Chapter 1 Introduction to Forensic Science and the Law

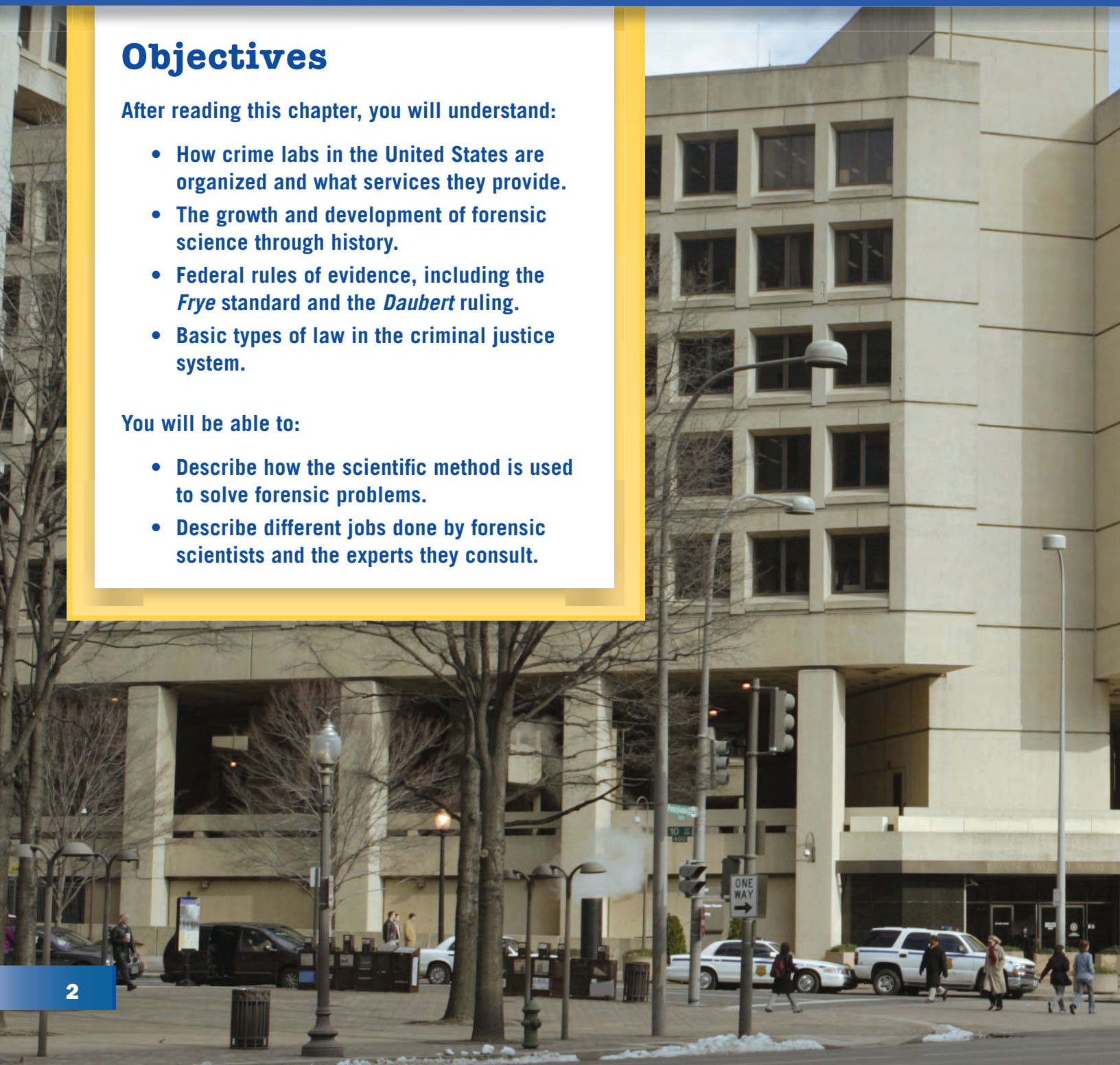
Objectives

After reading this chapter, you will understand:

- How crime labs in the United States are organized and what services they provide.
- The growth and development of forensic science through history.
- Federal rules of evidence, including the *Frye* standard and the *Daubert* ruling.
- Basic types of law in the criminal justice system.

You will be able to:

- Describe how the scientific method is used to solve forensic problems.
- Describe different jobs done by forensic scientists and the experts they consult.



"In school, every period ends with a bell. Every sentence ends with a period. Every crime ends with a sentence."

—Stephen Wright, comedian

Teacher Note

The TRCD for this chapter includes a PowerPoint presentation, which is an overview of the chapter. It can be used as introductory material or at the end as a review.

The TRCD also contains a crossword puzzle that can be used after students have learned the vocabulary from this chapter.

What Is Forensic Science?

Forensic science is the study and application of science to matters of law. Forensic scientists examine the associations among people, places, things, and events involved in crimes. You can use the terms *forensic science* and **criminalistics** interchangeably.

criminalistics: the examination of physical evidence. The term *forensics* may also include broader areas of investigation, such as pathology.

evidence: anything that tends to establish or disprove a fact. Evidence can include testimony, documents, and other objects.

ballistics: the science that deals with the motion, behavior, and effects of projectiles, most often firearms and bullets

Forensic scientists use crime labs to help them examine **evidence**. Most crime labs include several departments:

- physical science (including chemistry, physics, and geology)
- biology
- **ballistics**
- document examination
- photography
- toxicology and drug analysis
- fingerprints
- trace evidence

The word *forensic* is derived from the Latin *forensis* meaning forum, a public place where, in Roman times, senators and others debated and held judicial proceedings.

A forensic scientist's main job is to study the different types of evidence found at a crime scene. When evidence is brought into the lab, the first task is to identify what it is and then to attempt to determine its origin. Where did the evidence come from? How did it get there? The forensic scientist must be ready to testify as an expert witness at a trial or hearing. In this role, he or she presents data, weighs evidence, and gives an impartial opinion to the court. A forensic scientist also performs scientific research and trains others in the area of forensic science.

Forensic scientists come from many backgrounds; many have studied biology or microbiology, chemistry, physical science, geology, or one of the other sciences. They then learn about forensics through experience and independent study. Many have advanced degrees in forensic science. Some forensic scientists learn their profession through experience with a police force.

Crime Laboratories

The vast majority of crime labs are public, that is, funded by taxes at the federal, state, or local level. Most public labs provide services for police, prosecutors, and other law enforcement agencies. Private labs exist and can be accessed for a fee by public agencies or private citizens.

Sometimes public labs can be used by legal defense teams and private citizens, but these users must pay a fee. Most labs are maintained by the states for individual regions. Large cities, such as New York and Los Angeles, may have their own labs, while local labs may serve county and municipal agencies.

The Department of Justice maintains the FBI, DEA, and ATF laboratories. The Federal Bureau of Investigation (FBI) maintains the largest crime laboratory in the world. The Drug Enforcement Agency (DEA) operates seven labs throughout the country. These labs work mainly on investigating major illicit drug activities inside and outside the United States, but may also work with local law enforcement agencies on joint operations. The Bureau of Alcohol, Tobacco, and Firearms (ATF) operates three regional laboratories and a fire research laboratory. The ATF deals with crimes involving alcohol, weapons, explosives, tobacco, and organized crime. The Department of the Treasury maintains a lab for the Internal Revenue Service (IRS) specializing in questioned documents. The U.S. Postal Service has its own lab to handle crimes involving the mail. The Department of the Interior maintains the U.S. Fish and Wildlife Service lab specializing in crimes involving animals, such as poaching and importing endangered species, and crimes in national parks. The Department of Homeland Security now maintains the Secret Service lab, which has two main duties: One is to guard against counterfeiting and the other is to provide executive protection.

Suggested Assignment

Have students conduct research on their local and state crime labs. In the form of an essay or a research paper, have them address the following components:

1. Location of the labs
2. Number of people employed in the labs
3. Services provided
4. Number of cases processed per year
5. The most common types of evidence analyzed

This assignment will give students an idea of the scope of their local crime lab's capabilities and the number and types of cases processed there.

