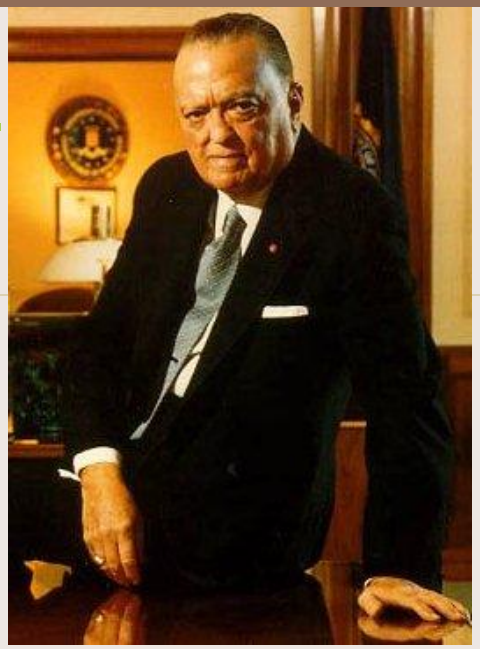
Locard's Exchange Principle

- "Every Contact Leaves a Trace."

- He believed that every criminal can be connected to a crime by particles carried from the crime scene.

- When a criminal comes in contact with an object or person, a cross-transfer of evidence occurs.

J. Edgar Hoover



- "Father of the FBI" - Director of Federal Bureau of Investigation during the 1930's
- Hoover's leadership spanned 48 yrs & 8 presidential administrations. His reign covered Prohibition, the Great Depression, WWII, the Korean War, the Cold War, & the Vietnam War.
- He organized a national laboratory to offer forensic services to all law enforcement agencies in the U.S.

The Trial of the Cen

- O.J. Simpson ***was*** a NFL football legend.
- He is now famous for having been tried for the murder of ex-wife Nicole Brown Simpson & her friend Ronald Goldman in 1994.
- He was acquitted in criminal court after a lengthy, highly publicized trial.

What went wrong?

- 1st on the scene, police found evidence of blood & entered the Simpson home without a search warrant, an action permissible b/c the situation was an emergency.

- HOWEVER, the police collected a pair of blood-stained gloves during their search.

- Collection of evidence without proper warrants became the key argument used by Simpson's legal team & ultimately led to his acquital.

What was learned?

If forensic evidence is to be admissible in court, the highest professional standards must be used at the crime scene!

People Important to Development of Forensic Science

- 14th Century Chinese- Forensic Medicine
- Orfila (Spanish physician first to systematically use autopsy material & chemical analysis & legal proof of poisoning & Raspil- Toxicology

- Alphonse Bertillon, 1930s:

- **Anthropometry**: a method of identifying criminals by their physical characteristics. This uses measurements of the head and body, facial characteristics, and mug shots of offenders.

- William Herschel, 1877- **Fingerprinting**. Herschel was a magistrate in India and began using them for registering land deeds, collecting pensions, and ensuring that convicts did not hire substitutes to serve their prison time.
- In 1888 Francis Galton designed a form for recording inked fingerprinting impressions and defined the three main pattern types and in 1900s, fingerprinting adopted by Scotland Yard who taught the St. Louis PD to use them at the 1904 World's Fair in St. Louis, MO, thus spreading the practice to the US.

- Dr. Edmond Locard pioneered the use of **trace evidence** to solve crimes. He set up the first known crime lab.

- "Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects. All of these and more, bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong, it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value."

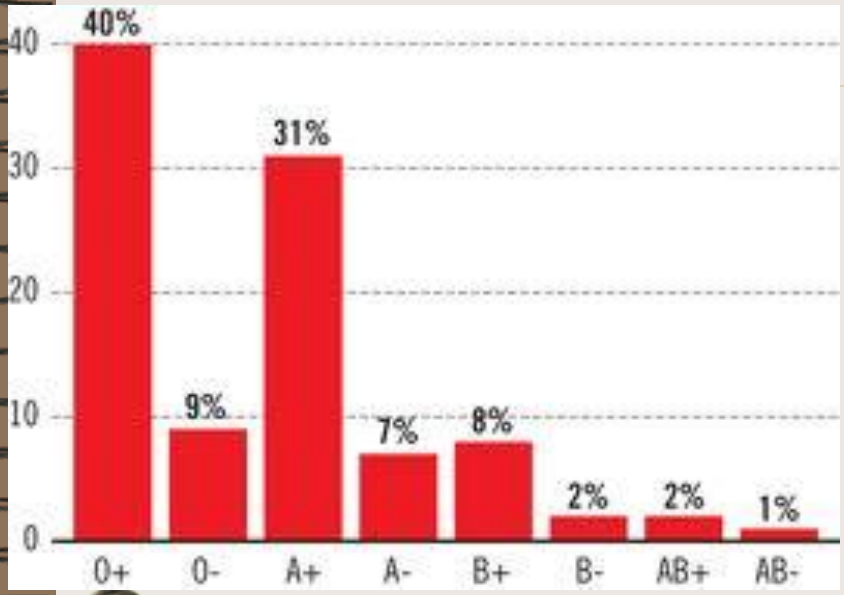
More People in Forensic Science

- Hans Gross, 1893- first person to coin the term **Criminalistics** to refer to scientific methods of identifying, apprehending, and prosecuting criminals.

History

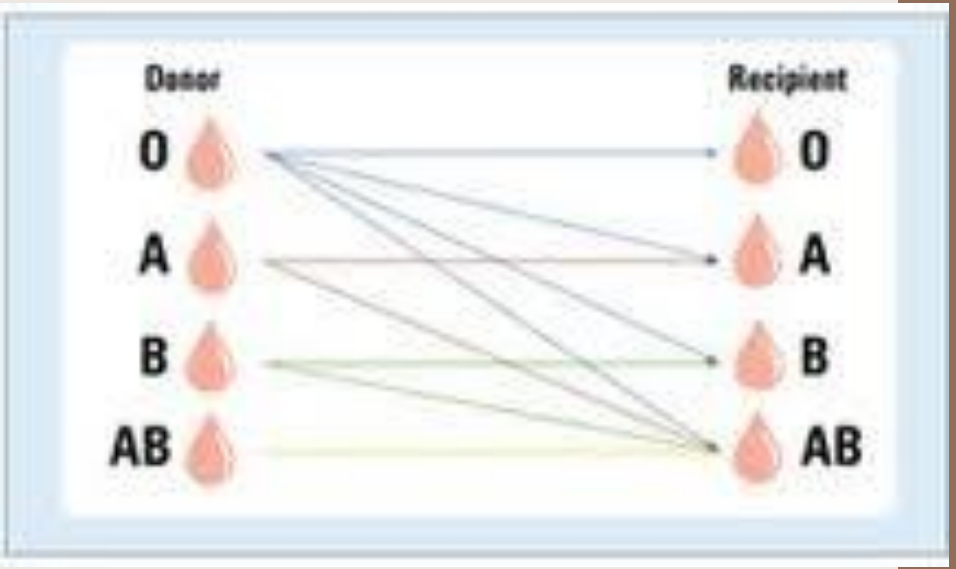
- Mathieu Orfila – the father of forensic toxicology.
- Alphonse Bertillion - devised the first scientific system of personal identification in 1879.
- Francis Galton – conducted the first definitive study of fingerprints and their classification.
- Leone Lattes – developed a procedure to determine blood type from dried blood stains.

Blood Types



O+ is most common blood type.

O is the universal donor.
AB is the universal recipient.



History

- Walter McCrone – utilized microscopy and other analytical methodologies to examine evidence.
- Hans Gross – wrote the first treatise describing the application of scientific principles to the field of criminal investigation.
- Edmond Locard – incorporated Gross' principles within a workable crime laboratory.
- Locard's Exchange Principle – states that a cross-transfer of evidence occurs when a criminal comes in contact with an object or person.

- Paul Kirk, 1950s - helped establish **criminology** as an academic discipline through his work at the University of California, Berkely. He specialized in microscopy and provided key blood spatter evidence resulting in the acquittal of Sam Sheppard in his wife's famous murder in 1955 (have you watched the movie *The Fugitive ?)*

DNA…nearly 100% accurate

- 1986, DNA was used to solve a crime for the first time when DNA profiling identified Colin Pitchfork as the murderer of two young girls in England
- Interestingly, the same case was also the first time DNA was used to exonerate an innocent suspect before Pitchfork was identified as the culprit

Where Forensic Scientists Work

- Law enforcement agencies
- Forensic Labs
- Universities
- Hospitals
- Consulting offices

Ethics

- Ethics are and extremely important part of working in forensic science. No matter which side they work for, forensic professionals must remain neutral at all times and prevent their personal feelings and opinions from getting in the way of discovering the hard facts.
- They must also be sure their work is the very best they can do, tests are conducted correctly, written reports must be accurate, and testimony must be truthful, complete, ad objective.
- Q: Why is this important?

