



Basic principles of forensic science for an introductory overview course

OVERVIEW

Key Concepts of Forensic Science

- Application of a scientific method, tool, or technique to aid an investigation or judicial proceeding
- Used to support or refute hypotheses about how an event occurred
- Results integrated into the investigation, part of a larger story
- Many subdisciplines

Forensic laboratory



Medical examiner



Characteristics of Forensic Data and Results

- Specific and complete, including caveats or limitations
- Reproducible; another forensic scientist provided with the same evidence and information should obtain the same results
- Falsifiable; results must be stated such that they can be tested for accuracy and completeness. A specific DNA profile or a specific blood alcohol measurement is falsifiable because the results can be confirmed by scientific testing
- Relevant to the case at hand. The analysis of a bloodstain sample would be done to obtain the DNA profile; cholesterol level in the blood is irrelevant

Selected Historical Figures

- **Alphonse Bertillon (1853–1914; French)**
 - Used measurements of physical features for identification called **anthropometry** or **Bertillonage**. Replaced by fingerprinting
- **Francis Galton (1822–1911; English)**
 - Fingerprints
- **Alexander Gottler (1882–1968; American)**
 - Forensic toxicology. Performed chemical analysis for the New York Office of Chief Medical Examiner (OCME)
- **Calvin Goddard (1891–1955; American)**
 - Comparison microscopy and firearms
- **Hans Gross (1847–1915; Austrian)**
 - Coined the term **criminalistics**

- **Alec Jeffreys (1950–; English)**
 - Developed early DNA testing methods
 - First to use DNA typing in a criminal matter (Colin Pitchfork case)
- **Paul Kirk (1902–1970; American)**
 - Generalist and educator
- **Edmond Locard (1877–1966; French)**
 - Trace evidence. Opened an early forensic laboratory
 - Credited for Locard's Exchange Principle, paraphrased as "every contact leaves a trace"
- **Charles Norris (1867–1935; American)**
 - Physician. Early head of the OCME
- **Mathias Orfila (1787–1853; Spanish)**
 - Worked in Italy and France. Forensic toxicologist and educator
 - Utilized the Marsh test for arsenic in the LaFarge case
- **Bernard Spilsbury (1877–1947; English)**
 - Physician and forensic pathologist

Bias and Human Error

- **Bias** can cause results of a forensic analysis to be influenced by factors other than evidence and testing results
- Usually unintended and unconscious
- Can be caused by **contextual information** irrelevant to the case
- **Confirmation bias** can occur if a specific result is anticipated or expected
- Prosecutorial bias/defense bias favors a specific side in the dispute

Interface with the US Legal System

US legal system

- Legal system designed to settle disputes
- **Adversarial**: based on comparing competing arguments
- **Criminal cases**
 - Accused/defendant vs. government (local/state/federal)
 - Prosecution vs. defense
 - **Burden of proof** on prosecution
 - Standard of proof: beyond a reasonable doubt
- **Civil cases**
 - Individual vs. individual, corporations, companies, etc.
 - Plaintiff vs. defense

Quality assurance/quality control (QA/QC)

- Practices and procedures used to ensure that forensic data are relevant and trustworthy
- **Cradle-to-grave process**—from evidence creation to final disposition
- Forensic laboratories can be **accredited**
- Analysts may be **certified** in some disciplines

- Burden of proof on prosecution
- Standard of proof: preponderance of evidence
- **Jurisdiction**: the entity empowered to hear a case—local (town, city, county), state, and federal
- Decision rendered by **trier-of-fact** (judge or jury)
- Rules on precedent—rulings by previous courts

US Rules of Evidence

- Process to allow evidence to be presented in a legal proceeding
- Evidence is admissible if it meets **admissibility standards**
- Applies to forensic results and data
- Admissibility standards vary across jurisdictions
- **Frye standard**
 - Informally called **general acceptance** admissibility standard
 - 1923 ruling
 - Decision to reject admission of polygraph (lie detector) test
 - Court ruled that to admit new type of test, it must have been accepted within that scientific discipline
- **Federal Rules of Evidence**
 - Congressionally enacted 1975
 - Frequently updated
 - Applies to federal jurisdictions
 - Adopted by other jurisdictions
 - Guidelines for expert testimony
- **Daubert standard**
 - Informally called **gatekeeper standard**
 - 1993 ruling in civil case
 - Trial judge to make admissibility decision; judge as **gatekeeper**
 - Ruling provided guidelines for making this decision
 - Included general acceptance, validation of method, standards, limitations, and potential errors
 - Part of **Daubert trilogy** of cases
- **Joiner decision**
 - Second of Daubert trilogy
 - 1997 ruling in civil case
 - Scientific evidence must be directly relevant
- **Kumho decision**
 - Third case of Daubert trilogy
 - 1999 ruling in civil case
 - Extended definition of expert beyond traditional sciences

- Methods created by **standard operating procedure (SOP)**
- **Traceability**: ability to trace result directly to nationally/internationally accepted standard
- **Control samples** analyzed with evidence
- Results reviewed by colleagues (**peer review**)
- Data reviewed and confirmed

Laboratory accreditation



Analyst certification

- Identify issues
- Implement corrective action
- Prevent future occurrences

FORENSIC SCIENCE

Forensic Science Study Guide

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