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Research crime lab at Michigan State University

Chemistry section of a crime lab

State or local crime laboratories may have the following divisions and functions:

- A physical science unit to examine drugs, soil, glass, paint, blood spatter patterns, and other trace physical evidence using chemistry, physics, or geology.
- A firearms unit to examine tool marks, weapons, firearms, and bullets.
- A document analysis unit to examine handwriting, typewriting, word processing and computer applications, paper, and ink.
- A biology unit to analyze body fluids, DNA, blood factors, hair, fibers, and plant life using biology, biochemistry, and microbiology.

Some larger crime laboratories may also have units specializing in photography, toxicology (poisons), latent fingerprints, polygraphs, arson, and evidence collection.

Sometimes forensic scientists may consult with other scientists who specialize in specific disciplines such as:

anthropology
psychiatry
odontology
engineering
computer technology
pathology
geology
environmental science
entomology
palynology
polygraphy
voiceprint analysis

odontology: in forensics, examination of bite marks and dental identification of corpses

pathology: investigation of sudden, unexplained, or violent death

entomology: the study of insects

palynology: the study of pollen and spores

polygraphy: the use of the "lie detector"

Highlights in the History of Forensic Science

History is not an isolated list of dates, but the story of events and people. Advances in any area of study come from previous ideas and discoveries, and sometimes from other areas that seem to be unrelated. And so it is with forensic science. For example, the development of spectroscopy by Kirchhoff and Bunsen in a German lab almost 150 years ago created a

way to identify different drugs. Here are other highlights in the history of forensic science:

about 500 CD	A bead and wire abacus is the first computer.
about 200 CD	According to legend, Archimedes determines density of a suspected gold crown using its weight and how much water it displaces.
BE 66	Emperor Nero murders his wife and presents her head on a dish to his mistress, who identifies the head as Nero's wife by two discolored front teeth.
142	Gunpowder is first described in China.
904	The Chinese first use gunpowder in warfare as incendiary projectiles called "flying fires."
1132	Gunpowder is used in thick bamboo to fire clay pellets; bamboo later replaced by bronze, and clay replaced with iron balls.
1149	King Richard I of England creates the job of coroner to investigate questionable deaths.
1216	The first written mention of the composition of gunpowder in Europe by Roger Bacon.
1248	The Chinese book *Hsi Duan Yu* describes how to distinguish a drowning victim from one who has been strangled. Also mentioned is a stabbing solved by observing flies attracted to blood on the killer's sickle.
1300	Portable, handheld "cannons," or *gonnes*, are developed.
1514	The earliest known use of blood spatter evidence is a trial in London in which the defendant, Richard Hunne, had been jailed for heresy and was then convicted of suicide, post mortem.
1540	Rifling appears in firearms.
1598	Fortunatus Fidelus is the first to practice forensic medicine in Italy.
1609	Francois Demelle publishes the first treatise on systematic document examination.
1628	Birth of Italian Marcello Malpighi, credited with noticing patterns in the skin of fingers.
1642	Blaise Pascal, at age 18, builds the first numerical calculating machine.
1668	Analysis of blowfly infestation of rotting meat allows Francesco Redi to refute the hypothesis of "spontaneous generation" of maggots.

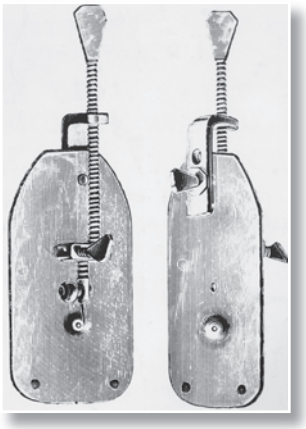
500 CDabacus

Archimedes' gold crown

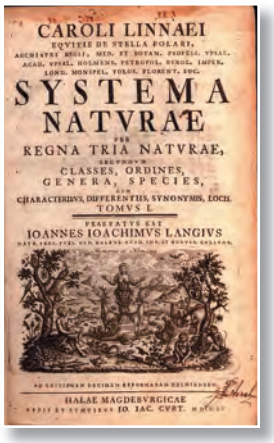
Nero's wife, Octavia

A figure firing a "handgonne," from a 1410 manuscript

Blowfly



Leeuwenhoek's microscope



Carl Linnaeus's publication on the science of taxonomy

A Babbage-type computing machine

The 1873 Colt "Peacemaker"

1670 The first high-powered microscope is constructed by Anton Van Leeuwenhoek of Holland.

Galvani's apparatus used on frog legs

1732 Luigi Galvani discovers that the human nervous system transmits information electrically; this is the basis of current "lie detection" equipment.

1735 Carl Linnaeus, also known as Carl von Linné, publishes the first edition of *Systema Naturae* in the Netherlands. He is often called the "Father of Taxonomy" for his introduction of a system of hierarchical classification.

1776 The body of General Joseph Warren, killed at the Battle of Bunker Hill, June 17, 1775, is disinterred from a mass grave and identified by Paul Revere, who had made his false teeth.

1784 The first documented case of physical matching occurs when an Englishman is convicted of murder because the torn edge of a wad of newspaper in a pistol matches a piece remaining in his pocket.

1810 First recorded use of questioned document analysis involving a chemical test for a particular ink dye.

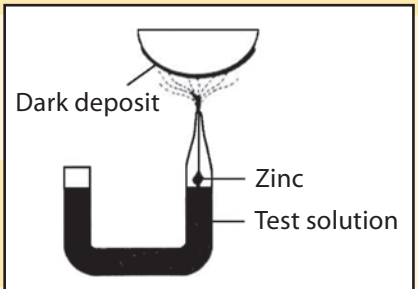
1810 The first detective force, the Sûreté, is established in Paris.

1813 Mathiew Orfila, considered the father of modern toxicology, publishes his book on the subject. Poisoning was a popular way of dispatching people.

1816 A farm laborer is convicted of murder based upon impression evidence.

1832 Charles Babbage invents his "Analytical Engine," the forerunner of modern computers.

1835 Scotland Yard, London's detective force, is the first to use bullet comparison to catch a murderer.



Marsh test apparatus

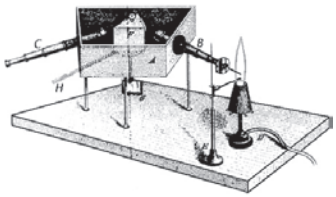
1836 James Marsh discovers a very sensitive chemical test to detect arsenic compounds.

1836 The first multishot pistol is developed by Samuel Colt. By the time of his death in 1862, he had made and sold almost a million guns.

1840 Forensic toxicology is first used to convict Marie Lafarge, by use of the Marsh test, of poisoning her husband with arsenic.

1841	Edgar Allan Poe's short story, *The Murders in the Rue Morgue*, is the first detective story using forensic science, influencing future authors including Arthur Conan Doyle.
1847	The earliest examination of hairs in a criminal investigation in the murder of the Duchesse de Praslin.
1850	For the first time, a murderer is convicted in the United States based on dental evidence.
1852	Earliest reported case involving fiber analysis where the fibers of the victim's clothes matched those on the murder weapon.
1853	Soil on suspect's boots matches that at the crime scene.
1855	First use of forensic entomology to estimate postmortem interval (PMI) by a French doctor, Bergeret d'Arbois.
1856	William Herschel, working in India, uses thumbprints on documents to identify workers.
1859	Gustav Kirchhoff and Robert Bunsen develop the science of spectroscopy.
1863	The first presumptive test for blood is developed, using the fact that hemoglobin oxidizes hydrogen peroxide.
1863	One of the earliest recorded cases involving simple firearms identification occurs during the United States Civil War, when Confederate General Stonewall Jackson is fatally wounded on the battlefield. Examination of the caliber and bullet shape determines that the bullet could only have been fired by one of his own men: The Confederates used a 67-caliber ball projectile, whereas the Union forces used a 58-caliber minie ball.
1879	Frenchman Alphonse Bertillon develops a system to identify people using body measurements.
1880	Scotsman Henry Fauld, working in Tokyo, uses fingerprints to exonerate an innocent burglary suspect.
1886	Paul Vieille invents a smokeless gunpowder called Poudre B which revolutionizes the effectiveness of small guns and leads to more recipes.
1887	Arthur Conan Doyle publishes his first Sherlock Holmes story, *A Study in Scarlet*.
1888	American George Eastman invents the first handheld camera. He calls it the "Kodak" camera and retails it for $25.

