
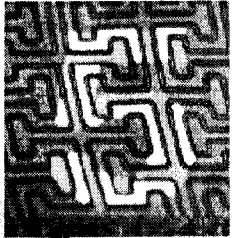



Chapter 1 – Introduction to Forensic Science

- Forensic science is the application of science to the criminal and civil laws that are enforced by police agencies in a criminal-justice system.
- Some scientific and mathematical disciplines (important to this course) that aid forensic science to explore a crime scene include:
 - a. Chemistry – study of matter
 - b. Biology – study of living things and processes
 - c. Physics – study of energy and motion
 - d. Geology – study of soils
 - e. Computer technology
 - f. Statistics – study of the probability of occurrence
 - g. Other disciplines (pathology, psychology, anthropology, etc.) are not subject for further study in this course after today.
- Science (forensic) helps with the collection and identification of evidence (as it is needed to apply the law).
- What the law says about evidence
- Frye vs US (1923) – Admissible scientific evidence must be **generally accepted** in the field to which it belongs, the Frye standard.
- Federal Rules of Evidence, an alternative to Frye vs US standards, says that a **witness** (qualified by knowledge, skill, experience or training) may testify and provide opinion if the:

- a. testimony is based on sufficient facts
 - b. testimony is based on reliable methods and principles
 - c. Witness has applied principles and methods reliably to the facts of the case.
- In *Daubert vs. Merrel Dow Pharmaceuticals, Inc.*, (1993) the Supreme Court ruled that **trial judge** ensures that the Federal Rules of Evidence are correctly applied, such that expert witness testimony is scientifically sound and correctly applied to the facts, including
 - a. Whether the scientific theory and technique has been tested, subject to peer review, and publication, and general acceptance
 - b. Potential rate of error for theory and techniques
 - c. Existence and maintenance of standards for the technique
 - In *Kumho Tire Co. vs. Carmichael* (1999) the Supreme Court ruled that the trial judge has the gatekeeping role for expert testimony in addition to scientific testimony.
 - *Coppolino vs. State (Florida)* firmly established the power of the trial judge to admit even new scientific evidence (succinic acid was detected as a breakdown product of succinylcholine chloride by a new technique).
 - Some scientists that contributed to forensic science
 - a. Mathieu Orfila (1879) – detected poisons and effects on animals.
 - b. Alphonse Bertillon (1879) – Used body measurements to ID individuals (anthropometry)

- c. Francis Galton (1892) – Used fingerprinting to ID individuals
 - d. Leone Lattes (1901) – Used blood types, including dried blood, (A, B, AB, O) to characterize individuals
 - e. Calvin Goddard – Determined whether a given gun fired a bullet (comparison microscope for visual evidence)
 - f. Albert Osborn – Applied science to use documents as evidence.
 - g. Walter McCrone – Applied microscopy (visual evidence) and analytical methodologies (science) to forensic cases
 - h. Hans Gross (1893) – Communicated how scientific fields of microscopy, chemistry, physics, mineralogy, zoology, botany, anthropometry, and fingerprinting could assist criminal investigations and crime detection
 - i. Edmund Locard – In one of the first crime labs, he developed what is now known as Locard's Exchange Principle (whenever two objects come into contact with one another, there is an exchange of materials between them) to associate objects with each other and with criminal activity.
- The oldest crime lab in the US was in 1923 for the Los Angeles Police Department under August Vollmer. In 1972, California created a network of state-operated crime labs, which became a model system for other states.
 - J. Edgar Hoover in 1932 organized a crime lab in the FBI (US) that offered forensic services to law enforcement. In addition to the FBI, the Bureau of Alcohol, Tobacco, and Firearms (BATF), the Drug Enforcement Agency (DEA), and the US Postal Inspection Service have federal crime labs that offer services.

- The US has a system of local, independent crime labs.
- Britain has a national system of regional crime laboratories.
- Canada has three government funded institutes.
- Some available scientific services (Crime Labs)
 - a. Physical Science Unit –ID and compare crime scene evidence such as drugs, glass, paint, explosives, and soil.
 - b. Biology Unit – ID and compare crime scene samples such as DNA, blood, other body fluids, hair, fibers, and plants.
 - c. Firearms Unit – ID and compare discharged bullets, cartridge cases, shotgun shells, ammunition, firearms, discharge residues, as well as any impacted objects to determine distance (and angle) of firing.
 
