History & Development of Forensic Science
Students will learn:

- How a crime lab works
- 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

Students 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.
When in Rome...

• “Forensic” comes from the *Latin* word “forensis” meaning forum.
• During the time of the Romans, a criminal charge meant presenting the case before the public.
• Both the person accused of the crime & the accuser would give speeches based on their side of the story.
• The individual with the best argument would determine the outcome of the case.
First Known Forensic Science

• 3rd Century China - A wife poisoned her husband and burned his body. The coroner noted no ash inside his mouth and simulated the crime with dead & live pigs. The dead pig had no ash and the live pig did have ash in its mouth. The Wife confessed when shown the evidence.

• Chinese first to see potential in fingerprints.
Murders at the Mansion

- August 20, 1989, Lyle Menendez, 21, & his brother Erik Menendez, 18, went out for the evening.
- When they returned, they found that their parents, Jose and Kitty, had been shot and killed in the living room.
- At 11:47 p.m. Lyle called 911. The police arrived shortly afterward. There was no evidence of forced entry, and nothing had been stolen from the home—an indication Jose and Kitty likely knew their attackers.
- A witness told police she had seen two men enter the home at around 10:00 p.m. The brothers were questioned at the scene, but they were not considered suspects. No gunshot residue tests were administered.
August 28, the brothers began cashing in on their $650,000 life insurance policy.

Jose and Kitty had owed money on their mortgage and several other loans.

After those had been paid, the brothers were left with a total inheritance of approximately $2 million.

By the end of the year, they had spent more than $1 million. This behavior drew suspicion from police.

The brothers were arrested in March 1990.

With little physical evidence, the investigators were hoping to find a link between the brothers and the guns used in the killings.
• Investigators searched the firearms records of a Big 5 store and uncovered the sale of two shotguns on August 18, 1989, to Donovan Goodreau of San Diego.

• Goodreau had an alibi for August 18 and August 20, and the signature for the firearms did not match his.

• A court order was issued for handwriting samples from Lyle and Erik. Erik refused to provide a handwriting sample.

• On December 8, 1992, the Menendez brothers were indicted by the Los Angeles Grand Jury.

• The trial began on July 20, 1993.
• The defense admitted the brothers killed their parents; they argued that the brothers had been sexually, physically, and emotionally abused for years.
• Under California law, jurors had to believe the brothers feared for their lives in order to acquit them.
• The case resulted in a mistrial.
• A second trial in 1995 resulted in guilty verdicts for Lyle and Erik.
• They were convicted of first-degree murder and conspiracy to commit murder.
• On April 17, 1996, the brothers were sentenced to life in prison without the possibility of parole.

Inheritance Killers - Erik & Lyle Menendez:
https://www.youtube.com/watch?v=lofyBKnas

Living next door to the killer Menendez brothers:
https://www.youtube.com/watch?v=5Inb6zCb5Ns
Mathieu Orfila (1787-1853)

• “Father of Toxicology”
• Wrote about the detection of poisons & their effects on animals.
Alphonse Bertillon

• “Father of Anthropometry”
• Developed a system to distinguish one individual person from another based on certain body measurements.
Anthropometry
Francis Galton (1822-1911)

• “Father of Fingerprinting”
• Developed fingerprinting as a way to uniquely identify individuals.
James Marsh
Scottish Chemist

• First to introduce chemical evidence of arsenic in a body during a trial in 1839.
Leone Lattes  (1887-1954)

- “Father of Bloodstain Identification”
- He developed a procedure for determining the blood type (A, B, AB, or O) of a dried blood stain.
Calvin Goddard  (1891-1955)

• “Father of Ballistics”
• Developed the technique to examine bullets, using a comparison microscope, to determine whether or not a particular gun fired the bullets.
Albert Osborn  (1858-1946)

- “Father of Document Examination”
- His work led to the acceptance of documents as scientific evidence by the courts.
Walter McCrone  (1916-2002)

• “Father of Microscopic Forensics”
• He developed & applied his microscope techniques to examine evidence in countless court cases.
Edmond Locard

- (1877-1966) Used the scientific method in criminal investigation. Background was medicine and law. **Father of criminalistics.**
- Built the world’s first forensics lab in France in 1910
The Locard Exchange Principle

- Locard Exchange Principle states:
  - *Whenever two objects come into contact with each other, there is always a transfer of material.*
J. Edgar Hoover

- “Father of the FBI” - Director of Federal Bureau of Investigation during the 1930’s
- Hoover's leadership spanned 48 yrs & 8 presidential administrations. His reign covered Prohibition, the Great Depression, WWII, the Korean War, the Cold War, & the Vietnam War.
- He organized a national laboratory to offer forensic services to all law enforcement agencies in the U.S.
- VERY CONTROVERSIAL
  - He exceeded & abused his authority with unjustified investigations & illegal wiretaps based on political beliefs rather than suspected criminal activity
  - FBI directors are now limited to 10-year terms
Sir Alec Jeffreys

- First to develop a DNA profile (DNA fingerprint) 1984
The Scientific Method

- Forensic science begins at the crime scene.
- Forensic scientists rely on the **SCIENTIFIC METHOD**.
- **Scientific Method**: is a series of logical steps used to solve a problem.

*Figure 1-8. The scientific method.*
Steps in the Scientific Method

• **Identify the Problem:**
  crime has been discovered & police arrive at the scene.

• **Do Background Research:**
  Observe and collect the physical evidence found at the crime scene. (done by the police & investigators)
• Construct Hypothesis: (police)
  – hypothesis is an attempt to answer the following questions: what happened, how did it happen, and when did it happen?
  – The crime-scene investigator does not form a hypothesis. Instead, he or she sends the evidence to the crime lab for further analysis.