In 1849 J. W. Webster, professor of chemistry at Harvard, was accused of murdering George Parkman, M.D. The body had been dismembered and the head burned in a furnace; however, blocks of porcelain teeth were found in the ashes. Dr. Parkman's dentist recognized the dentures as some he had made for the victim. Eventually Webster confessed and was hanged.



Kirchhoff and Bunsen's spectroscopy apparatus

Minie ball

Fingerprint

Sherlock Holmes

A couple confessed to murdering a man named Gouffe for his money. A body found in a sack in the Rhone River some time later was identified as the victim by Lacassagne through some remarkable detective work. He established that the murder victim had walked with a limp and had suffered from inflammation of one ankle and water on the knee. The corpse's height and age were assessed through his bones and teeth. All these details were the same as for the murdered man, but Gouffe had had brown hair, and the corpse's hair was black. Lacassagne had observed in previous studies that hair could change color inside a coffin. When it was learned that the murderers had originally placed the body in the sack in a trunk, which had broken open in the river, the identification was complete.

1892 Galton book

1888	Chicago is the first U.S. city to adopt the Bertillon system of identification.
1889	Alexandre Lacassagne publishes a text on matching bullets to individual gun barrels.
1892	Francis Galton, a nephew of Charles Darwin, publishes his book on fingerprints and their use in solving crimes.
1892	Argentina becomes the first country to replace the Bertillon system of measurements with fingerprints when Juan Vucetich solves a particularly gruesome murder using bloody fingerprints.
1894	Alfred Dreyfus is convicted of treason in France based, in part, on mistaken handwriting identification by Bertillon.
1894	Doctor Jean Pierre Mégnin presents his theory of successional insect waves inhabiting a corpse.
1895	Two Canadian researchers start a number of systematic entomological studies on human corpses.
1896	Edward Henry develops the prototype fingerprint classification system now used in Europe and the United States.
1898	Photomicrographs of two bullets allow individualization of the minutiae.
1900	Scotland Yard adopts the Galton–Henry system of fingerprint identification.
1900	Austrian Karl Landsteiner identifies human blood groups. In 1930 he receives a Nobel Prize for this work (see Table 1.1).
1901	Paul Uhlenhuth develops the precipitin test, which distinguishes

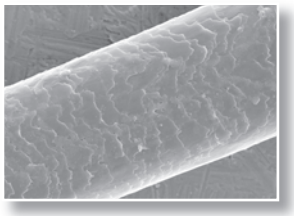
Table 1.1: Landsteiner's Blood Groups

Blood Type	Antigens	Antibodies
A	A	B
B	B	A
AB	A & B	None
O	None	A & B

	between human and animal blood. The test is used in the murder conviction of Ludwig Tessnow in the same year.
1902	Harry Jackson, a burglar, becomes the first Englishman to be convicted solely on the basis of fingerprints.
1903	Two convicts with the same name and same anthropometry (Bertillon) measurements are found in Fort Leavenworth prison. Two years later, their fingerprints are found to clearly distinguish between them.
1903	The New York City Police Department starts to create fingerprint files of arrested persons. This system is adopted by the New York State prison system two years later.
1903	Russian botanist Mikhail Tswett invents chromatography.
1904	Edmond Locard formulates his famous principle, "Every contact leaves a trace."
1904	Presumptive test for blood is developed based on benzidine, a new chemical developed by Merck.
1905	President Theodore Roosevelt establishes the FBI.
1906	Bite mark evidence is first used in an English court to convict two hungry burglars using teeth marks found in cheese at the scene.
1907	The first recorded instance of fired cartridge casings being evaluated as evidence in an investigation of a brawl involving U.S. soldiers at Brownsville, Texas.
1910	The first police crime laboratory is started in Lyon, France, by Edmond Locard.
1910	Victor Balthazard publishes the first comprehensive study of human and animal hair. He also uses photographic enlargements of bullets and cartridge cases in an attempt to connect an individual bullet to a particular weapon.
1910	American Albert Osborne publishes the seminal treatise *Questioned Documents*.
1915	Italian Leone Lattes develops a method for determining the blood group of dried bloodstains.
1920s	Luke May, one of the first American criminalists, pioneers striation analysis in tool mark comparisons.
1920s	Russian palaeontologist Mikhail Gerasimov develops a method to reconstruct facial appearance from a skull. He is later popularized as the character Andreev in the detective novel *Gorky Park*.
1920s	German investigator Georg Popp uses botanical and soil identification in solving a crime.

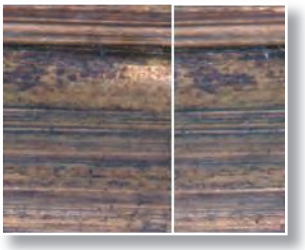
Tswett's chromatography apparatus, 1903

Edmond Locard, 1877–1966



Human hair

In ancient India a grain of rice could be used as a lie detector. The suspect was asked to chew a grain of rice and then spit it out. A suspect who couldn't do it because his or her mouth was too dry was declared guilty.



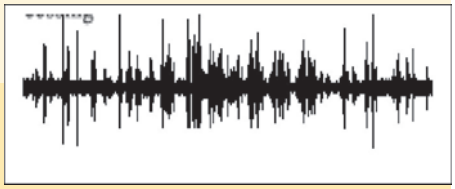
Matching striations of bullet with comparison microscope

The Thompson submachine gun often used by gangsters

ENIAC

1921	The first lie detector is built by John Larson, a University of California medical student.
1922	A Nobel Prize is awarded to Englishman Francis Aston for developing the mass spectrometer.
1923	The Los Angeles Police Department establishes the first police laboratory in the United States.
1923	In the court case *Frye v. United States*, polygraph test results are ruled inadmissible, bringing about the concept of "general acceptance," or evidence accepted by the scientific community.
1925	The comparison microscope for use in bullet comparison is perfected, and its use is widely publicized in the Sacco and Vanzetti trial of 1926.
1929	The infamous St. Valentine's Day Massacre occurs when seven gangsters are gunned down. Examination of all firearms-related evidence dispels the rumors that police were involved.
1932	The FBI crime laboratory is created.
1935	In Scotland, blowfly larvae provide a vital clue in the murders of Dr. Ruxton's wife and maid.
1937	Walter Specht finds that the chemical luminol glows in contact with latent blood.
1940	Landsteiner and Wiener describe Rh blood groups.
1940	The Complex Number Calculator, the first digital computer, is demonstrated at Bell Labs.
1941	Voiceprint identification is first studied at Bell Labs in New Jersey.
1946	The Electronic Numerical Integrator and Computer, ENIAC, is dedicated. It contains 18,000 vacuum tubes in cabinets 8′ × 100′, weighing 80 tons. It can do 5,000 additions and 360 multiplications per second.
1948	The American Academy of Forensic Sciences (AAFS) meets for the first time in Chicago and soon publishes the *Journal of Forensic Science*.
1948	Keith Simpson launches the science of bite mark analysis (forensic odontology) when he examines bite marks on a dead woman.