Forensic Scientists at Work in Medical Examiner's Morgue

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Expert Witness

- Determined by…
  - Education
  - Experience
  - Training
  - Cerification
  - Demeanor

Set-ups of Labs

- Varies a lot!
- Possible sections in a lab
  - Biology/DNA
  - Chemistry/Drug?Toxicoloy
  - Firearms/Toolmarks
  - Trace (not always)
  - Arson/Explosives (not always)

Set-up of Labs Cont'd

- Questioned Docs (not always)
- Polygraph, voice Detection (not always)
- Medical Examiner (usually a separate office)

Other Areas of Forensic Science

- Forensic Art
- Forensic Psychiatry
- Forensic Odontology
- Forensic Pathology
- Forensic Engineering
- Computer Forensic
- Jurisprudence (law)

Other fields are called upon to lend their expertise in solving particular aspects of a crime….

- Accountant
- Aviation
- Computer specialist
- Environmental scientist
- Medical investigator
- Image enhancement specialist
- Forensic nurse
- Photographer
- Polygraph examiner
- Radiologist
- Speech scientist

The “CSI Effect”

- Q: Class discussion: Why do you think CSI could be good/bad.
- This is a TV series o crime and investigations.

"CSI Effect" cn't…

- Since 2000, shown in 200 countries with over two billion viewers (not to mention spin off shows such as Criminal Minds
- Some Jury members have unrealistic expectations of forensic techniques used in criminal cases:
  - How quickly they can be solved
  - forensic analysis sometimes yields more than one result (sends the investigation in multiple directions)
  - Has changes the way some criminals commit crimes (attempt to destroy evidence)
  - On positive note, it has led to increase in applications to forensic science research programs at universities

CAUSE, MANNER AND TIME OF DEATH

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Definition of Death

- In 1968 Black's Law Dictionary defined Death as: *the cessation of life; the ceasing to exist; defined by physicians as the total stoppage of the circulation of the blood, and cessation of vital functions consequent thereon, such as respiration, pulsation, etc.*

What is Death?

- **Cellular Death**
  - The tissues and their constituent cells are dead.
    - No longer function or have metabolic activity, primarily aerobic respiration
    - From cardiorespiratory failure
    - Different tissues die at different rates

Definition of Death

- **Clinical Death**
  - The cessation of respiration and circulation functioning. Resuscitation may or may not be possible.
    - Anoxia and hypothermia
      - May live for more than 5 minutes after cessation of respiration and circulation.

What is Death?

- **Somatic Death**
  - Irreversible loss of personality, being unconscious, unable to be aware of or communicate with one's environment, unable to appreciate any sensory stimuli or to initiate any voluntary movement.
  - Reflex nervous activity may persist and circulatory and respiratory functions continue either spontaneously or with artificial support so that the tissues and cells of the body, other than those already damaged in the central nervous system, are alive and functioning.

Definition of Death

- **Brain Death**
  - An irreversible process.
  - Irreversible cessation of all brain functions, including brain stem.
  - ***PVS*** – Persistent Vegetative State = permanent damage to frontal lobe function and not brain stem.

Definition of Death

- **Brain Death** is determined by:
  - Coma and cerebral responsiveness
  - Apnea
  - Fixed and Dilated Pupils
  - Absence of Cephalic Reflexes (brainstem)
  - Absence of Electrical Impulses in the Cerebrum(no EEG pattern)
    - Two physicians required to pronounce brain death; one must be a neurologist.

Death Certificate

- Medicolegal requirement of the death certificate
  - Cause and
  - Manner of Death

Death Certificate

- The death certificate has two major groupings for the cause of death:
  - Primary or immediate cause of death
  - Secondary cause of death

Primary Cause of Death

- The Primary cause of death is subdivided into a three-link sequential chain
  - Primary cause of death:
    - Hypoxemic necrosis of brain (brain death)
      due to
    - Exsanguination
      due to
    - Gunshot wound (GSW) of abdomen

Secondary Cause of Death

- Includes conditions which are not related to the primary cause of death but are substantially contributory to the individual's demise
  - Emphysema of the lungs
  - Arteriosclerotic cardiovascular disease

Cause of Death

- The reason someone dies is the cause of death
- **Proximate cause** of death refers to an underlying cause of death as opposed to the final cause.
  - The "original" underlying medical condition which initiates a lethal chain of events culminating in death.
    - i.e.. a shotgun blast to the head, stab wound to the chest or coronary atherosclerosis.
- **Immediate cause of death**
  - What kills a person now, but was originally precipitated by something else (proximate)

Mechanism or Mode of Death

- An abnormal physiological state that pertained at the time of death
  - i.e. coma, congestive heart failure, cardiac arrest, pulmonary edema, septicemia and hemorrhage
- **Mechanism of death** describe the specific change in the body that brought about the cessation of life.
  - **usually only "Cause" and "Mechanism" are listed on the dead certificate**

Manner of Death

- The circumstances surrounding a death or how the cause of death came about.
- Circumstantial events or manner of death may be:
  - Natural due to disease or
  - Unnatural due to: Accident, Suicide, Homicide, Questionable/Undetermined.

Certification of Death

- Five Classifications of Death
- Referred to Manner of Death
  - **Natural**: pathology; death caused by disease.
  - **Accident**: not intentional or by a criminal act.
  - **Suicide**: death by one's own hand.
  - **Homicide**: death by another.
  - **Questionable**: cause and/or motive is not known; generally when other classifications are not used. Also "Undetermined" death is used. "Equivocal" or unascertained has also been used as well.

Examples:

Manner of death: - homicide

Cause of death: - smothering

Mechanism of death: - asphyxia

Manner of death: - homicide

Cause of death: - stabbing

Mechanism of death: - loss of blood

- Man shot during robbery. Man stabilizes. Develops pneumonia. Followed by kidney failure, liver failure, heart failure, death. Had prior lung and heart disease, and probably would have survived if not for these diseases.

Manner of death: - homicide

Cause of death: - gunshot

Mechanism of death: - heart failure

Special Forensic Services

- Forensic Pathology involves the investigation of unnatural, unexplained, or violent deaths.
- As medical examiners or coroners, they determine the cause of death.
- Can conduct an autopsy or medical dissection and examination of a body in order to determine the cause of death.

Special Forensic Services

- **Several stages of death after expiration.**
- **RIGOR mortis results in the shortening of muscle tissue and stiffening of body parts in the position at death.**

  Occurs within first 24 hours and disappears within 36 hours.

  LIVOR mortis results in the settling of blood in areas of body closest to the ground.

  Begins immediately on death up to 12 hours after death.

Stages of Death

Special Forensic Services

ALGOR mortis results in loss of body heat.

General rule – begins an hour after death.

Body loses heat at a rate of 1 to 1.5 degrees F per hour until body reaches environmental temperature.

Forensic Anthropology concerned with the identification and examination of human skeletal remains.

Special Forensic Services

- Forensic Entomology is the study of insects and their relation to a criminal investigation often to estimate time of death.
- Forensic Psychiatry involves the relationship between human behavior and legal proceedings.
- Forensic Odontology involves the use of teeth and bite marks to assist in identifying a victim in an unrecognizable state.

Special Forensic Services

- Forensic Engineering involves failure analysis, accident reconstruction, and the causes and origins of fires and explosions.
- Forensic Computer Science involves the examination of digital evidence.

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Definition of Sexual Assault

Sexual assault includes:

- Penile/vaginal intercourse
- Contact between the genitals and mouth
- Contact between an anus and a penis
- Penetration of the vagina or anus with a foreign object, including a finger

Definition of Sexual Assault

When one of the following conditions exist

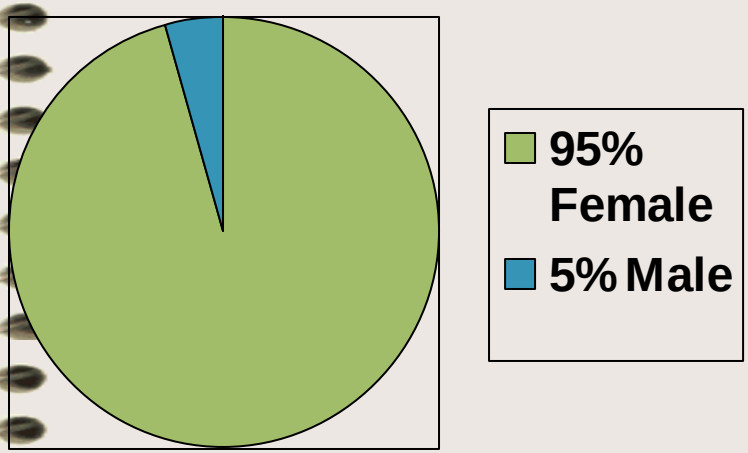
- Force, even if there is no bruise or injury
- Fear, even if the victim didn't fight back
- A person is disabled and cannot give consent
- A person is severely intoxicated or unconscious as a result of drugs or alcohol
- The victim is under the age of 18

