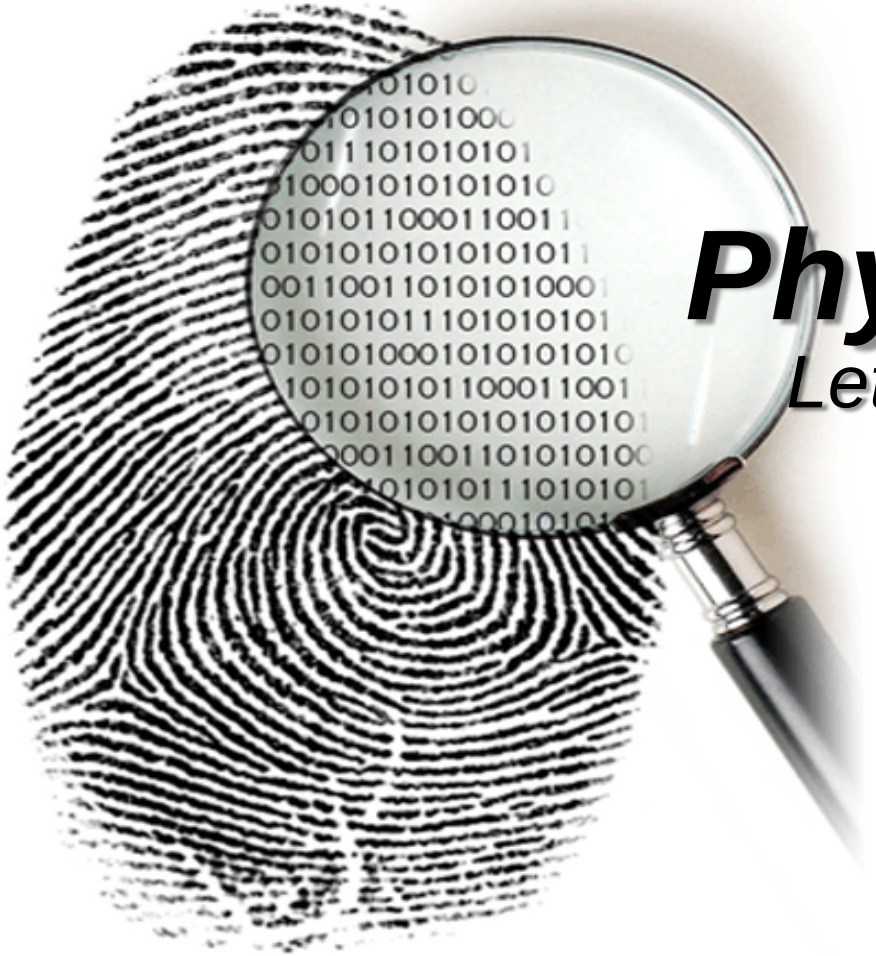


Physical Evidence

Let the Evidence speak for itself

Locard’s Exchange Principle

"Every Contact Leaves a Trace"

The value of trace (or contact) forensic evidence was first recognized by Edmund Locard in 1910. He was the director of the very first crime laboratory in existence, located in Lyon, France.

The Locard’s Exchange Principle states that "with contact between two items, there will be an exchange." For example, burglars will leave traces of their presence behind and will also take traces with them. They may leave hairs from their body or fibers from their clothing behind and they may take carpet fibers away with them.

Source: http://www.virtualsciencefair.org/2004/fren4j0/public_html/trace_evidence.htm

Investigating the Evidence

Drug Chemistry – Determines the presence of controlled substances and the identification of marijuana

Trace Chemistry - Identification and comparison of materials from fires, explosions, paints, and glass.

Microscopy – Microscopic identification and comparison of evidence, such as hairs, fibers, woods, soils, building materials, insulation and other materials.

Biology/DNA – Analysis of body fluids and dried stains such as blood, semen, and saliva.

Toxicology – Tests body fluids and tissues to determine the presence of drugs and poisons.

Latent Prints - Identification and comparison of fingerprints or other hidden impressions from sources like feet, shoes, ears, lips or the tread on vehicle tires.

Ballistics (Firearms) – Study of bullets and ammunition through the comparison of fired bullets, cartridges, guns, and gunpowder patterns on people and objects.

Toolmarks – Examines marks left by tools on objects at a crime scene or on a victim, such as a hammer used to break a door or a screwdriver used to pick a lock.

Questioned Documents - Examination of documents to compare handwriting, ink, paper, writing instruments, printers, and other characteristics that would help to identify its origin.