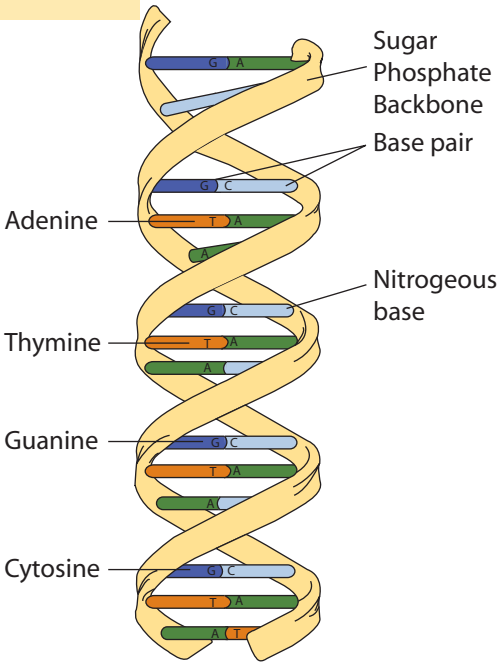
Lie detector polygraph



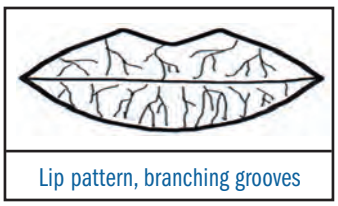
Voice sound spectrum

1952	British researchers Martin and Synge receive the Nobel Prize for their invention of gas-liquid partition chromatography, a powerful method of analyzing mixtures of drugs and poisons.
1954	R. F. Borkenstein, a captain in the Indiana State Police, invents the Breathalyzer for field sobriety testing.
1955	De Saram publishes careful and detailed measurements of body temperature decrease in executed prisoners to determine time since death.
1955	The murder trial of Dr. Sam Sheppard publicizes blood spatter evidence, and inspires several movies, television programs, and books.
1957	The growth stages of skeletal bones are identified by Americans Thomas Mocker and Thomas Stewart, forming the basis of forensic anthropology.
1959	James Watson and Francis Crick discover the DNA double helix.
1960s	Maurice Muller adapts the Ouchterlony antibody-antigen diffusion test for precipitin testing to determine species.
1960	Gas chromatography is used for the forensic identification of petroleum products.
1961	Hungary becomes the first country in Europe to carry out research on the subject of lip prints.
1967	The FBI inaugurates the National Crime Information Center (NCIC), the first national law enforcement computing center with information on wanted persons and stolen vehicles, weapons, and other items of value.
1969	The Association of Firearm and Tool Mark Examiners (AFTE) is formed.
1972	Body armor made of Kevlar is introduced. It is currently credited with saving the lives of more than 2,000 police officers since inception.
1972	Dr. William M. Bass starts the Forensic Anthropology Center, otherwise known as "The Body Farm," at the University of Tennessee.
1973	Canada's Royal Canadian Mounted Police (RCMP) finish computerizing their fingerprint files.
1975	The Federal Rules of Evidence are enacted.

Breathalyzer



DNA double helix

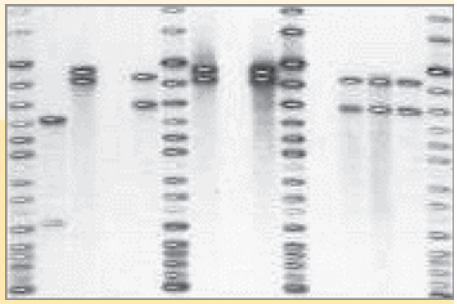


Lip pattern, branching grooves

1976	Gas chromatography–mass spectrometry (GC-MS) is first evaluated for forensic purposes.
1977	The Fourier transform infrared spectrophotometer (FTIR) is adapted for use in the forensic laboratory.
1977	In Japan, investigators accidentally discover that superglue reveals latent fingerprints.
1977	The Internet is born.
1977	A limited computerized scanning mechanism is first used to develop a database in forensic science by the FBI's Automated Fingerprint Identification System (AFIS).
1978	Britain's Yorkshire Ripper case highlights the value of computers in investigating serial killings and leads to the development of "psychological profiling" techniques in the following decade.
1979	Bite mark evidence is a key in convicting serial killer Theodore "Ted" Bundy.
1981	IBM introduces its personal computer (PC) for use in the home, office, and schools.
1982	The term *serial killer* is first used to describe a killer who kills repeatedly and obsessively, on separate occasions.
1984	Professor Alec Jeffreys discovers that each human being has unique DNA, except in the case of identical twins.
1986	The polymerase chain reaction (PCR) DNA replication technique is developed specifically for forensic use by Cetus Corporation.

Replica of Ted Bundy's teeth

IBM's 1050



DNA fingerprint

Peter Sutcliffe, called the Yorkshire Ripper, was arrested in 1981 after killing 13 women in northern England. He battered his victims with a ball-peen hammer and then stabbed them. If descriptive details about Sutcliffe, such as shoe size, blood type, and the like, had been stored on a computer, he probably would have been questioned further when he was picked up the first time, and the detectives working on the case later would have known that he had been interviewed before. Thus, a few lives could have been saved.

1987	DNA profiling is used to identify Colin Pitchfork as the murderer of two girls in England and to exonerate someone previously suspected of the murder. Three months later, the same techniques are applied to convict Tommy Lee Andrews for a series of sexual assaults in Florida.
1989	In the United States, Gary Dotson becomes the first person to have a conviction overturned on the basis of DNA evidence. Dotson had served eight years of a 25- to 50-year sentence for rape.
1990	Author Patricia Cornwell's first novel, *Postmortem*, is published. It features good forensic science, as do more than ten of her subsequent books.
1990	The first prosecution under the federal computer crime statute is for a release of a "worm" into the Internet by a graduate student.
1991	A computerized, automated imaging system is introduced for comparing marks of bullets and shell casings. It is called the Integrated Ballistics Identification System, or IBIS. The following year, a similar system, called DRUGFIRE, is introduced in the FBI.
1992	DNA short tandem repeats (STR) are used in forensic DNA analysis.
1993	In the court case of *Daubert v. Merrell Dow*, the court changes the standard of admission of scientific evidence.
1995	eBay is founded by a French-born Iranian computer programmer.
1996	Computerized searches of the AFIS fingerprint database are implemented by the FBI, using both live scan and card scan devices.
1996	Mitochondrial DNA typing is admitted in a U.S. court for the first time.
1998	An FBI index of DNA profiles called NDIS (National DNA Index System) is incorporated with CODIS (Combined DNA Index System).
1999	AFIS is further refined to form IAFIS, Integrated Automated Fingerprint Identification System.
1999	IBIS and DRUGFIRE are combined to form the National Integrated Ballistics Identification Network (NIBIN).
2001	USA PATRIOT Act of 2001 allows for the search and seizure of computers.
2002	CODIS enables the first match between NDIS and a DNA profile from Florida, resulting in an arrest and conviction.
2007	The largest AFIS repository in America is operated by the Department of Homeland Security's U.S. Visit Program,

Bullets

	containing over 63 million persons' fingerprints, primarily in the form of two-finger records.
2007	There are now approximately 400 crime labs and nearly 40,000 people involved in forensic science in the United States.

Suggested Assignment

Give students a time range from which to choose a historical event of interest and research the topic. Depending on how many students you have in class, you may wish to divide the timeline into blocks of years so that the topics are spread over the entire period and not concentrated in one decade. Create a poster including the following components:

1. The date and title
2. Graphics (drawing, photo, sketch, table, or graph)
3. A one-page summary overview of the discovery or significant event
4. A description of how the discovery contributed to modern-day forensic science and analysis of evidence

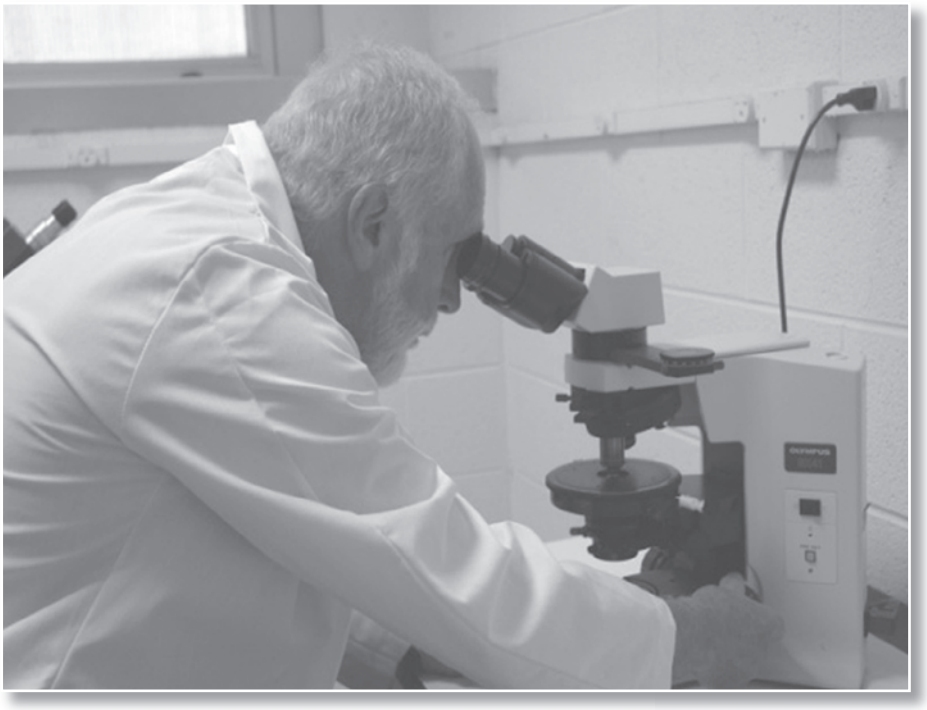
The posters can then be presented individually to the class, and then posted in the room or outside the classroom as a timeline. Students should learn in more detail some of the history of forensic science.