Non-Physical Violence

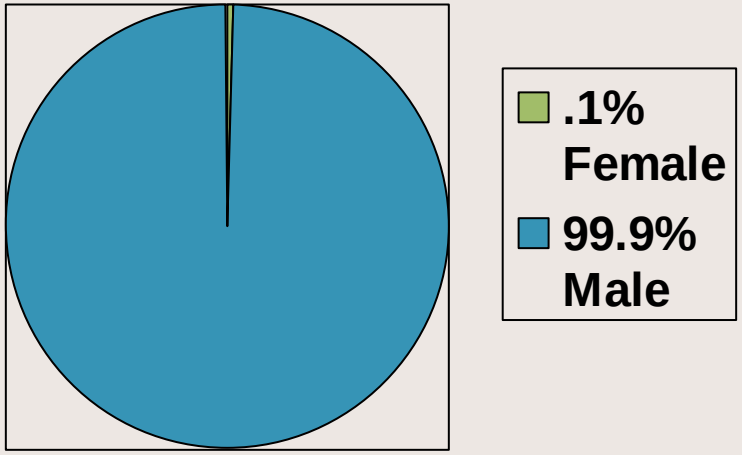
- The threat of violence
- Threatening to tell that they had sex if they don’t
- Threatening to hurt self if they don’t have sex

Victim & Suspect Gender Factors

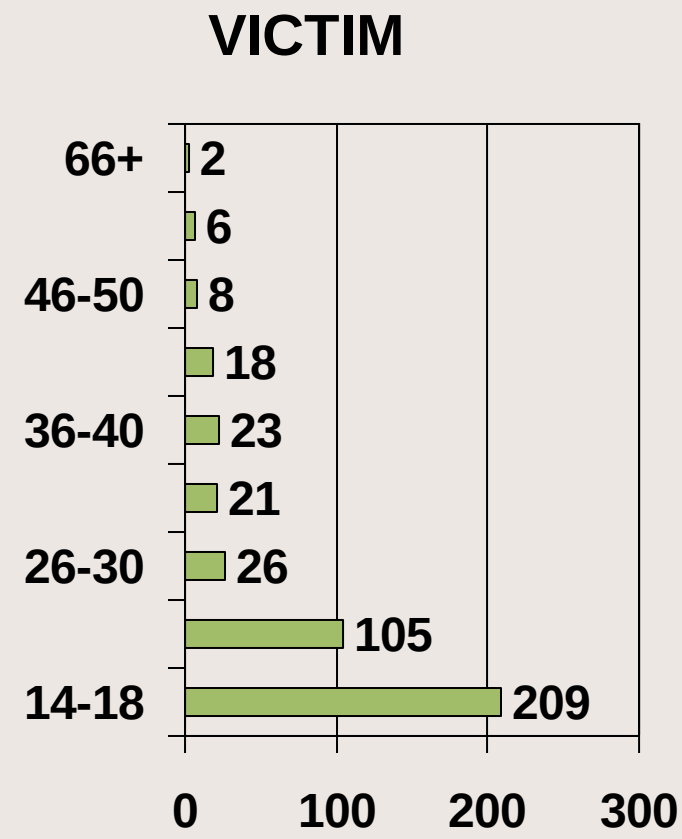
VICTIM

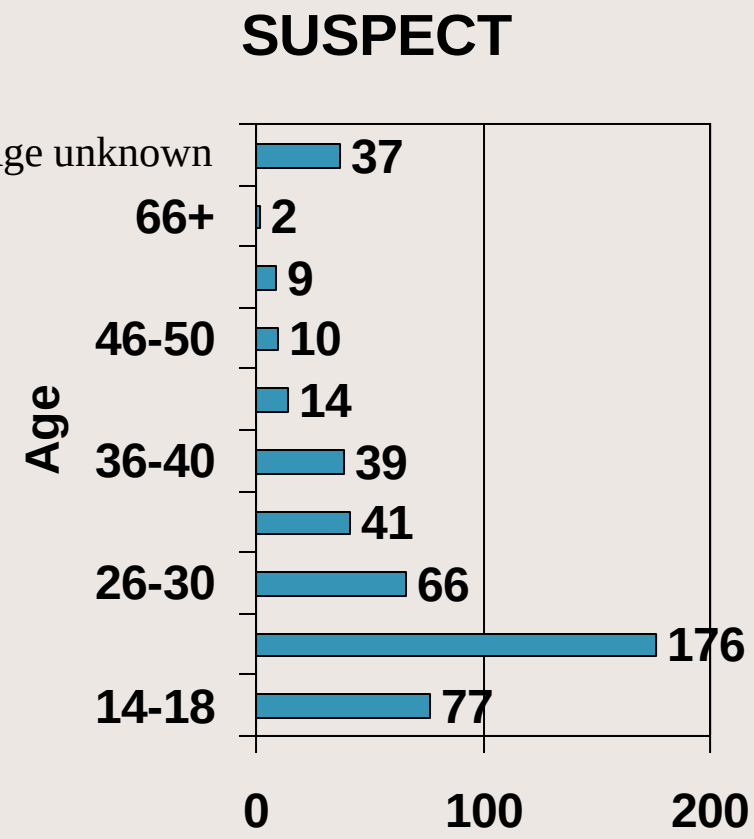


SUSPECT



Non-stranger Assault – Age Factor

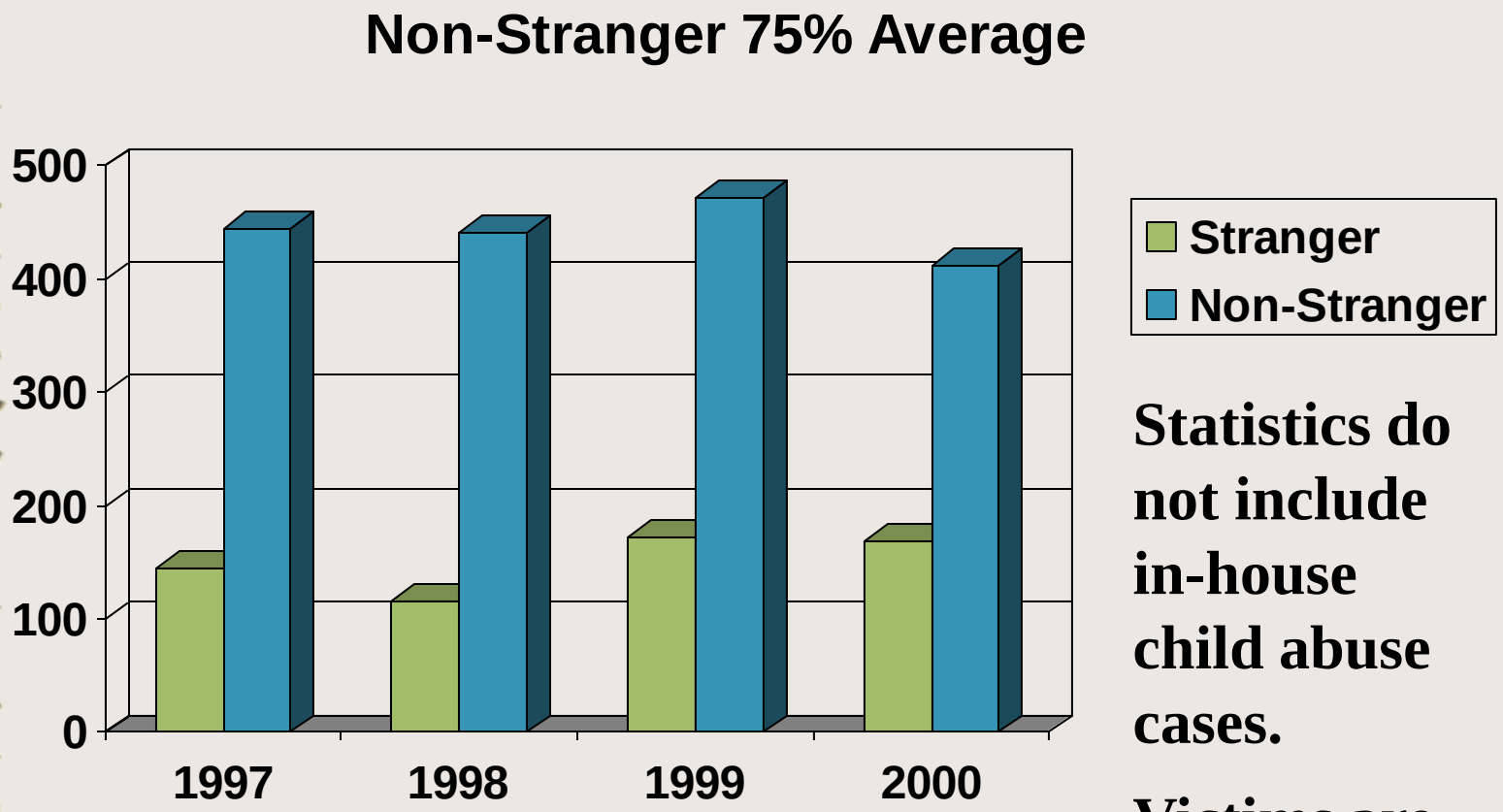




Who is a Non-Stranger?

- Boyfriend
- Co-worker/classmate
- Long time friend
- Relative
- Someone from the neighborhood
- Someone you just met

Sexual Assaults



Statistics do not include in-house child abuse cases.

Victims are 14 years of age or older.