Source: http://www.isp.state.il.us/forensics/

Evidence Examples

Tiny Pieces of Evidence

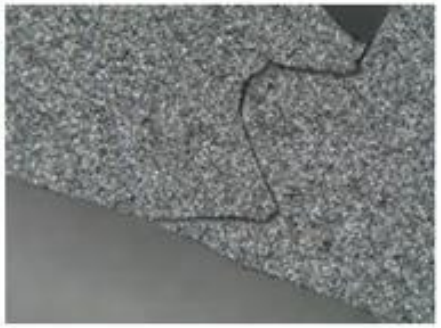
Paint

• Physical and chemical analysis of paint evidence (chips or residue) can indicate it's **class**, such as automobile paint, house paint, nail polish, etc. The evidence can be compared to 40,000 different types of paint classified in a database, which can be used to identify a particular make or model of car or brand of tool.

• Paint evidence can also indicate **individual** characteristics if an investigator is able to find similarities between two samples, such as the color, number of layers, chemical composition, or a physical match between the edges of two paint chips – one from a tool and one from a crime scene.

Paint Transfer on a Car

Paint Layers



Physical Match of Paint Chip Edges

Did you know?
Most paint evidence submitted to a lab will come from hit-and-run cases involving automobiles.

Images: http://www.state.nj.us/njsp/divorg/invest/criminalistics.html

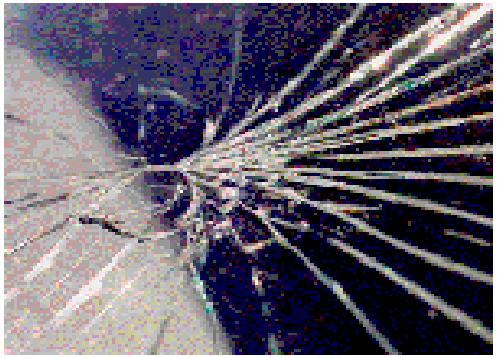
Glass

• Glass particles can be found at various crime scenes, such as breaking and entering, hit and run, vandalism, or murder.

• Glass at a crime scene is analyzed to determine its color, surface characteristics, tint, thickness, density, chemical composition, and refractive index (RI).

• The results of the tests provide clues about the crime and help investigators connect the evidence to a suspect or other object used in a crime, such as matching glass from a crime scene to a headlight to a suspect's car.

Magnified image of glass fragments



The pattern of cracks in a windshield fracture can reveal information about speed, occupant position, and angle of impact.

CSI Glass Analysis

Images: http://www.rsc.org/images/b606109e-300-(FOR-TRIDION)%20(iStockphotos)_tcm18-68354.jpg, http://www.mtcforensics.com/investigation.html

Explosives

- Explosive substances can be examined to determine its chemical composition to identify the type of explosive used and its origin.

- Traces of explosives found on a suspect's clothing, skin, hair, or other objects may be matched to explosives from the crime scene.

- Materials used to make an explosive device will be compared to evidence found in the suspect's possession to confirm a match.

CSI & Explosives

Chemical Reaction Bomb

Pipe Bombs

Image: http://www.state.nj.us/njsp/divorg/invest/criminalistics.html

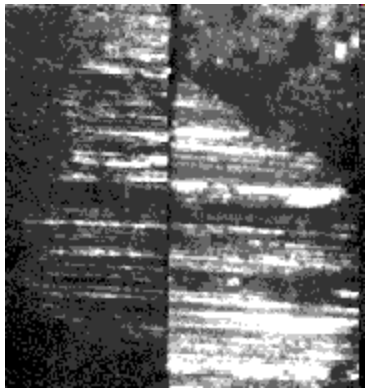
Ballistics

• Characteristics of ammunition, firearms, and residue are examined to find matches between suspects and the evidence found at a crime scene.

• Chemical tests can reveal **gunshot residue (GSR)** on the hands, face, or clothing of a victim or suspect to indicate how close a person was to a fired gun.

• Rifling (grooves) in a gun barrel causes distinctive grooves, indentations and scratches upon fired bullets, which can be matched to the weapon that fired them.

• Police are able to search the **Integrated Ballistics Identification System (IBIS)** database to compare markings from bullets, cartridge cases, and shotgun shells to ballistic evidence.