Methodology

A fundamental principle of investigation for every crime scene comes from Edmond Locard, a forensic investigator in the early 1900s. Locard strongly believed that a criminal could be connected to a crime by trace evidence collected at the crime scene. He stated:

> Whenever two objects come into contact, there is always a transfer of material. The methods of detection may not be sensitive enough to demonstrate this, or the decay rate may be so rapid that all evidence of transfer has vanished after a given time. Nonetheless, the transfer has taken place.

The forensic scientist must be methodical in his or her work. He or she must first observe general characteristics of the evidence and then observe more specific features. He or she must link evidence to a crime and to the suspects by identifying and comparing relevant material.



Scientist using microscope

Scientists solve problems using an approach known as the scientific method. It includes the following steps:

1. Observe a problem or questioned evidence and collect objective data.
2. Consider a hypothesis or possible solution to the problem based on observation, giving direction to the work plan. This step requires inductive reasoning, experience, and imagination.
3. Examine, test, and analyze to support or refute the hypothesis.
4. Use deductive reasoning to make a determination as to the significance of the evidence.
5. Evaluate and verify all evidence. This step is especially critical to a forensic scientist because someone's liberty can depend on this work. All possible errors must be stated. Consideration must be given to standardization, reproducibility, validity, reliability, and accuracy.

Finally, the forensic scientist must come up with a theory or opinion that is able to stand up to scientific and legal scrutiny.

The Locard Principle

Activity 1.1

You are sitting at your desk. What are you in contact with? What possible transfer of material could have taken or is taking place? Make a list. How could you have prevented any transfer if you had thought about it first? What transferred material could be traced to you directly?

Think about when you came to school today. Did you leave any evidence that you were here other than being observed by others (eyewitness accounts)?

Is it difficult not to leave a trace? And, after the fact, is there lots to worry about from leaving evidence of your presence? Do you think premeditated contact can diminish identifiable transfers? Give some hypothetical examples where destroying evidence might leave more that could identify you.

Possible Answers

Contact at desk from the floor to the seat to the desktop to objects thereon. Possible transfer of footprints, fibers from clothing, hair, fingerprints, pencil, etc. Prevention: Don't come to class; otherwise, wear booties, gloves, and hat; spread plastic on the chair and desktop (but that might leave a trace identifiable to the person who brought in the plastic to sit on). What can be traced to the individual: fingerprints, chewing gum (under desk). At school today, other than classroom transfers: lunch stuff (fingerprints, DNA, tooth marks), cigarette butt outside school, vehicle, notes, cell phone calls, stuff in locker. Hypothetical examples: Use your imagination, such as wiping fingerprints with a handkerchief that is left behind, wiping up blood with a blanket from your car, vacuuming trace evidence and leaving behind fingerprints on the emptied cleaner, etc.

Criminal Justice and the Law

Laws have been established to regulate relationships between individuals and between organizations or agencies and individuals. These codes of conduct have been in existence since the beginning of civilization in one form or another and are based on what a particular society deems important. Modern laws are a result of a long history of social customs, rules, practices, legal decisions, and rulings that are considered acceptable.

United States Constitution

The United States Constitution is the supreme document and final authority on laws pertaining to individual rights, and on the power of the government to create laws and to create limits on punishments. The Constitution itself does not contain a list of all laws that govern our country. It must be interpreted in deciding whether new or existing laws are acceptable based upon the ideals of our core democratic principles. All federal laws overrule state laws.

There are a number of different types of law in the U.S. criminal justice system:

- **Statutory law**, or written or codified law, is the "law on the books" as enacted by a governmental body or agency having the power to make laws (such as Congress). Statutory law is based on the Constitution.
- **Common law** or **case law** is made by judges. *Precedents* are decisions made in previous cases or superior courts that are used as a basis to justify later decisions made in similar cases. They must be followed, and become a part of the law itself. The U.S. Supreme Court carries the greatest influence, as decisions it makes are incorporated into the process by which lower courts make their decisions. The principle of recognizing previous decisions as precedents is called ***stare decisis***, "to stand by the decision." Once a decision is made in court, it is written down and becomes law. This makes for predictability and consistency in how the law is applied.
- **Civil law**, sometimes referred to as private law, deals with relationships between individuals involving such matters as property or contracts. It provides a formal means for regulating noncriminal relationships among individuals, businesses, agencies of government, and other organizations. Contracts, marriages, divorces, wills, property transfers, negligence, and products manufactured with hidden hazards are all civil concerns. It is up to an individual to bring the suit to court. Civil law is more concerned with assigning blame than with establishing intent. In civil cases, a "preponderance of evidence" is required to convict. Violations of civil law are generally punishable by fines or transfer of property.
- **Criminal law**, sometimes referred to as public law, deals with regulation and enforcement of rights. It is concerned with offenses against an individual that are deemed offensive to society; the state

statutory law: legislative acts declaring, commanding, or prohibiting something

common law or **case law**: the body of law made up of judicial opinions and precedents

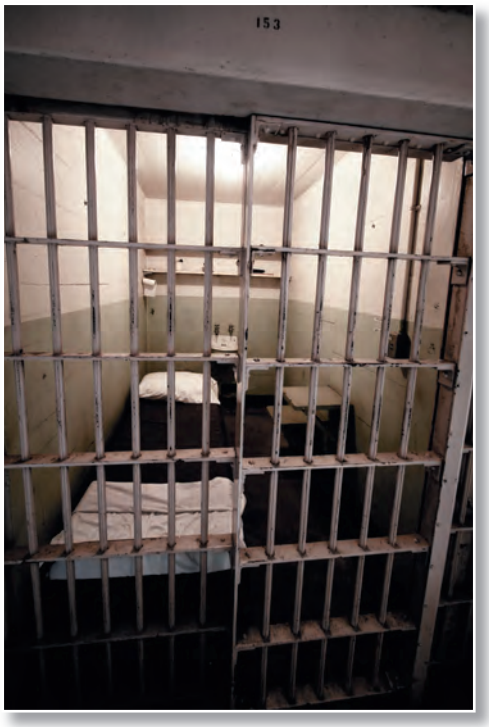
stare decisis: "to stand by the decision," meaning previous legal decisions are to be followed

civil law: law that deals with noncriminal suits brought to protect or preserve a civil or private right or matter

criminal law: regulation and enforcement of rights, setting the acceptable limits of conduct in society

becomes the plaintiff (as in *U.S. v. Toby* or *State of Michigan v. Smith*). The roots of our law come from medieval England, where offenders who violated the "King's Peace" were thought to be offending not just an individual, but the order established under the rule of the monarch. A **misdemeanor** is a minor crime such as theft, minor assault and battery, or possession of small amounts of illegal drugs. A **felony** is a major crime such as murder, rape, armed robbery, serious assault, dealing in illegal drugs, fraud, auto theft, or forgery. In criminal cases the prosecution must prove guilt "beyond a reasonable doubt" to convict the suspect. Violations of criminal law are punishable by fines, community service, probation, incarceration, or, in extreme cases, life in prison or capital punishment (death).

- Equity law is remedial or preventive (such as an injunction or a restraining order). These laws are for cases not covered by common law.
- Administrative law includes rules or laws established by agencies such as the Internal Revenue Service (IRS), Social Security Administration, or branches of the military.



Jail cell

Forensic scientists may examine evidence concerning the breaking of any and all of the types of law listed above. All collectors and handlers of evidence must be aware of the rights guaranteed in the Bill of Rights of the U.S. Constitution, so that all evidence is collected properly and without violating any individual's rights.

