

# Introduction to Forensic Science

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## LEARNING OBJECTIVES:

1. Discuss the role of forensic scientists.
2. Describe the role of medical examiners.
3. Describe chain of custody of forensic evidence.
4. Describe the organization and function of forensic laboratories in the United States.

**ABBREVIATIONS:** DNA, deoxyribose nucleic acid

**INDEX TERMS:** Chain of custody; Criminalistics; Forensic pathology; Forensic science, Medical examiner;

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Forensic science, sometimes referred to as criminalistics, applies the knowledge of science to the definition and enforcement of laws. Criminalistics is a branch of forensic science that is involved in the collection, analysis, and interpretation of physical evidence produced by criminal activity.<sup>1</sup> This field of study involves several scientific disciplines: biology, chemistry, and physics. Forensic science is not a branch of law enforcement, and forensic scientists are not law enforcement officers. Despite how they are portrayed on television, forensic scientists do not interrogate and arrest suspects and do not usually investigate crime scenes. The main duties of a forensic scientist are to analyze physical evidence, interpret the results and testify in a court of law. Forensic scientists are expert witnesses who express opinions as to the significance of laboratory findings.

Forensic science plays a role in criminal and civil law. Forensic scientists help determine cause of death, identify perpetrators of crimes, identify bodily remains, track the electronic transfer of money, investigate internet fraud and identity theft, and reconstruct vehicular accidents. Laws regulate the safety and quality of our food and water, the potency of medications, motor vehicle emissions, and pesticides used on crops. It would be impossible to monitor compliance with laws if not for accurate laboratory testing. Forensic science is becoming increasingly broad in its application to law and criminal investigations.

Crime laboratory analyses are only relevant if the specimens received are properly collected, transported and preserved. Crime scene evidence is often collected and transported by trained police officers. In cases of personal assaults, such as rape, forensic nurses in emergency departments collect evidence from victims. A significant difference between clinical and forensic specimens is maintaining chain of custody for forensic evidence. The possession of physical evidence must account for every person who has handled the evidence, and the evidence must be maintained in such a way to prevent tampering. If the chain of custody documentation is not complete, the laboratory results will not be permitted in a court of law.

A common testing principle in forensic analysis is comparison. Physical evidence from an unknown source is collected at a crime scene, and this unknown or questioned specimen is compared to a specimen from a known source or reference sample. For example, a DNA profile can be determined on a blood stain from a crime scene. This profile can be compared to the DNA profile of a suspect. If the two profiles have a high probability of a match, this places the suspect at the crime scene. Without a reference sample for comparison, the DNA profile has little value. Ballistics, fingerprinting, and hair and fiber analysis all rely on comparison testing.

Medical examiners are pathologists trained to perform postmortem examinations. Forensic pathology is a

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specialization area performed by medical examiners to determine the cause of death as well as the postmortem interval, the length of time since death occurred. Both are often critical to crime investigations. During an autopsy, medical examiners examine the body and clothing, and they collect tissue and fluids for microscopic examination and laboratory testing. A wide variety of specimens can be analyzed. Toxicologic testing can be performed on blood, gastric contents, and cerebrospinal fluid for drugs of abuse and prescription medications. Vitreous humor, fluid in the eyes, can be tested for potassium to help determine the postmortem interval. Many of the methodologies used in a forensic science laboratory are also used in clinical laboratories.

The United States has no national system of forensic laboratories; local law enforcement agencies operate their own crime laboratories. The services each laboratory provides depends on funding, personnel, equipment, and crime statistics. The majority of forensic laboratories are publicly funded by a federal, state, or local government unit. There are nearly 500 public forensic laboratories in the United States and 50 to 100 private forensic laboratories.<sup>1</sup> In contrast, Great

Britain has a national system of regional laboratories under the direction of the government's home office. The United States does, however, have several federal agencies with forensic laboratories. The Federal Bureau of Investigation, a unit of the Department of Justice, has one laboratory in Quantico, VA. This laboratory supports the investigation efforts of the Federal Bureau of Investigation, and if requested, will test certain types of physical evidence for other law enforcement agencies and forensic laboratories.

The field of forensic science has changed substantially since the first laboratory was established in Lyons France under the direction of Edmund Locard in 1910. The first forensic laboratory in the United States was established by the Los Angeles Police Department in 1923. Forensic science involves many areas of scientific investigation. In this short series of articles, we discuss DNA analysis, forensic microbiology and forensic toxicology.

### REFERENCES

1. Houck MM, Siegel JA. Introduction. In: Fundamentals of Forensic Science, 2nd ed. Boston: Elsevier; 2010.

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