Sex Crimes
75% Committed by Non-Strangers

- Misdemeanor Sexual Battery

  This crime occurs when the suspect touches the private or intimate body part(s) of the victim, against his or her will, but where there was no restraint.

For this section, the touching could be either over or under the clothing.

- Example: A man walks by and grabs a woman's breast as she passes him.

Sex Crimes
75% Committed by Non-Strangers

- Child Molest (Felony)
- A person of any age involved with a child under the age of 16/18

Sex Crimes
75% Committed by Non-Strangers

- Unlawful Sexual Intercourse

  (A Felony when there is more than 3 years age difference)
- This crime occurs when an adult, 18 and older, has sexual intercourse with anyone under the age of eighteen (18)

Sex Crimes
75% Committed by Non-Strangers

Unlawful Sexual Intercourse

- If a 17-year old is having sex with a 14-year old, both are victims and suspects
- If the suspect is over 21 and the victim is under 16, this is a mandated reporting offense

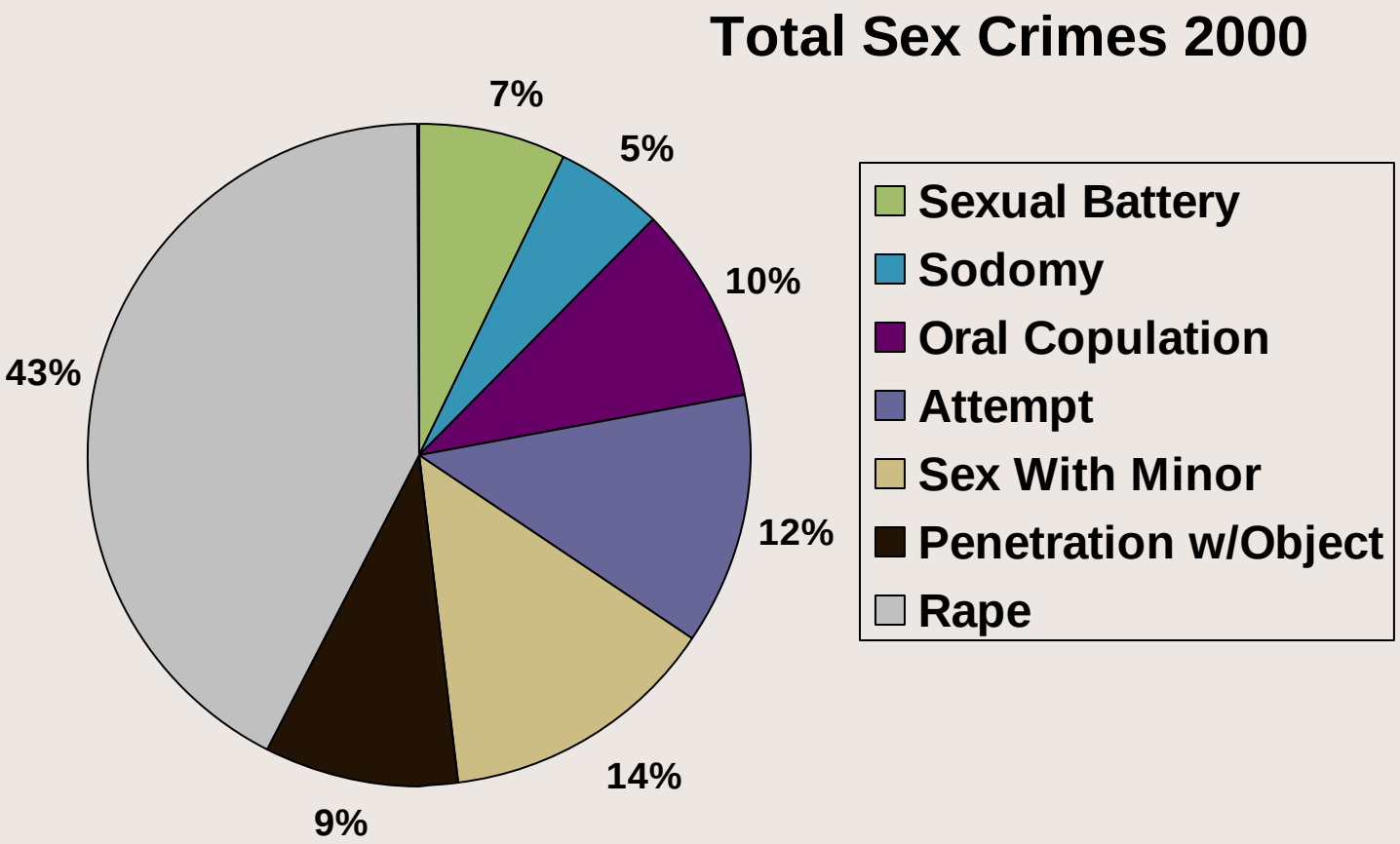
Sex Crimes
75% Committed by Non-Strangers

Felony Sexual Battery

This crime occurs when the victim is held or restrained and the suspect touches (skin to skin) the private or intimate body part(s) of the victim

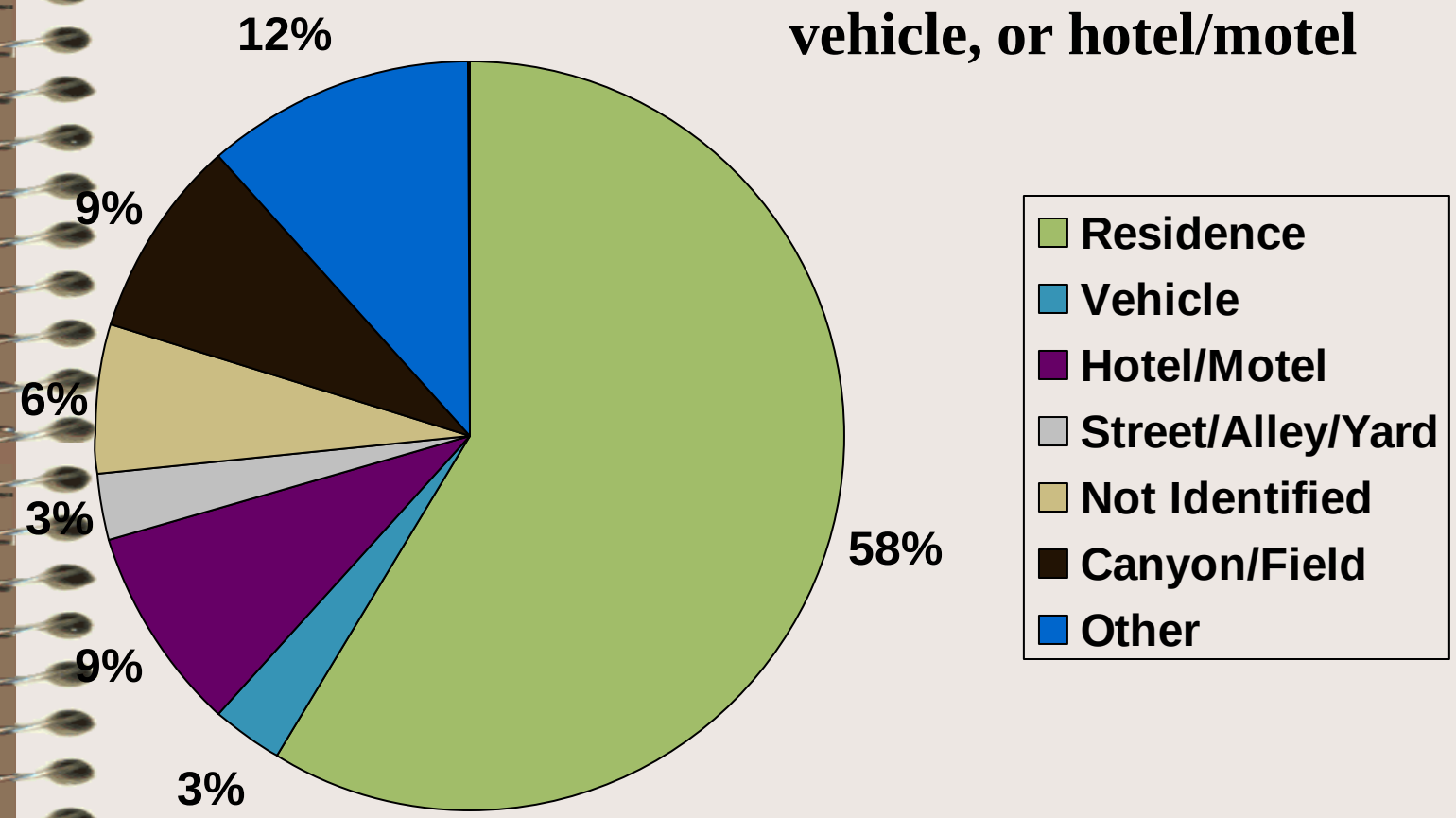
- Example: A male student pushes a female classmate against the wall, reaches under her blouse and bra, and touches her breasts.