The following are some of the individual rights guaranteed by the U.S. Constitution in times of normalcy.

misdemeanor: a minor crime, less than a felony, usually punished with a fine or confinement other than in a prison

felony: a serious crime, such as murder, punishable by more than one year of imprisonment up to execution

probable cause: situation in which a reasonable and prudent person, viewing the available information, would conclude that a crime has been committed and that the suspect committed it

Teacher Note

This material may spur a review of what students learned in government class. They should know how laws are enacted and by whom. You might ask a social studies or government teacher how to tie in and integrate

Individual Rights Guaranteed by the Bill of Rights

The right to be presumed innocent until proven guilty

The right not to be searched unreasonably, either on one's person or in one's home

The right not to be arrested without **probable cause**

The right against unreasonable seizure of personal property

The right against self-incrimination

The right to fair questioning by police

Class Discussion

In class, see how many of these rights are familiar to your students and whether they understand the implications of each. Note that some of these rights have conditions; for example, the right to bear arms has some restrictions and regulations, e.g., we can't bring guns to school.

The due process clause of the U.S. Constitution was derived from the Magna Carta in the year BE 1215. Under due process, neither the king (in those days) nor the American government (now) can take away your life, liberty, or property without following the appropriate legal procedures.

The right to protection from physical harm throughout the justice process

The right to an attorney

The right to trial by jury

The right to know any charges against oneself

The right to cross-examine prosecution witnesses

The right to speak and present witnesses

The right not to be tried again for the same crime

The right against cruel and unusual punishment

The right to due process

The right to a speedy trial

The right against excessive bail

The right against excessive fines

The right to be treated the same as others, regardless of race, gender, religious preference, country of origin, or other *personal attributes*

Teacher Note

Ask the government teacher if the Patriot Act is part of his or her curriculum. This may be a good place to integrate what students do in government class with forensic science.

The term *personal attributes* is not well defined; hence all the controversy these days.

According to the Patriot Act of 2001, actions labeled as presenting a "clear and present danger" to the national security of the country may lead to the suspension and/or limitation of these rights.

Types of Crimes

Class Discussion

Have students look up the Patriot Act and discuss how these rights may be affected and under what conditions.

Any time a law has been broken, a **violation** has occurred. Violations can be minor crimes or major crimes. Crimes are classified as infractions, misdemeanors, or felonies for the purpose of sentencing.

An **infraction** is a minor offense or petty crime that is considered less serious than a misdemeanor. Examples include jaywalking, traffic violations, and littering. The penalty for an infraction is typically a fine.

Teacher Note

Consider asking your best students to construct a flow chart of the entire process of arrest, investigation, and administration of justice from what they have learned in the pertinent sections of the chapter as well as from external resources.

An example is given on the TRCD, Blackline Master 1.1.

violation: a breach of a right, duty, or law

infraction: violation of a rule or law that is not punishable by prison

Misdemeanors are punishable by no more than one year in jail. Cases involving misdemeanors are usually heard by the district court closest to where the crime took place. A first offense of drunk driving, vandalism, shoplifting, simple assault, trespassing, or prostitution is an example of a misdemeanor. Fines may range from less than $250 up to $2,500. Community service is sometimes part of the sentence.

Felonies are more serious crimes that carry stiffer penalties. They are tried in the district court closest to where the crime took place. The district court conducts a preliminary examination to decide whether the case will

Table 1.2: Society's Major Crimes

Category	Wrong
Violent crime	Murder, force, violence, threats, fear, rape
Property crime	Stealing, depriving, trespass, intimidation, arson
Crime against morality	Prostitution, seduction, illicit behavior, slavery, kidnapping
Crime against public order	Disorderliness, threats to public safety and peace
Crime against government	Rebellion, treason, sedition, perjury, corruption
Crime by government	Genocide, torture, brutality, civil rights violations
Hate crime	Bias, prejudice, discrimination
Organized crime	Dealing in illegal goods and services, money laundering
White-collar crime	Deception, fixing, gouging, nonviolent illicit financial gain
Occupational crime	Opportunism, misuse of professional capacities
Victimless crime	Addiction, illegal exchange
High-technology crime	Fraud, illicit computer use, blackmail

be transferred to circuit court for trial. Arson, aggravated assault, burglary, robbery, homicide, and rape are examples of felony crimes. Punishments for a felony conviction may range from five years up to life in prison, or even, in some states, the death penalty. Fines may be levied up to $100,000. Probation may also be determined for felonies.

Criminal law recognizes twelve categories of crime, which can range from infractions to felonies (Table 1.2). Such a list exemplifies our present society's view of wrongs. Can you think of more examples to add?

Steps in Pursuing Justice

The steps in pursuing justice are complex and confusing because of different jurisdictions (federal, state, local), different state rules and procedures, the type of crime, extenuating circumstances, prior history, and so on. What follows is a rather generic description of a criminal procedure.

A crime is committed. It then must be discovered. A suspect may be identified. The police investigate what may have happened. Information is collected. The crime scene is documented and searched for evidence. All information is assembled into a report for the

"Lady Justice" adorns courthouses throughout the nation. Its origin dates from Roman times; the lady represents Themis, the goddess of justice and law. The scales signify the impartiality of justice; the sword, the power of those making decisions; the blindfold, that justice is not subject to influence.

prosecutor. An investigation ensues, and an arrest warrant is issued if the **elements** of a crime are present.

elements: in criminal law, the specific factors or parts of a crime

booking: a police procedure following arrest that records basic information about the suspect, a photograph, and fingerprints, and perhaps includes a lineup

***Miranda* rights** or ***Miranda* warning**: rights guaranteed by the Constitution that police must tell arrestees about, especially the right to remain silent and the right to an attorney

arraignment: the first act in a criminal proceeding, where the defendant is brought before the court to hear charges and enter a plea

bail: money put up to guarantee that the defendant will appear in court as directed. A bondsman pays the bail for a fee of 10 percent of the bail amount. If the defendant does not appear when the time comes, the bondsman may hire bounty hunters to find and return the suspect.

Basically, the elements of a crime involve (a) if a crime actually occurred, (b) if the accused intended for the crime to happen, and (c) if there is a timely relationship between a and b. For example, the five elements of a robbery may include (1) taking away (2) another's property, (3) in their presence, (4) with intent to steal, (5) using force or fear.

After a suspect has been arrested, he or she is taken to the police department for **booking** and informed of his or her ***Miranda* rights**, if questioning is to occur. If the suspect is not questioned, no *Miranda* warning is necessary. The individual is brought before a magistrate, judge, or commissioner for **arraignment** within a proscribed number of hours, usually less than 72. At this time, the court may appoint a public defender, inform the suspect of the charges and his or her rights, and set **bail**, if deemed appropriate. The suspect offers a plea of guilty, not guilty, not guilty by reason of insanity, double jeopardy (if he or she has already been tried for the same crime in the same court), or ***nolo contendere*** (no contest). Future court dates are also set.

Miranda v. Arizona, 384 U.S. 436 (1966)

Before a law enforcement officer may question a suspect regarding the possible commission of a crime, the officer must inform the detainee about his or her *Miranda* rights, making sure the detainee understands them.

WARNING OF RIGHTS

1. You have the right to remain silent and refuse to answer questions.
2. Anything you do or say may be used against you in a court of law.
3. You have the right to consult an attorney before speaking to the police and to have an attorney present during questioning now or in the future.
4. If you cannot afford an attorney, one will be appointed for you before any questioning if you wish.
5. If you decide to answer questions now without an attorney present, you will still have the right to stop answering at any time until you talk to an attorney.
6. Knowing and understanding your rights as I have explained them to you, are you willing to answer my questions without an attorney present?

Suggested Assignment

Have students determine where their local courts, either county or city, are located. Ask them to research and write an essay including the following information:

1. The number of cases processed in the past year
2. The number of cases that were plea-bargained in the past year
3. The criteria used for which cases are plea-bargained and which are not
4. An example of a local crime where the prosecution used plea bargaining with the suspect(s) to lower the charge
5. Comparison of the number of cases processed by the crime lab to the number of cases brought to court

Local courts, newspapers, and the Internet are good sources of information. Students will learn that the vast majority of court cases do not use any type of forensic analysis.

The suspect is then brought before a judge. If the crime is considered a felony, the next step is a **preliminary** or **evidentiary hearing**, again, within a proscribed number of days. There is no jury. As the prosecution presents the case, the accused has the right to cross-examine witnesses and produce favorable evidence. The judge considers the offense and the defendant's record and then either decides to dismiss and/or reduce the charges for insufficient evidence, or determines that there is enough evidence to set a date for arraignment for trial. A pretrial conference may be arranged if a not guilty plea has been entered.

