Power of Evidence

General Science 1
Forensic Science Unit 2

Modified from a presentation developed by T. Trimpe 2006  http://sciencespot.net/
Types of Evidence

Evidence used to resolve a crime can be split into 2 areas: **testimonial** evidence and **physical** evidence.

- **Testimonial** evidence would be any witnessed accounts of an incident or crime.

- **Physical** evidence refers to any **material items** that would be present on the crime scene or the victims. These items would be presented in a crime investigation to **prove** or **disprove** the facts of the issue.

- **Trace evidence** refers physical evidence that is found at a crime scene in **small** but measurable **amounts** and can be anything from strands of **hair** or skin cells to **tool marks** and physical (fracture) matches. Trace evidence can be used to identify a **victim** or **suspect** or determine how a crime was committed.

Source: http://www3.sc.maricopa.edu/ajs/crime_scene_technician.htm
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.

**Evidence Examples**

**Paint**
- Paint is examined with microscopes and several analytic instruments to determine its chemical composition. There are forty thousand different types of paint classified in a database available to police.
- Paint can be transferred from one vehicle to another in an accident or a paint chip left at the crime scene can be used to determine the make and model of the vehicle it came from. Most paint evidence submitted to a lab will come from hit-and-run cases involving automobiles.
- Paint transferred from a window to a suspect’s tool in a break and entry can place that tool at the crime scene.

**Explosives**
- Powders and exploded/unexploded devices can be examined to determine what type of explosive may have been used.
- After the Bomb Squad makes sure a device is safe, they submit a sample of the explosive or the debris to the Trace Unit. These items are then analyzed with chemical spot tests and analytical instrumentation to determine their chemical make-up to help identify which type of explosive was used.
- These results can then be compared to any evidence found in the suspect’s possession.

Glass

- In car accidents, fragments of glass can be embedded in a victims’ hair or clothing. In break and entries, suspects often get glass fragments on their clothing.
- Glass particles can be compared to particles collected from the crime scene to determine if they have a common origin.
- Glass tint, thickness, UV fluorescence, density, and refractive index can all be used to match glass samples to glass found at a crime scene.
- Reconstructing a pane of glass may help determine the direction of the impact or sequence of impacts may be determined.

Dust & Dirt

- This type of evidence can reveal where a person has been, where they live, where they work, and if they have pets.
- Alibi soil samples are taken in many criminal investigations with most soil samples taken from the top surface of the soil in small amounts.
- Other debris in the sample and pollen can reveal where a person has been (outside).

Firearms (Ballistics)

- Characteristics of ammunition, components and residue are examined to find matches.
- Bullets are never removed from their holes. The whole surrounding surface is cut out.
- Gunshot residue (GSR) from the hand or face needs to be done within six hours, and a lab can compare it with target residue.

Fluids

- Semen, saliva or sweat can usually be found in spatters, drops or stains and can be fresh, coagulated or in dried form.
- Each form has its own particular method of collection and preservation.
- Bodily fluids, such as vomit, can be found at scenes and used to test for alcohol, drugs, and poisons. Cigarette butts may contain dried saliva. Semen containing sperm is particularly valuable for DNA analysis.

Blood

- There are 150 known proteins, 250 known enzymes, and many more antigens in blood.
- Investigators can often estimate the time a crime occurred from how dry the blood is.
- The shape of blood at the scene (pool, drops, stains, or splashes) can provide clues as to what happened as well as the location and description of bloodstains.
- Blood evidence is frequently used to eliminate a pool of suspects.

Wounds

- Wounds can often be matched to weapons, tool marks on the weapon, or at least the weapon's size, shape, and length.
- Wound pattern analysis is a special technique that often provides clues to how a crime was committed or characteristics of the suspect (left-handed, right-handed, height, etc.)

Tool Marks
• When a tool is made and used, tiny nicks and chips begin to form, which adds unique characteristics to its blade and edges. Tools may also pick up traces of substances it came in contact with.
• Tool marks can be found at break and enters, robberies and other crime scenes where tools were used.

Shoeprints & Tire prints
• Questioned impressions from crime scenes can be photographed, lifted, or cast with dental stone to compare to suspect shoes or tires.
• Impressions can be three-dimensional when left in snow or soft soil, or they can be two-dimensional when a dirty, bloody, or other impression is left on a hard surface.
• Footwear impressions can lead to identification of a suspect because of the treads on the shoes that are worn down to each person’s walking style. There may also be accidental scratches, nicks and cuts are left on the bottom of your shoe.
• Tires undergo the exact same changes making them unique as well.