Sex Crimes by Type

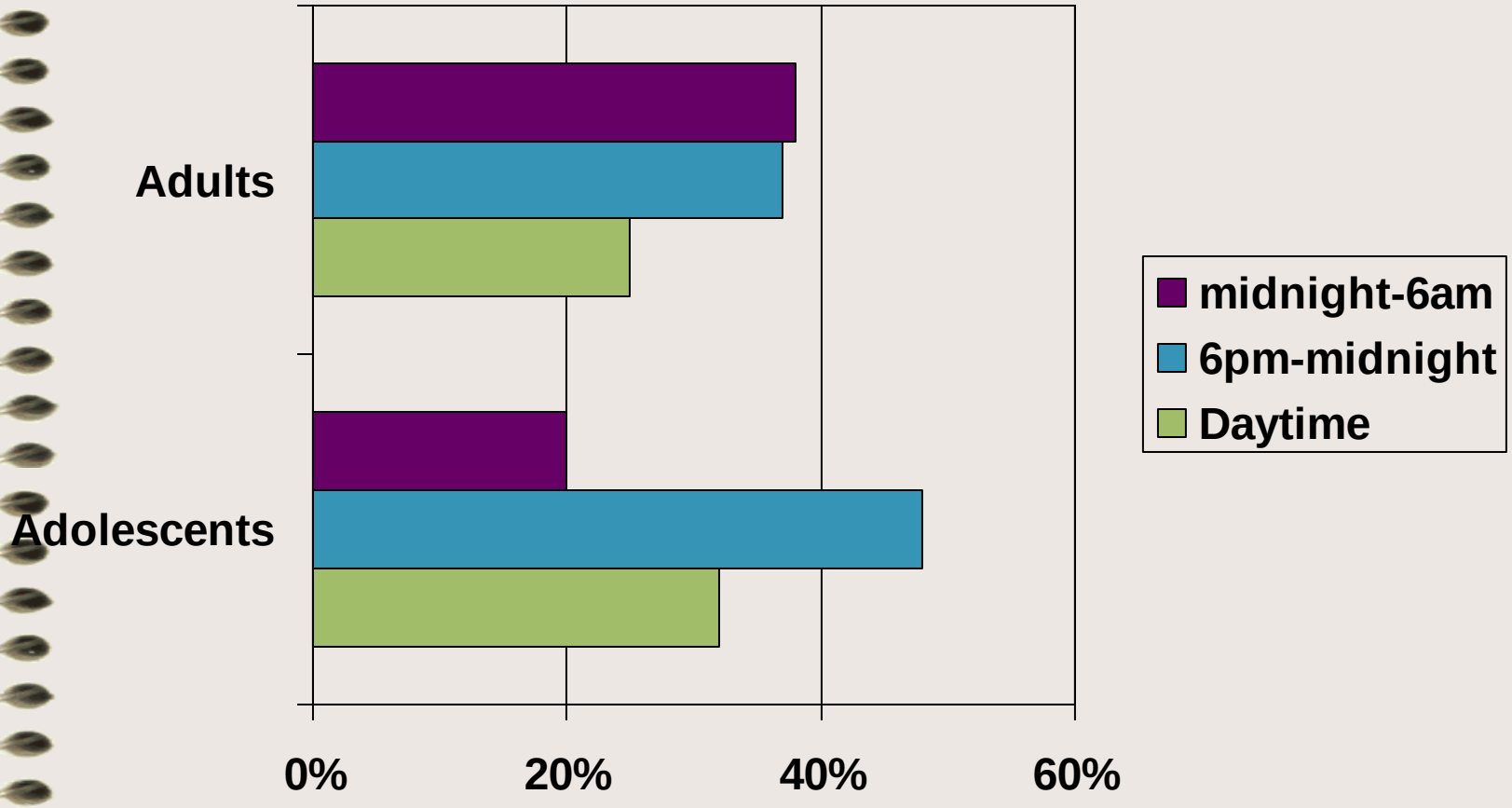


Sex Crimes by Location

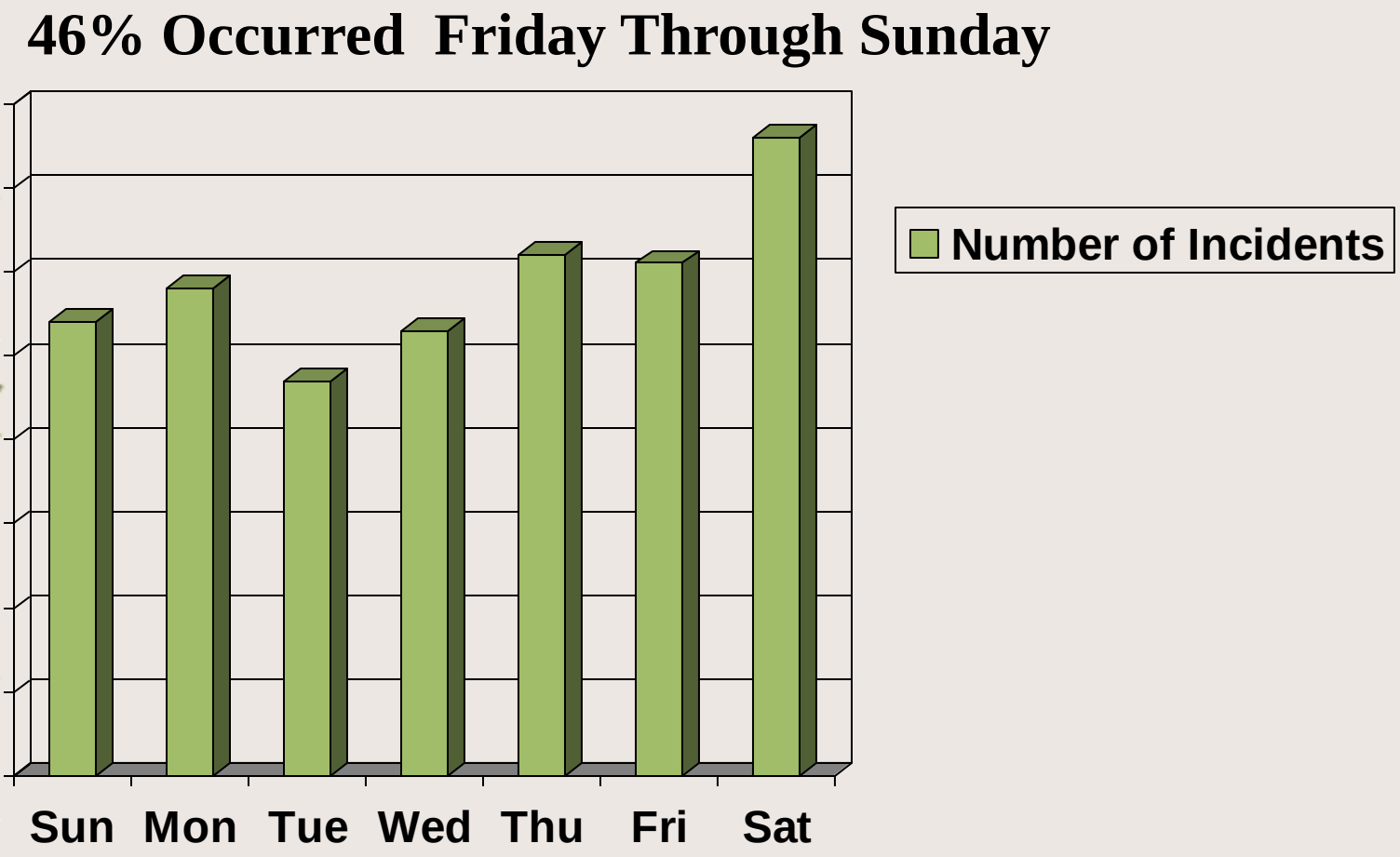
70% Occurred in a residence, vehicle, or hotel/motel