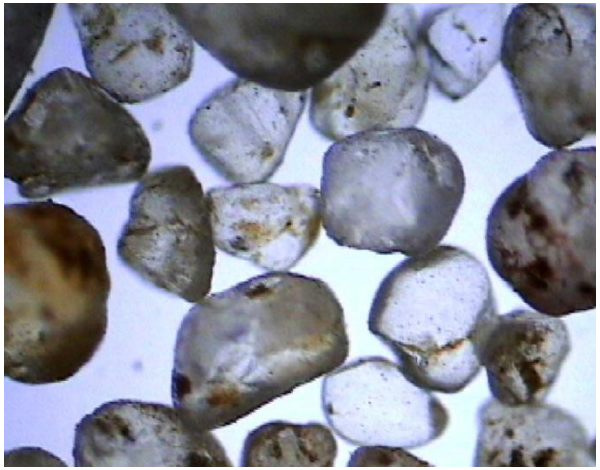
Investigators can compare the striations on bullets to see if they match.

Did you know?

Caliber (handguns & rifles) or **gauge** (shotguns) refers to the size of the internal diameter of a gun's barrel.

Learn more about ballistics …

Image: http://www.geocities.com/j_ksinha/img/mid1.gif



Microscopic Image of Sand

Dust & Dirt

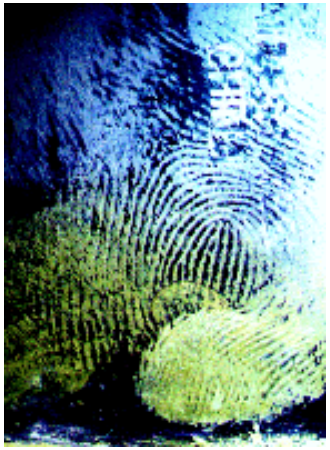
• Dust, dirt, or sand evidence can reveal where a person has traveled and may be picked up at a crime scene or left behind.

• Investigators examine the samples for chemical composition, pollen, plant material, and other organic matter to find links to a specific crime scene.

Fingerprints

• There are 3 types of fingerprint patterns: arches, loops, and whorls. Investigators also identify unique ridge characteristics in a fingerprint that can be used to identify a suspect or victim.

• AFIS (Automated Fingerprint Identification System) is a database used by investigators at local, state, and national levels to search for matches to fingerprints found at a crime scene.



Images: http://www.npsg.uwaterloo.ca/resources/images/microscope/Sand%200004.jpg

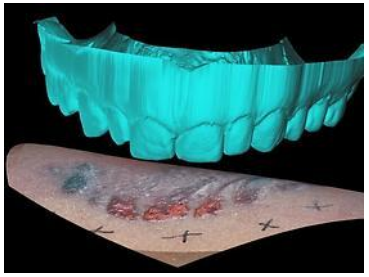
Impression Evidence

Shoeprints & Tire Tracks

• Impression evidence can be photographed, lifted with tape, or cast with plaster to compare to a suspect's shoes or tires.

• Investigators will examine the evidence to identify the brand of shoe or tire based on its tread pattern and other physical features to provide leads in the case.

• Shoes and tires will also show wear patterns after being used for a period of time as well as other features (scratches, nicks, and cuts) that can be used to match evidence to specific items. For example, shoeprints can be matched to a suspect based on how the treads on the shoes that are worn down due to that person's walking style.



Bite Marks

• Each of the 32 teeth in humans is unique due to age and wear.

• Impressions and photographs of bite marks left on a victim, assailant, or other object at a crime scene can often be matched to dental records.

Tool Marks

• Tiny nicks and chips form on the edges of a tool as it is used, which can be used to identify matches between evidence and suspects.

• Tools may also pick up traces of blood or other substances that can be tested or have fingerprints that can be lifted.

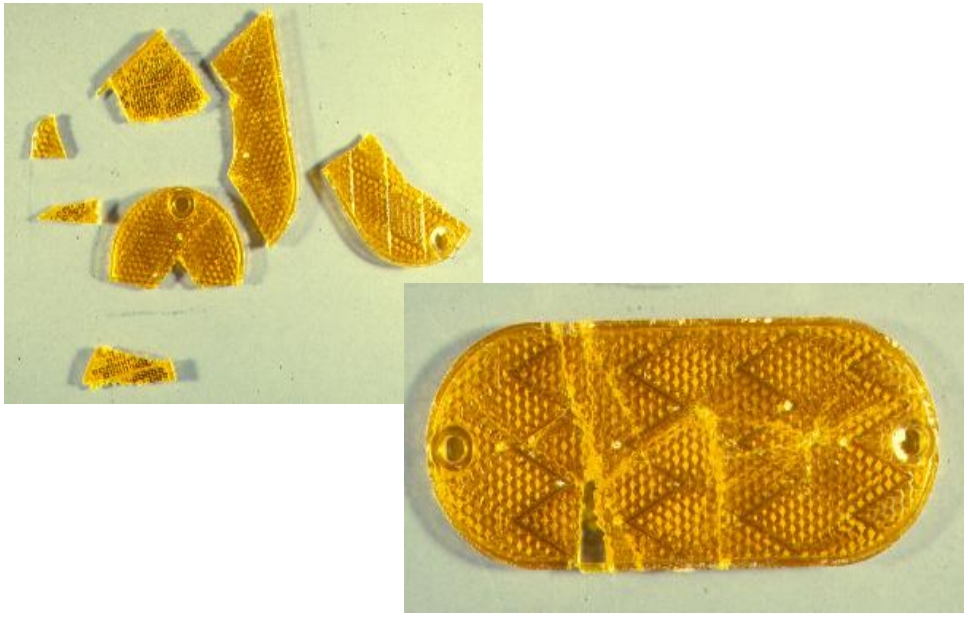
Images: http://www.wrongfulconvictionlawsuitdefense.com/uploads/image/28santos_600.jpg, http://www.dps.state.ia.us/DCI/Crime_Lab/images/toolmarks.jpg, & http://www.masterpiecestudios.com/images/171463.gif