Handcuffed person

Some states may use a **grand jury** instead of a preliminary hearing, especially for a felony. The grand jury determines whether there is enough evidence to bring the accused to a formal trial. The composition of the grand jury varies by state, but usually consists of 16 to 23 citizens. Only the prosecutor presents evidence. There is no cross-examination. The jury decides by majority vote; there is no need for a unanimous decision. If the jury decides to **indict** the suspect, a trial date is set.

The plea of not guilty by reason of insanity has a very specific legal definition. In 1984 Congress passed the Comprehensive Crime Control Act. The federal insanity defense now requires the defendant to prove, by "clear and convincing evidence," that "at the time of the commission of the acts constituting the offense, the defendant, as a result of a severe mental disease or defect, was unable to *appreciate the nature and quality or the wrongfulness* of his acts." This is generally viewed as a return to the standard of "knowing right from wrong." The act

nolo contendere: in a criminal lawsuit, when a defendant neither admits nor denies committing a crime but accepts punishment as though he or she were guilty

preliminary or **evidentiary hearing**: a hearing before a magistrate or a judge to determine whether a person charged with a crime should be held for trial; also sometimes called a preliminary examination

grand jury: a group of people sworn to inquire into a crime and, if appropriate, bring accusations (indictments) against the suspected criminals

indict: to formally accuse a person of a crime

A typical jury box

A modern courtroom

also contains guidelines that set out sentencing and other provisions for dealing with offenders who are or have been suffering from a mental disease or defect. Most crimes must show intent; an insanity plea removes intent.

plea bargaining: an agreement in which a defendant pleads guilty to a lesser charge and the prosecutor in return drops more serious charges to avoid the cost and time of a trial

In the United States, a person is presumed innocent until proven guilty beyond a reasonable doubt by a jury of his or her peers. The burden of proof in criminal cases rests entirely on the prosecution. Only about 50 percent of all people arrested are eventually convicted, and of those, only about 25 percent are sentenced to a year or more in prison.

Plea bargaining can occur at many points in the judicial process. In fact, about 90 percent of cases are plea-bargained, which reduces the court's case load. A plea bargain means that the defendant and the prosecution work out a deal about the sentencing without going to trial.

Suggested Assignment

Have students conduct research on grand juries and preliminary hearings. In the form of an essay or a research paper, have them address the following components:

1. What types of cases use a grand jury
2. What types of cases use a preliminary hearing
3. The number of grand juries and preliminary hearings held in your state last year
4. Discussion of a case held in front of a grand jury in your state, including information on:
   a. the crime
   b. the suspect(s)
   c. the evidence presented
   d. the length of the hearing
   e. the conclusion of the hearing

This assignment will impress upon the student the fact that a grand jury only makes a decision on whether or not to indict, and not on guilt or innocence.

Federal Rules of Evidence

probative: in evidence law, tending to prove something

material: in evidence law, relevant and significant. A material witness has information about the subject.

hearsay: testimony given by a witness who relates not what he or she heard, saw, or knows personally, but what others have said. The knowledge is dependent on the credibility of the person who first made the statement, and therefore is not admissible in court unless it meets a hearsay exception.

expert witness: a person who is a specialist in a subject that is often technical, who may present his or her expert opinion without actually witnessing any occurrence relating to the case. This is an exception to the rule against giving an opinion in a trial, provided that the expert is qualified by his or her expertise, training, and special knowledge.

There are legal rules of evidence that govern if, when, how, and for what purpose evidence in a case is placed before a "trier of fact" (the judge or jury). These rules define what evidence is admissible and how it can be used for the jury. Most important, evidence must be relevant; that is, it must prove something (be **probative**) and it must address the issue of the particular crime (be **material**). If the evidence is not material or probative, it is useless. Evidence is admissible if it is reliable and the person who presents it is believable and competent. Generally, **hearsay** is inadmissible in criminal court because it is not reliable, is not taken under oath, and does not allow for cross-examination. It is, however, admissible in civil suits.

Expert Testimony

The person who presents scientific evidence, the **expert witness**, must establish his or her credibility through credentials, background, and experience. Two legal decisions have had a great influence on whether scientific evidence can be used in court.

An expert witness testifying in court on fingerprint evidence

Class Discussion

This might be a good time to ask the class, "What is 'evidence'?" Students will come up with all kinds of answers ranging from specific types of evidence, such as fingerprints, hair, etc., to a more general statement of anything that helps to solve a case. This discussion will set the stage for the next chapter.

The *Frye* Standard: *Frye v. United States,* 1923

In 1923 James Frye was convicted of murder in the second degree. On appeal, the trial counsel for the defendant offered an expert witness to testify to the result of a deception test made on the defendant, claiming that during the first trial the testimony was not accepted. The test was described as the systolic blood pressure deception test (a precursor to the polygraph). The decision of the Supreme Court was to let the conviction stand. The court stated that, to be accepted in a court of law, the scientific evidence must be given by an expert witness and have gained "general acceptance" in the particular field of study. After the presentation by the expert witness, the jury can decide whether the evidence has any significance to the case. The ***Frye* standard** does not offer any guidance on reliability.

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Suggested Assignment

Students may want to research more details of the *Frye* and *Daubert* cases and write a report or abstract on one or both of the cases.

***Frye* standard**: commonly called the "general acceptance" test, the *Frye* standard dictates that scientific evidence is admissible at trial only if the methodology or scientific principle on which the opinion is based is "sufficiently established to have gained general acceptance in the particular field in which it belongs." The *Frye* test applies only to "new" or "novel" scientific methodologies.

The *Daubert* Ruling: *Daubert v. Merrell Dow Pharmaceuticals, Inc.,* 1993

In 1993 two minor children and their parents sued Dow, claiming that the children's serious birth defects had been caused because, during the mother's pregnancies, she had used a prescription drug marketed by Dow. The court decided that the evidence did not meet the standard of "general acceptance" for admission of expert testimony. In appeals, the Supreme Court decided that, in the 70 years since the formulation of the *Frye* standard, society had become more complex

and technologically sophisticated, so that "general acceptance" was no longer the appropriate standard for admissibility.

Daubert ruling: revision of the *Frye* standard for admissibility of expert scientific evidence. The *Daubert* ruling implicitly endorses a classical definition of the scientific method, including hypothesis testing, estimates of error rates, peer-reviewed publication, and general acceptance.

junk science: theories based on distorted, flawed, or untested hypotheses not derived from or tested by the scientific method

In the ***Daubert* ruling**, the court stated that the *Frye* standard is not the only rule for admissibility of scientific evidence. The *Daubert* rule applies only to federal courts, but states are expected to use the decision as a guideline in setting standards. The trial judge must assume responsibility for admissibility and validity of evidence presented in his or her court. Guidelines offered for judgment are:

1. The scientific theory or technique must be testable.
2. The theory or technique must be subject to peer review and publication; this means that other experts in the field must be able to study the research to determine whether it seems valid.
3. The rate of error or possible errors must be given.
4. The technique must follow set standards.
5. The court must consider whether the theory or technique has attracted widespread acceptance within a relevant scientific community.

What does a forensic scientist do? A forensic scientist has two major duties:

- Analyze evidence and prepare reports on the analyses. Sometimes a forensic scientist will work a crime scene, especially a murder.
- Testify in court as an expert witness. (The judge decides if expert testimony is needed and who is qualified to give it [*Daubert*]).

Emphasis is foremost on science, then on forensics. If you can't do good science, then you are a liability to forensic science.

The *Daubert* ruling came about in response to a rapidly changing technological society. Unacceptable delays in accepting new theories or techniques (such as DNA fingerprinting) led to the decision. The ruling also strengthened the rules of evidence to keep **"junk science"** (pseudoscience) out of the courtroom.

The forensic scientist's role is to help law authorities decide whether a crime has been committed and to help identify the perpetrator. The scientist brings proof of evidence and provides results and conclusions through a report written and presented to nonscientists.

A forensic scientist may be asked to evaluate evidence as an expert witness in court, and then give an opinion about the significance of his or her findings. That opinion is based on a reasonable scientific certainty that comes from training and experience. The accused person's guilt or innocence and, therefore, life or liberty may be at stake. Both the defense and the prosecution can present expert opinions and argue the merits of the testimony.

The opinion's significance may be accepted or rejected by the jury or judge. The forensic scientist or expert witness has an obligation to be an advocate for the truth and should not take sides for either the defense or the prosecution.