Physical (Fracture) Matches
• When an object breaks, tape is torn, or something is cut, two unique edges are formed. These edges can be compared by the naked eye, and under high magnification to see if they fit together like puzzle pieces and were part of the same object.
• If the edges fit together they are said to physically match one another and investigators know that the two objects were at one time a single object.

Image: http://www.dps.state.ia.us/DCI/Crime_Lab/images/toolmarks.jpg
Skeletal Remains
• Forensic anthropologists analyze skeletal remains to determine four characteristics for a victim: age, sex, race, and stature.
• Determining the sex of a victim is the first step in the analysis of unidentified human remains. The innominate bone, which comprises the pelvis, offers the most definitive traits. The humerus or femur is also used and an analysis of the skull can give investigators clues about the whether the person was male or female.
• Determining the age and stature (height) of a victim can be done by analyzing the development of the teeth, bone growth, and the length of specific bones, such as the femur.
• Determining the race of a victim can be done by analyzing the skull for specific characteristics that are common among people of different races.

Fingerprints
• A fingerprint can conclusively identify both suspects and victims, since everyone has unique fingerprint patterns.
• Databases, such as AFIS (Automated Fingerprint Identification System) are available for rapid computerized searching, on national, state and local levels.

Source: http://www.crime-scene-investigator.net/excavation.html
**Questioned Documents**

- Everyone has a unique style of handwriting and most printers also have a unique printing style. Handwriting style and ink patterns created by a printer can be compared to match a document to a suspect.
- Paper chromatography can be used to analyze the ink by separating it into its different components or colors.

**Bite Marks**

- Each of the thirty-two teeth in humans is unique due to age and wear.
- Bites can tell how quickly the offender subdued the victim and can often be matched to dental records.

**Hairs & Fibers**

- Hairs and fibers may be transferred from the suspect or the suspect’s clothes to the victims’ and vice versa, such as a pedestrian struck by a vehicle may leave hairs and fibers on the suspect’s vehicle bumper or windshield or carpet fibers attaching to a suspect’s shoes.
- Hair with roots may provide individual DNA evidence.
- Hair also has characteristics. There are 14 different elements that can be identified in a hair sample.
- Fibers are usually collected from clothing, carpeting, furniture, beds, and blankets.
- There are over a thousand known fibers, and several thousand known dye formulas.
Securing and Collecting Evidence

- **Liquids and arson remains** stored in **airtight, unbreakable containers.**
- **Moist biological evidence** is stored in **breathable containers** to **dry out,** reducing the chance of mold contamination.
- Then placed in a **paper bindle,** which is then placed in a plastic or paper container.
- Then **sealed with tape** and **signed** across the tape.
Evidence Log

- Case number
- Item inventory number
- Description of evidence
- Name of suspect
- Name of victim
- Date and time of recovery
- Signature of person recovering evidence
- Signature of any witness present during collection
Chain of Custody

- Evidence properly packaged and handed to next person responsible for its care
- That person gives it to an investigator
- The investigator opens the package at a new location on the bag.
- On completion of examination, the tech repackages the evidence with original packaging, reseals and signs the custody log.
Crime-Scene Reconstruction

• Crime-scene reconstruction: involves forming a hypothesis of the sequence of events before the crime was committed through its commission.
• Evidence is examined and compared to witness statements
• Investigator looks at evidence and attempts to determine how it fits into overall scenario.
• Evidence does not lie, but it could be staged.
Staged Crime Scenes

- **Arson** - suspect stages a fire to cover some other crime
- **Suicide/murder** - suspect stages murder scene to look like a suicide. Death is caused by drugs or alcohol. Motive could be insurance money, unhappy marriage, or simply theft.
- **Burglary** - staged to collect money… other ideas?
- Consider these points:
  - Treat all deaths as **homicides**
  - Do wounds match the weapon?
  - Wounds self-inflicted?
  - Establish a **victim profile through interviews**
  - Evaluate behavior of victim/suspect before event
  - Corroborate states with evidential facts
  - **Reconstruct** the event
  - Conduct examinations to determine the facts of case