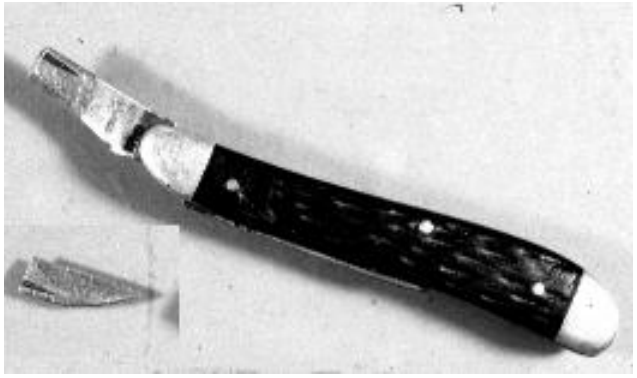
Fracture Matches

• When an object broken, torn, or cut, two unique edges are formed, which are referred to as fracture lines.

• These edges can be compared by the naked eye or with microscopes to see if they fit together , which indicates that they may have been part of the same object at one time.

• Investigators may compare the edges on pieces of tape, glass fragments, paint chips, pieces of a car from an accident, paper bag, etc. to find possible matches.





Duct Tape Evidence

Images: http://www.modernmicroscopy.com/main.asp?article=11&print=true&pix=true

Wounds

• Wounds can often be matched to weapons or tool marks on the weapon. Investigators may also be able to determine the weapon's size, shape, and length.

• Analysis of a wound may provides clues to a victim's injuries, characteristics of the suspect (left-handed, right-handed, height, etc.), and positions of the victim and suspect at the time of the incident.

FBI Questioned Documents UNIT

Questioned Documents

• Examiners will analyze a ransom note or other document to find clues to link it to a crime scene or a specific suspect. They will analyze the type of paper used, printing method or handwriting style, and type of ink.

• Other unique features, such as watermarks on stationary or indentations made as someone wrote on a page in a notebook, may provide useful clues.

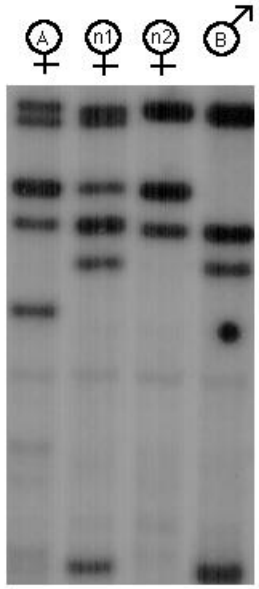
Image: (Bottom Left): http://dofs.gbi.georgia.gov/vgn/images/portal/cit_11783501/81672146questioned%20document.jpg

Insects

• Flies, beetles, and other insects can provide useful clues about a corpse.

• Forensic entomologists use factors such as weather conditions, the location and condition of the body, and their knowledge of the life cycles of insects to help them estimate the postmortem interval or PMI (the time between death and the discovery of the body).

DNA



• Investigators can extract DNA from almost any tissue, including hair, fingernails, bones, teeth and body fluids. The DNA is used to create a profile that can be compared to profiles from suspects or victims.

• CODIS (Combined DNA Index System) is a database maintained by the FBI that is used to find matches to unknown DNA samples from a crime scene.