1.1: Strong Whiskey

CASE STUDY

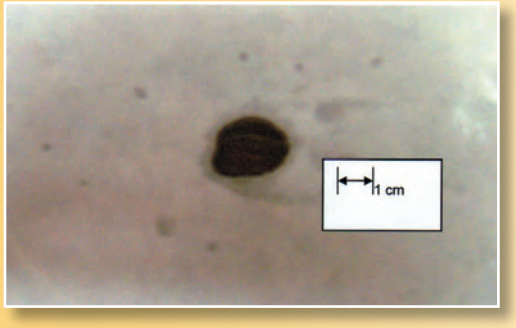
From the files of coauthor John Funkhouser

A man took a slug of what he thought was Jack Daniel's whiskey. He suffered extreme oral and esophageal burns. It was thought that the Jack Daniel's bottle contained not whiskey, but sulfuric acid. The lawyer representing the plaintiff (the man who drank the stuff) contacted a forensic scientist to analyze the contents. A chemical spot test and a simple titration of the diluted product confirmed that it was, indeed, sulfuric acid, at a concentration of approximately 83 percent.

Jack Daniel's bottle

Manufactured strength of sulfuric acid is commonly 98 percent or 93 percent, which in both cases is termed "concentrated." The former is what chemists use; the latter is sold in hardware stores as a drain cleaner. The next common industrial grade is 70 percent. So a concentration of 83 percent was perplexing. (Battery acid is usually about 33 percent.) The forensic scientist surmised that the product in the liquor bottle was used drain cleaner; this would account for the dilution as well as the light brown color (similar to that of true whiskey), which probably resulted from dissolved metals. A cursory spot test indicated the presence of metals in the acid.

Someone had probably used the drain cleaner, decided to save it, and so poured it into a handy receptacle, but did not label it. Was a crime committed? Who was at fault—the man who took a drink or the person who did not label what was in the Jack Daniel's bottle?



Hole burned in a piece of paper by a few drops of "Jack Daniel's"

Case Study 1.1

No crime was committed unless there was intent to harm. There probably was not, but we don't know the circumstances. The greater fault lies with whoever did not label the Jack Daniel's liquor bottle. This negligence could devolve into a civil suit to gain medical compensation as well as money for pain and suffering. The person who failed to label the bottle was clearly negligent, and he or she or the insurance company would have to pay. But suppose that when the house was purchased, the new owner never checked the bottle. See how things get complicated?

Answers

1. Students state in their own words, "Whenever two objects come into contact, there is always a transfer of material."
2. physical science, biology, ballistics, document examination, photography, toxicology, and/or fingerprints
3. bite marks and teeth
4. anthropology, psychiatry, odontology, engineering, computer technology, pathology, geology, environmental science, entomology, palynology, polygraphy, voiceprint analysis
5. 200 BC
6. 1514
7. false teeth
8. body mass
9. 1905
10. Francis Crick
11. 1975

Checkpoint Questions

Answer the following questions. Keep the answers in your notebook, to be turned in to your teacher at the end of the unit.

1. **Briefly state the Locard principle.**

2. **List four departments commonly found in a crime lab.**

3. **Forensic odontology is the study of _____ and _____.**

4. **Forensic scientists must sometimes consult with scientists who specialize in other areas. Name five of these areas.**

5. **When was science first used to help solve crimes?**

6. **The earliest known use of blood spatter evidence was in _____.**

7. **In 1776 Paul Revere identified the remains of General Joseph Warren by what type of evidence?**

8. **Bertillon used _____ to identify people in 1879.**

9. **The FBI was established in _____.**

10. **James Watson and _____ discovered the structure of DNA in 1959.**

11. **Federal Rules of Evidence that determine what evidence is accepted in court were enacted in _____.**

12. The computerized AFIS was established by the _____ in 1996.

13. List steps that could be taken to solve a scientific problem (a scientific method).

14. Name seven types of laws in the United States.

15. Discuss three differences between civil and criminal cases.

16. Name ten individual rights guaranteed by the Bill of Rights.

17. What is the purpose of a preliminary hearing?

18. Explain the plea of *nolo contendere*.

19. What must the defendant prove to be found "not guilty by reason of insanity"?

20. Explain how a violation and an infraction are different.

21. What are the differences between misdemeanors and felonies?

22. What are the Federal Rules of Evidence, and why are they needed?

23. Why should evidence be probative?

Answers, *continued*

12. FBI

13. 1. Observe a problem or questioned evidence and collect objective data. 2. State a hypothesis or possible solution to the problem. 3. Examine, test, and analyze to support or refute the hypothesis. 4. Use deductive reasoning to determine the significance of the evidence. 5. Evaluate and verify. There are many different versions of the scientific method. Students may have learned a slightly different version in another science class.

14. the U.S. Constitution, statutory law, common law, civil law, criminal law, equity law, and administrative law

15. Civil cases involve disputes between individuals, government, organizations, or businesses; the case has to be initiated by one side. Civil cases are concerned with assigning blame. A preponderance of evidence is required to convict. The remedy is usually in the form of fines or transfer of property. Criminal cases are crimes against an individual. The state initiates the case, becoming the plaintiff. The state must prove beyond a reasonable doubt to convict. The remedy is in the form of fines, community service, probation, and/or incarceration. Both civil and criminal cases may be heard before a jury.

16. See pages 19–20.

17. The judge decides whether there is enough evidence for the case to go to trial. Bail may be determined.

18. The accused does not deny the facts, claims no crime, or does not understand the charges.

19. The defendant did not know that what he or she was doing was wrong or would harm another.

20. Every crime is a violation; an infraction is very minor, usually punished by a fine.

21. Misdemeanors are considered less serious crimes than felonies. Felonies have harsher penalties.

22. The rules of evidence were established to determine whether the evidence presented is acceptable to be admitted in court. These rules are necessary to prevent "junk science" from being submitted by nonscientists or those who are not experts.

23. It must prove a point; otherwise it is useless.

Answers, *continued*

24. If it is not relevant or significant, it is useless.

25. Hearsay is basically secondhand testimony that may be admitted in civil court but not in criminal court, because the person who supposedly knew the facts is not in court to state his or her exact words, the trier-of-fact cannot judge the demeanor and credibility of the alleged firsthand witness, and the other party's lawyer cannot cross-examine the firsthand witness.

26. The *Frye* standard came about in 1923, stating that the scientific evidence must be given by an expert witness and have gained "general acceptance" in the particular field of study. The jury then determines the significance of the evidence. The 1993 *Daubert* ruling came about in response to a rapidly changing technological society. It stated that the trial judge will decide on the admissibility of evidence based on five guidelines: The technique must be testable, be subject to peer review, have a stated rate of error, follow standards, and have widespread acceptance.

27. See page 25, or have students research the case for more detail.

28. See page 25, or have students research the case for more detail.

29. Student answers will vary.

30. training and experience

31. Student answers will vary. Some examples are Van Leeuwenhoek's microscope, Kirchhoff and Bunsen's spectroscopy, Eastman's camera, Landsteiner's blood grouping, Lattes's reconstitution of dried bloodstains, Larson's lie detector, Aston's mass spectrometer, Martin and Synge's gas–liquid chromatography, and Watson and Crick's DNA model.

32. Arrest; being booked; probably jail until arraignment, where you would plead "guilty"; then a preliminary hearing for sentencing. You would probably be out on bail until you show up for jail time, if this is the sentence.

33. any type, both civil and criminal

34. when the person is not going to be questioned

24. Why should evidence be material?

25. Why is hearsay inadmissible in court?

26. Explain the major differences between the *Frye* standard and the *Daubert* ruling when dealing with physical evidence and determining whether or not the evidence will be accepted in a court of law.

27. Describe the case that the *Frye* standard was based on.

28. Describe the *Daubert* case.

29. Give some examples of what might be considered "junk science."

30. A forensic scientist testifying in court as an expert witness bases his or her opinion on _____.

31. Study the timeline of forensic history on pages 6–16 and give three examples of a scientific discovery that developed into a forensic technique in use today (or depicted on the television show *CSI*).

32. If you were caught red-handed in a burglary, what procedures would you expect to experience before sentencing?

33. In what types of cases can a defendant opt for a jury trial?

34. When does an officer not have to read *Miranda* rights to an arrested person?

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