Sex Crimes by Time of Day

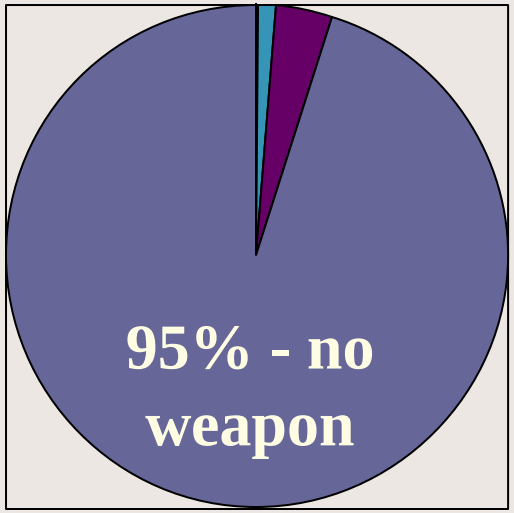


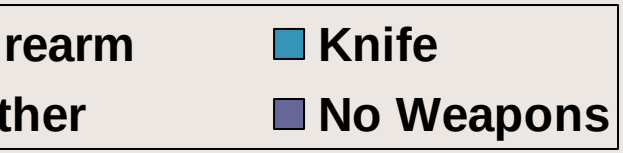
Sex Crimes by Day of Week



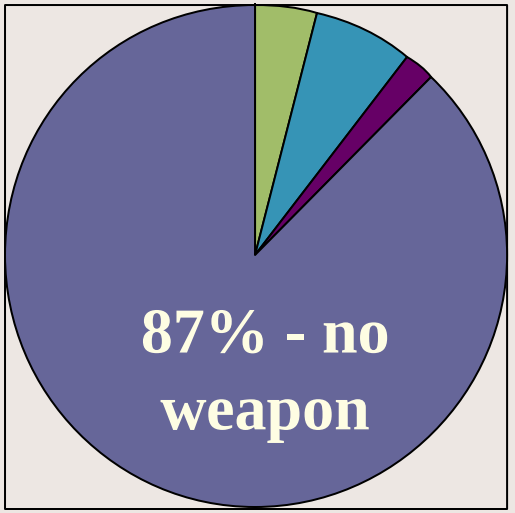
Suspect Weapon

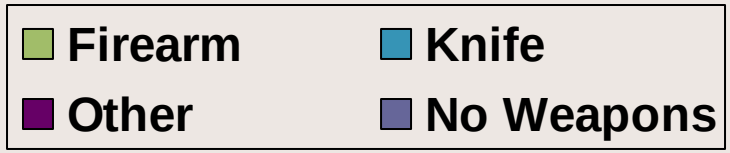
Non Stranger



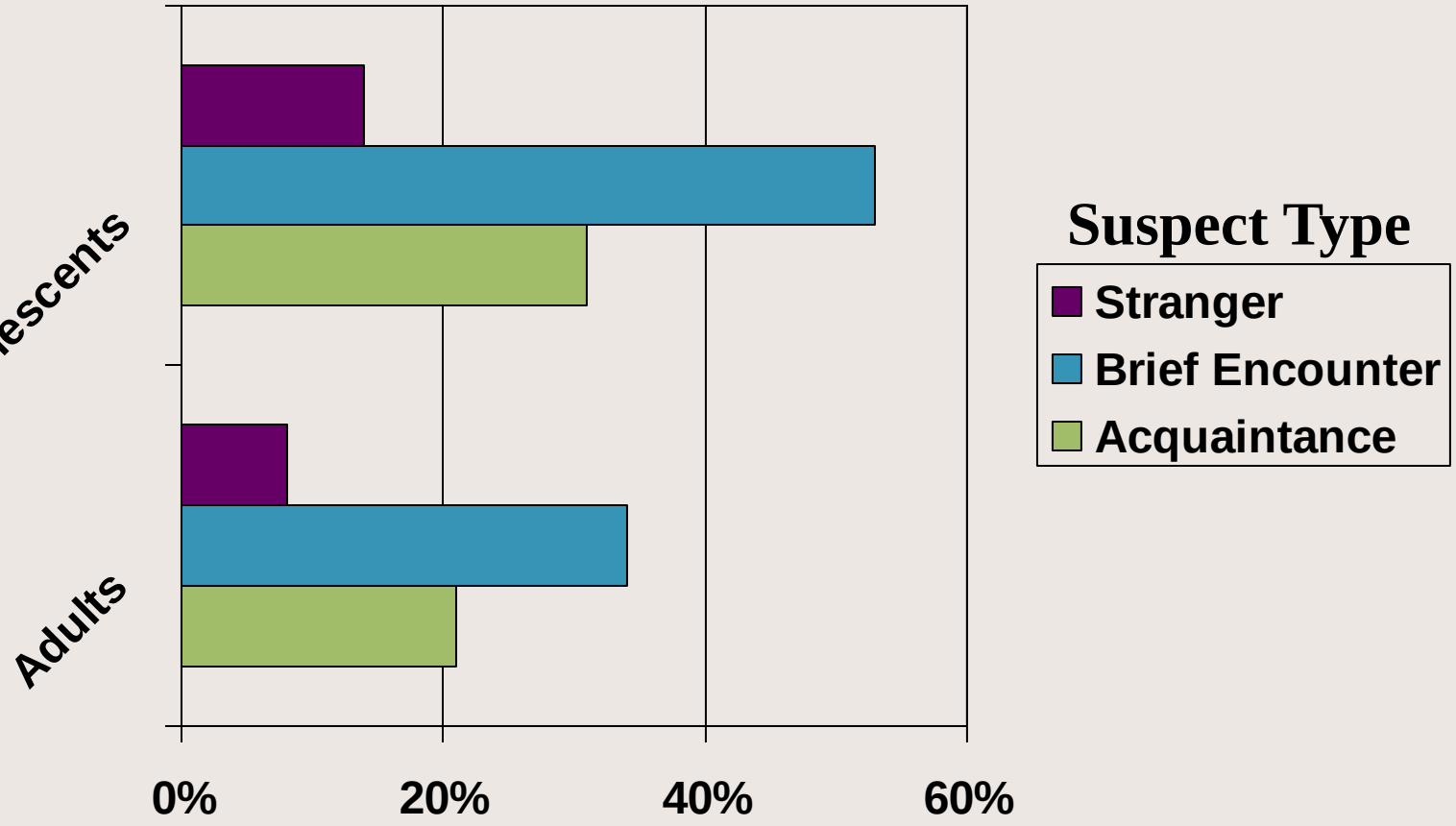


Stranger





Victim Use of Drugs



Trace evidence

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Value of Physical Evidence

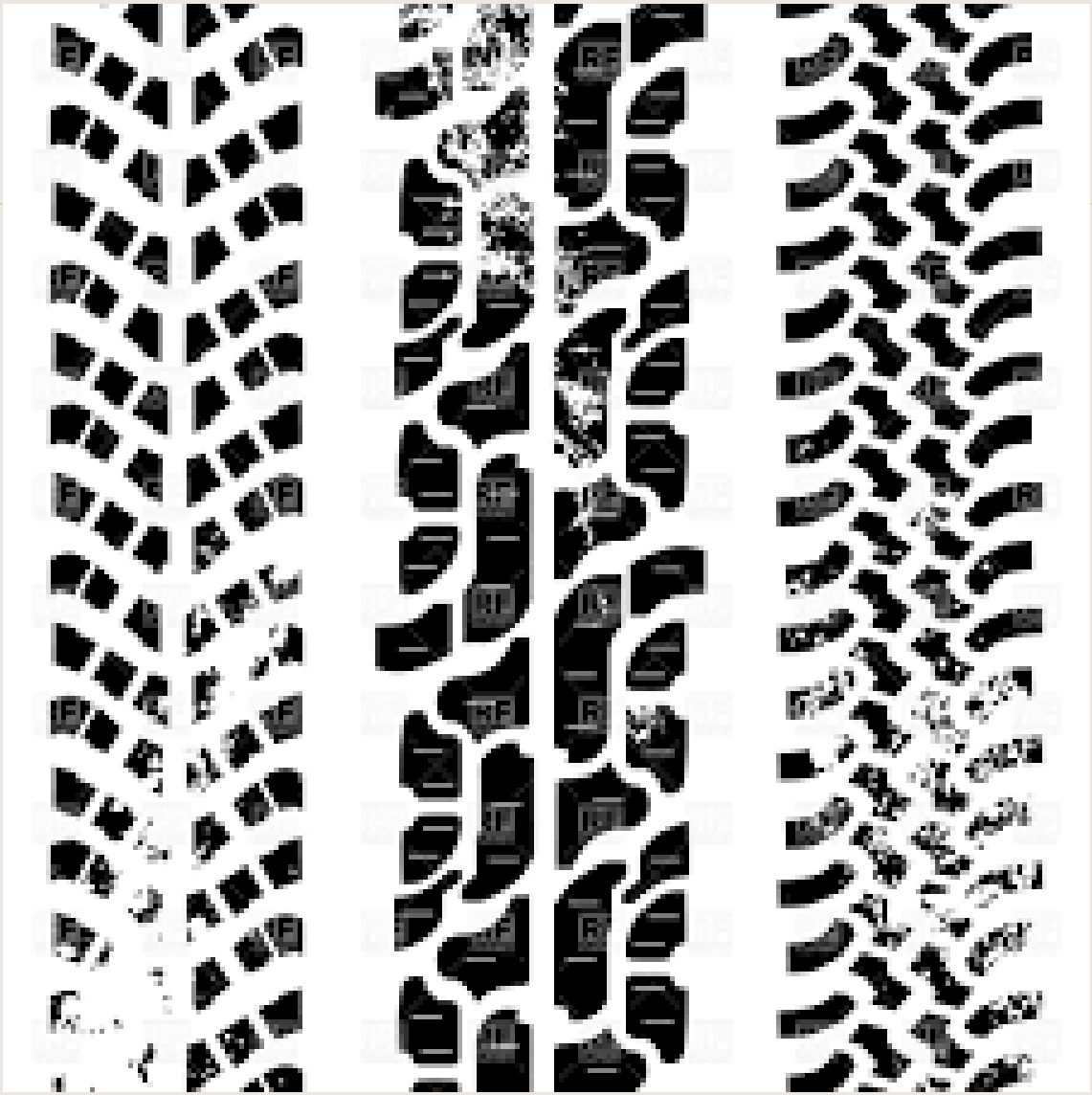
- -Helping to establish the scope of the crime scene
- Placing a perpetrator at a scene
- Connecting a suspect with a weapon
- Supporting witness statements
- Connecting crime scene areas (abduction, vehicle used, dump site)