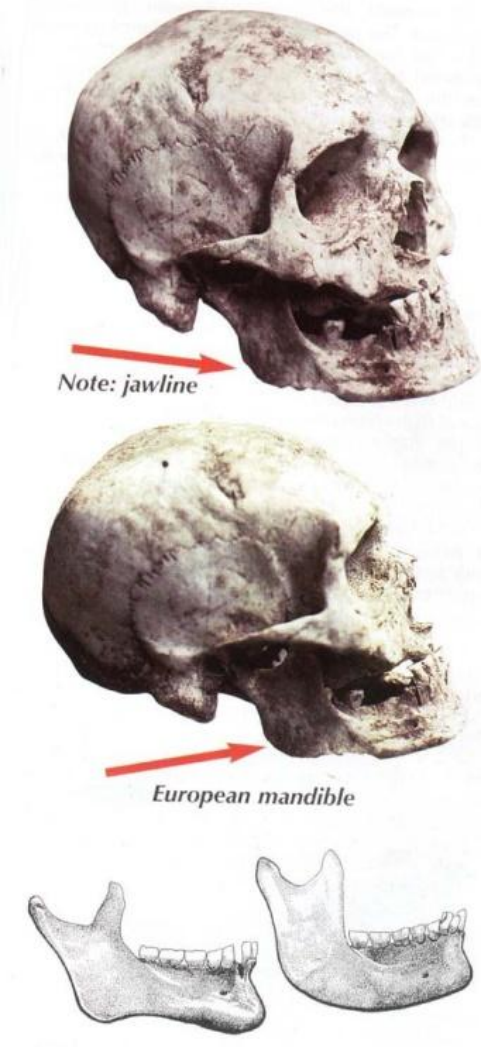
Images: http://biology.arizona.edu/sciconn/lessons2/Vuturo/vuturo/photos/desmus.gif

Skeletal Remains

• Forensic anthropologists analyze skeletal remains to determine four characteristics for a victim: age, sex, race, and stature (height/build).

- Sex - Determined by examining the pelvis, humerus, and femur
- Age and stature – Determined by analyzing the development of the teeth, bone growth, and the length of specific bones, such as the femur.
- Race – Determined by analyzing the skull for characteristics that are common among people of different races.

• DNA samples can be collected from bone, teeth, and hair to provide clues to a person's identity. Scientists may also be able to gain clues as to a person's past, recent injuries, or the cause of death based on bone fractures and other signs of trauma.



Source: http://www.crime-scene-investigator.net/excavation.html
Images: http://www.celticnz.org/images/Feedback/SkullSkeleton.JPG and http://www.legacyhealth.org/images/Housecalls/claviclefx.jpg

What do forensic anthropologists do?

Generally, forensic anthropologists DO NOT do any of the following:

- Collect trace evidence (hair, fibers)
- Run DNA tests
- Analyze ballistics or weapon evidence
- Analyze blood spatter
- Conduct autopsies

What a forensic anthropologist does DO to aid in a case:

- Goes to a crime scene to assist in the collection of human remains
- Cleans up the bones so that they may be looked at
- Analyzes skeletal remains to establish the profile of the individual
- Looks at trauma evident on the bones to establish the pathway of a bullet or the number of stab wounds
- Works with a forensic odontologist (dentist) to match dental records
- Testifies in court about the identity of the individual and/or the injuries that might be evident in the skeleton

Source: http://web.utk.edu/~fac/forensic.shtml

Body Fluids

• Blood, semen, saliva, sweat, and urine can be analyzed to give investigators information about the crime as well as its victim or the suspect.

• Chemicals and ultra violet light can be used at a crime scene to find body fluid evidence. Areas with potential evidence are swabbed, bagged and collected in vials, which are air tight and have a low risk of cross contamination.

Examples:

▶ Vomit and urine can be used to test for alcohol, drugs, and poisons.

▶ Cigarette butts may contain dried saliva.

▶ Semen containing sperm is valuable for DNA analysis.

▶ Blood can provide DNA evidence and blood spatter can provide clues about the crime.

Source: http://www.virtualsciencefair.org/2004/fren4j0/public_html/trace_evidence.htm Images: http://www.trutv.com/library/crime/criminal_mind/forensics/chinatown_widow/4.html

Hairs & Fibers

• Hairs and fibers may be transferred from the suspect or the suspect's clothes to the victims' and vice versa. For example, a suspect may pick up carpet fibers on his shoes or leave hairs behind at a crime scene.

• Hairs can be examined to identify their origin, such as human or animal. Hairs with roots intact can be tested for DNA.

• Fibers are used to make clothing, carpeting, furniture, beds, and blankets. They may be natural fibers from plants or animals or synthetic fibers that are man-made.

Microscopic Image of Hairs & Fibers

What evidence would you collect?

Mock Crime Scene: http://www.masss.gov