 - d. Document Examination Unit – Analyze handwriting, typewriting, printing, obliterations, erasures, documents (including indentations to underlying ones), and burned documents to determine authenticity and source.
 - e. Photography Unit – Examine and record physical evidence, including IR, UV and X-ray to make information visible (good for courtroom).
 
 - f. Toxicology Unit – Determine presence or absence of drugs and poisons (including the effects) on objects, organs, or body fluids. (recently a growing need)
 
 - g. Latent Fingerprint Unit – Make fingerprints visible

h. Polygraph Unit – Lie detector (typically used by criminal investigator rather than forensic scientists)

i. Voiceprint Analysis Unit – ID and compare voiceprints to subjects.

j. Crime Scene Investigation Unit – Collects and process crime scene evidence. Trains investigators.

k. Forensic Pathology – Investigation of unexplained, sudden, violent, or unnatural death

i. Rigor Mortis – stiffening of muscle mass that disappears 24 hours after death (time of death)

ii. Livor Mortis – settling of blood in body parts closet to the ground for first 12 hours (time and position of death, movement of body after death)

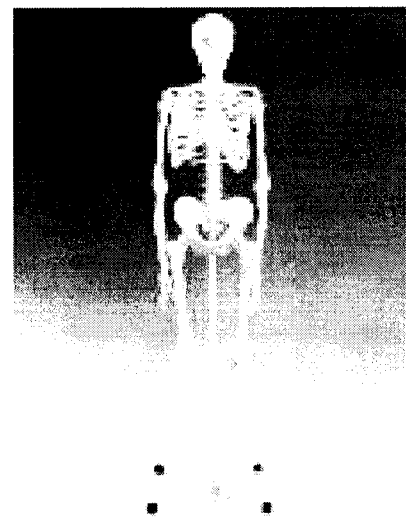
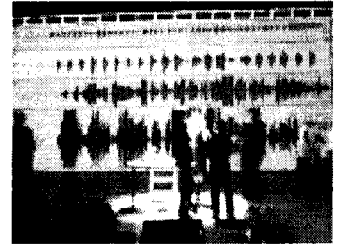
iii. Algor Mortis – heat loss by body $1.0-1.5^{\circ}\text{F}/\text{hour}$ to indicate time of death

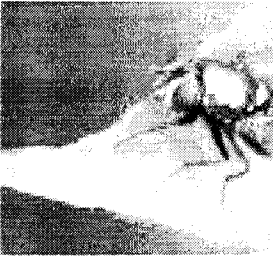
iv. Contents of digestive tract (time of death and location before death)

v. Clouding of the lens of the eye (time of death)

vi. Decomposition of body (time of death)

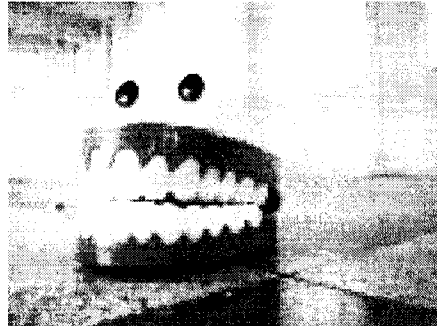
l. Forensic Anthropology – study of human skeletal remains






m. Forensic Entomology – study of insects (such as blowflies with their eggs and maggots) to estimate time of death

n. Forensic Odontology – study of teeth (especially when body is unrecognizable) based on X-rays, dental casts, photographs, bite marks



o. Forensic Engineering – conduct failure analysis, accident reconstruction, and causes/origins of fires and explosions,



p. Forensic Computer and Digital Analysis – collect information from computers, including deleted, overwritten, encrypted, or damaged data.

- Science, in its ideal form, is based only on the facts (the evidence), so science tends to be a good tool to use to make a legal case.
- Science is based only on what is known (at the time), and not on what is unknown or suspected (but these play a role in developing science), so it is possible to draw wrong conclusions based on incomplete or inaccurate information.
- Scientific experiments (as used in forensics) can never ‘prove’ a general statement, such as “the suspect is guilty”, where prove means 100% certainty of truth. The laws of probability and statistics prevent this. Science, however, can make statements of truth that can be used as evidence.

- For example, is the suspect guilty based on the evidence presented below? What other data should be collected?
 - a. Gun residue was found on the suspect's hands later that day, and a gun was found at the crime scene.
 - b. Fibers found on the gun and the surrounding area at the crime scene match fibers found in a car belonging to the suspect and in the suspect's home.
 - c. A bank security camera caught the suspect's car in the same block as the crime scene within 1 hour from the time of death as determined by algor mortis.