Physical Evidence is Varied

- Blood, semen, and saliva
- Documents
- Drugs
- Explosives
- Fibers
- Fingerprints
- Firearms and ammunition
- Glass
- Hair
- Impressions
- Organs and physiological fluids
- Paint
- Petroleum products
- Plastic bags
- Plastic, rubber, and other polymers
- Powder residues
- Soil and minerals
- Tool marks
- Vehicle lights
- Wood and other vegetative matter

Categories of Evidence:

- **Biological/Physiological**
  - **Blood, semen, saliva and other bodily fluids.**
- **Chemical**
  - **Narcotics, prescription drugs, powders associated with firearms.**
- **Physical**
  - **Fingerprints, footprints, impressions, tool marks, tyre marks, firearms evidence.**
- **Non-specific/miscellaneous**
  - **Photography, dye marks, voice analysis.**



Six Types of Evidence

- **Trace evidence**
- **Transfer evidence**
- **Indented or impression evidence**
- **Striated evidence**
- **Geometric evidence**
- **Chemical evidence**

Trace Evidence

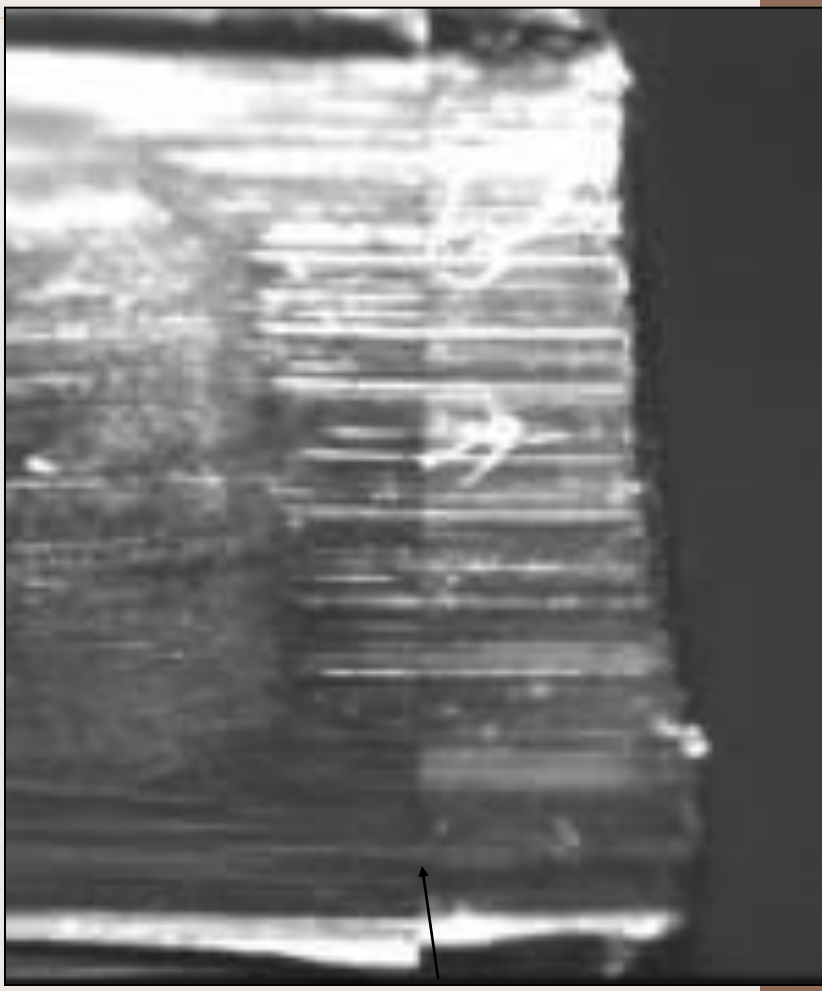
- **Trace evidence is material found at a crime scene or accident scene in small but measurable amounts.**

- **This is important as it can definitively link an individual or object to the scene.**

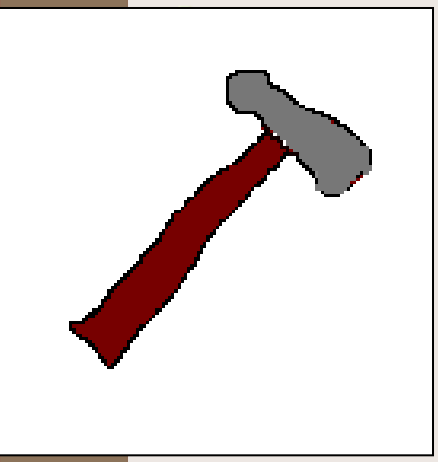
Comparison Microscope

Comparison Microscope

- An optical bridge allows viewing of evidence side by side.
- Useful for comparing bullets, fibers, hair…

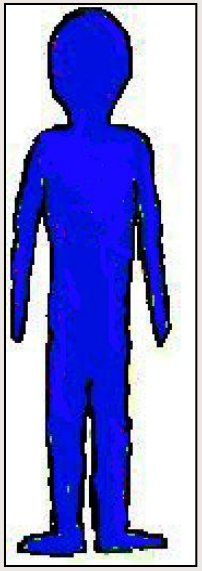


Why is Trace Evidence Useful?

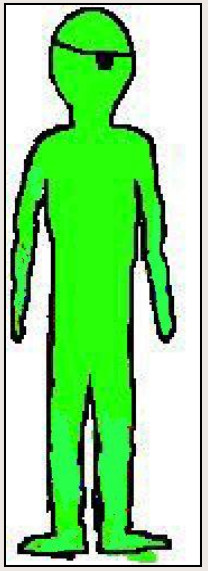


Object

Location



Victim



Suspect

Can link objects and people.

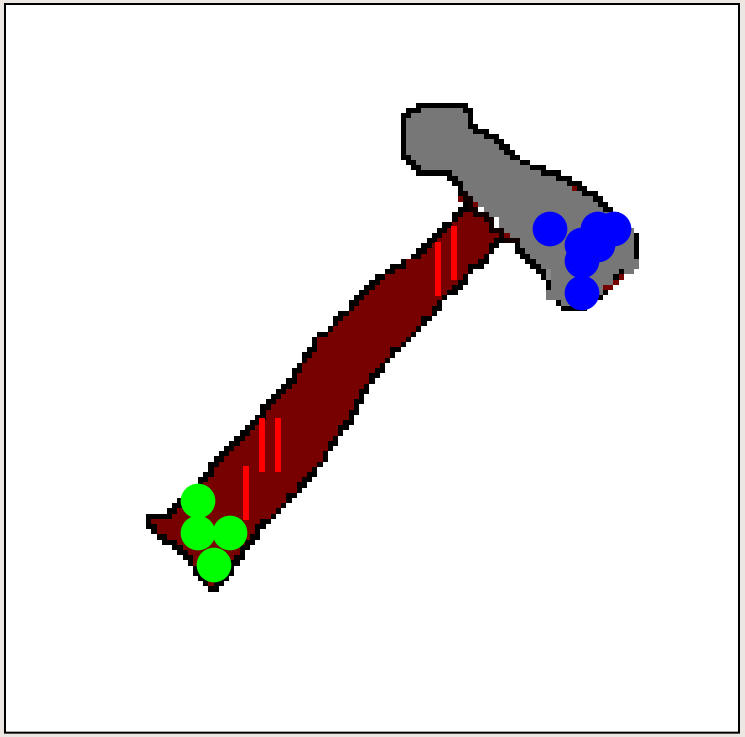
Object

Trace evidence on hammer may include:

Blood/Tissue from Victim

Blood/Fingerprints from Suspect

Fibers from Rug in van



Location

Trace evidence on rug may include:

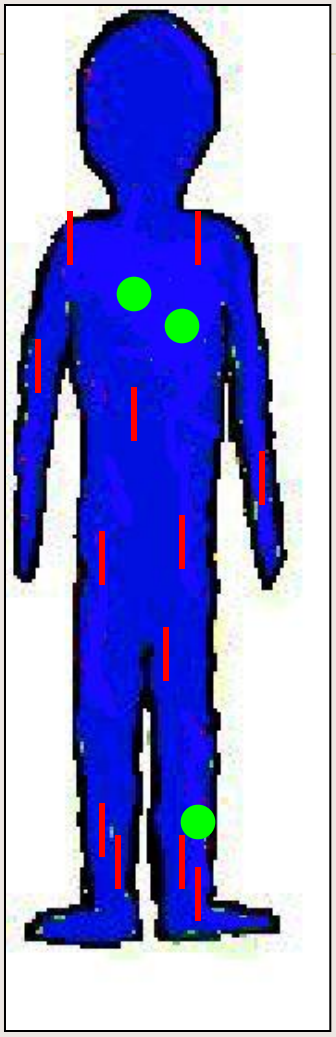
- **Blood/Tissue from Victim**
- **Blood from Suspect**

Victim

Trace evidence on Victim may include:

Blood/Semen from Suspect

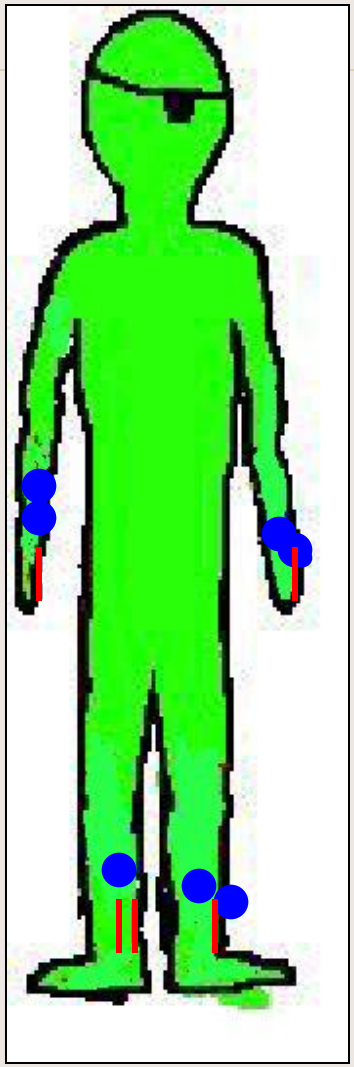
Fibers from Rug in van



Suspect

Trace evidence on suspect may include:

- **Blood/Tissue from Victim**
- **Fibers from Rug in van**



Collecting Trace Evidence

Who collects the evidence?

- **Police Officer**
- **Crime Scene Investigator**
- **Forensic Scientist**

Depends on the state/community

Often one person to ensure consistency of labeling

These 3 methods can be done at the crime scene or in the crime lab.

1. **Visual Inspection**
2. **Tape Lift**
3. **Vacuum**

Visible Inspection

- Use naked eye or hand lens.
- Evidence removed and packaged for later analysis
- Use bright light and forceps to collect.

Visible Inspection (Packaging)

- **Small paper envelopes are bad (Holes allow small objects to escape).**
- **Use small plastic bags, glass vial or paper using a druggist fold.**
- **Double package. Label each package.**

Tape Lift

- **Clear tape is used.**
- **Repeatedly apply tape to small area until most of the stickiness is gone.**
- **Tape is folded back upon itself, taped to a glass slide or taped to a piece of plastic.**
- **Put in separate labeled container.**

  Be sure to document specific area covered.

Vacuuming

- Nozzle should be short and transparent.
- Debris is collected on a filter or membrane

What is the purpose of analysis?

To identify the source of the collected evidence.

Fiber recovered from victim.

Source: Matches fibers from rug in suspect's van

Soil found on Suspect's shoe

Source: Matches soil at crime scene

Blood found on suspect's couch

Source: Matches blood of victim

The Catch:

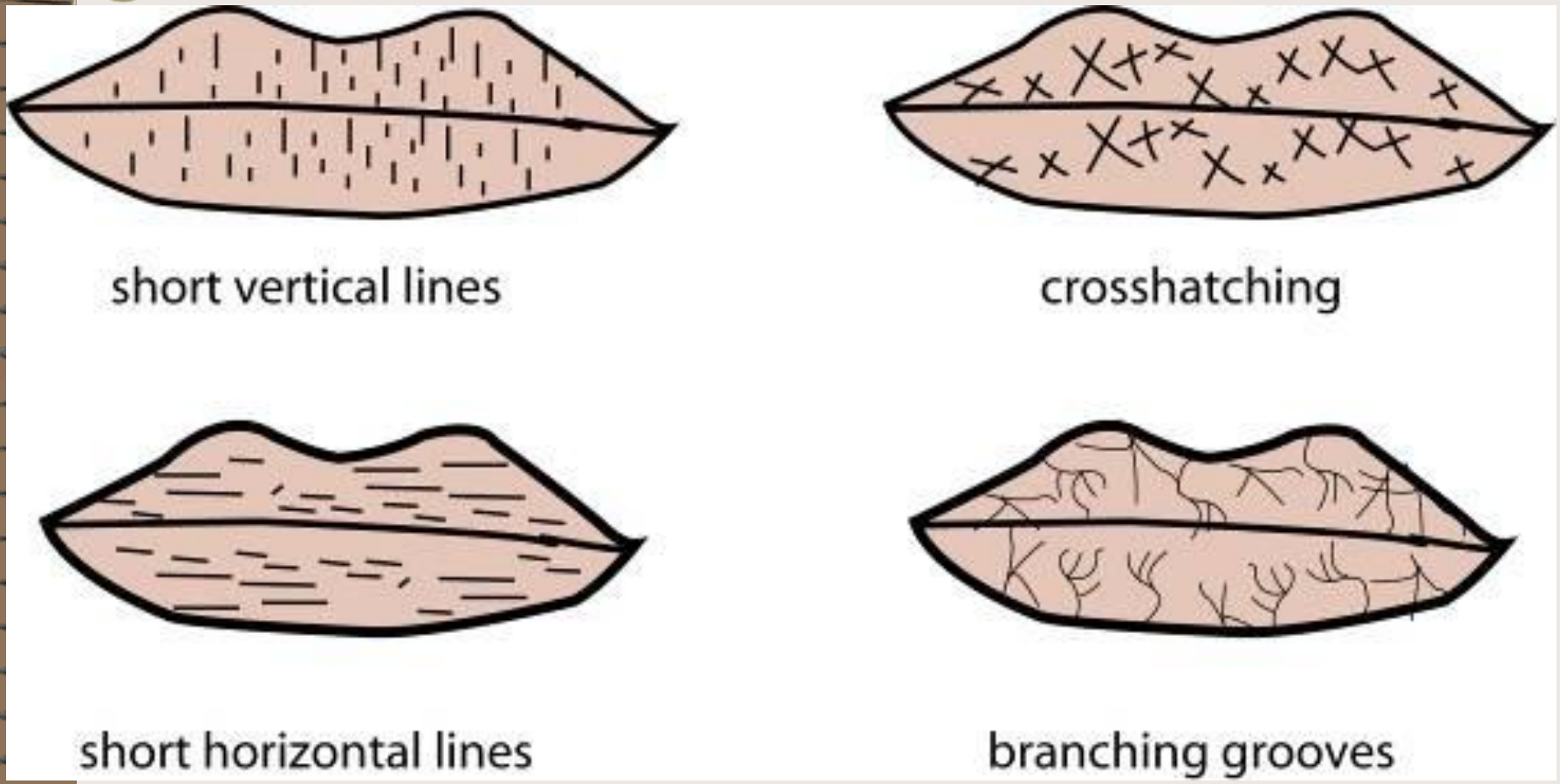
With trace evidence, an investigator usually cannot say that one piece of evidence definitely originated from a specific item.

The investigator can only tell the court/ jury what similarities were found and give them an idea of how rare those similarities are.

What about lip stick

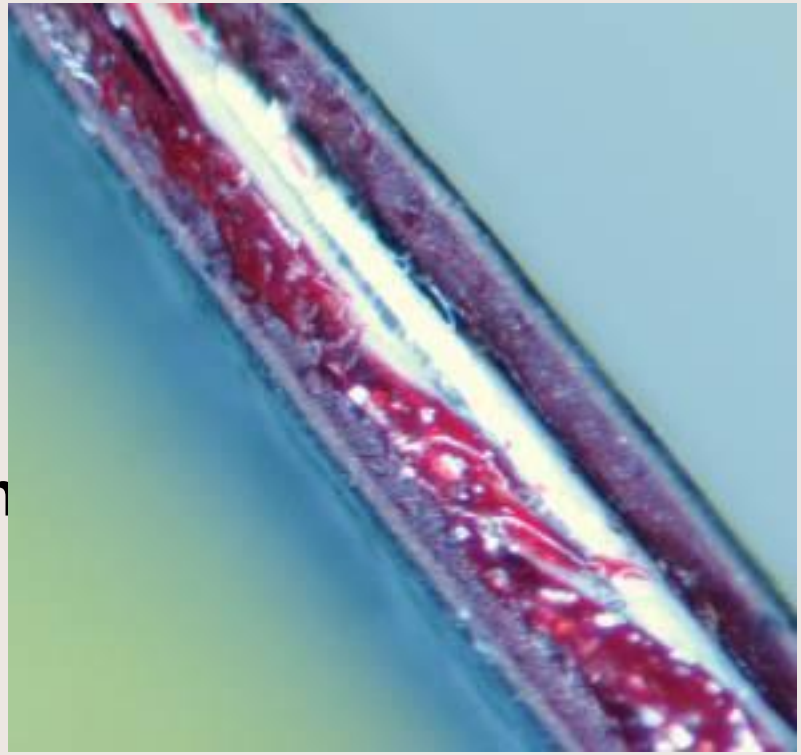
Lip Prints

Lip prints are different and can be used to identify suspects. There are several general patterns:



Paint

- Paint can be used as evidence in hit-and-run cases.
- The layers of different paints in a cross section may be unique.



END OF SECTION

- REACTIONS
- QUESTIONS