• Establish a set of Procedures: send the physical evidence collected to the lab for testing. Ex. The hair removed from a crime scene is tested to reveal color, texture, and shape.
• **Analyze results:**
  – If the toxicology report shows no use of drugs & there is no follicular tag (no nuclear DNA), it means that the hair will most-likely not be linked to anyone. The tests can help investigators reduce the number of potential suspects.

• **Draw conclusion:**
  – After all of the physical evidence has been processed and evaluated, a conclusion is drawn. If a suspect can be linked to a crime, then the suspect is apprehended.
The Crime Scene Investigation (CSI) Team

• Team of legal and scientific experts who work together to process a crime scene and evaluate the evidence.

• Divided into a field investigative unit & crime lab scientists.

<table>
<thead>
<tr>
<th>Field Investigative Unit</th>
<th>Crime Lab Scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Secure the crime scene</td>
<td>• Receive/sign for evidence</td>
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<tr>
<td>• Photograph the crime scene</td>
<td>• Review paperwork</td>
</tr>
<tr>
<td>• Search the crime scene</td>
<td>• Complete chemical and/or physical tests on evidence</td>
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<tr>
<td>• Properly collect and package evidence</td>
<td>• Complete an analysis of the findings</td>
</tr>
<tr>
<td>• Complete proper forms</td>
<td>• Provide expert testimony</td>
</tr>
<tr>
<td>• Evidence submission form</td>
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<tr>
<td>• Chain of custody</td>
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<tr>
<td>• Deliver or ship evidence to proper processing site</td>
<td></td>
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<tr>
<td>• Provide expert testimony</td>
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</tbody>
</table>

*Figure 1-9. Responsibilities of the crime-scene investigation team.*
The Crime Scene Investigation (CSI)

- Police officers are usually the first to arrive at the scene.
  - They secure the scene and provide first aid to anyone who needs it.
- Crime-scene investigators
  - record details about the crime scene and collect physical evidence.
  - include photographers, sketch artists, and evidence collectors.
- Medical examiners are called in when there is a death.
Crime Labs

• Evidence collected at the scene is sent to the crime lab for analysis.
• Forensic scientists at the crime lab:
  – specialize in fields such as chemistry, toxicology, pathology, and firearms.
  – remain completely neutral in their analysis.
  – do not form a hypothesis or draw conclusions about guilt or innocence.
• Information gathered from chemical and physical tests can be used:
  – to establish a timeline of events.
  – may corroborate a witness’s statement.
• Poor communication:
  – could lead to critical mistakes.
  – Could put the entire process is in jeopardy.
    • Ex, if the evidence is not collected properly, investigators in the crime lab may not make the correct analysis.
PROCESSING A CRIME SCENE

- The first authorized personnel to arrive:
  - must secure the scene, usually with crime-scene tape,
  - move unauthorized people away from the area.
  - Help someone in need of medical attention before doing anything else.
  - detain and questioned people around the area (depending on the situation).
• Before any evidence is collected:
  – Sketch & photograph the entire scene.
  – Evidence must be left undisturbed in its original location.
    • If circumstances warrant moving the evidence: ex. to tend to an injured victim, it must be noted in the records.
    • Measurements of the crime scene and locations of items of evidence must be documented.

• After the crime scene and the evidence have been photographed,
  – the field investigator will begin to collect and package the physical evidence.
The size and location of a crime scene will determine the search method used:

- **Zone**—building or other structure—homicide, home invasion, robbery, sexual assault, etc.
- **Spiral**—large area, no barriers—open field—kidnapping, homicide
- **Line search**—large area looking for a large object in a single direction—site of a plane crash
- **Grid**—large area looking for a large object in two directions—arson investigation

*Figure 1-11. Investigators choose the search method based on the size and location of the crime scene.*
EVIDENCE

• The analysis of physical evidence and the presentation of findings in court are the most powerful resources available to a prosecutor.

• Often, the physical evidence presented at court can be the determining factor of guilt or innocence of the suspect.

• Two basic types of evidence exist—
  – Testimonial
  – Physical
Testimonial evidence-

• gathered by law enforcement or CSI
• witness testimony used to build a timeline of events or to confirm a suspect’s whereabouts.
Physical evidence-

• material collected or observed at a crime scene that could link potential suspects to a crime.

• can range in size from a drop of blood to large objects, such as furniture or a door.
  – Ex. a document, hair, fibers, fingerprints, soil, and blood.
• Each piece of evidence collected must be packaged separately to avoid cross-contamination
  – Ex. bloody clothing is first air dried and then packaged in a paper bag.
  – A pool of blood will be swabbed. The swab is then air dried and placed in a plastic vile.
• blood evidence must be dried prior to storage in order to prevent mold and bacterial growth.
chain of custody

• provides documentation of every person who has come into contact with the evidence. (acts as a “paper trail.”)
• Established once an item of evidence is collected.
• The name recorded are:
  – the person who collected and packaged the evidence is recorded.
  – each person who has handled, analyzed or transported the evidence is recorded.
• Every time the evidence is opened, a new seal is formed. The person who handled the evidence then signs over the new seal.
• Demonstrates to the courts that the evidence that is being presented at trial is free of contamination, alteration, or substitution.
# Evidence/Chain of Custody Document

<p>| | | |</p>
<table>
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<td>3. EOC NUMBER:</td>
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<td>4. COLLECTED BY:</td>
<td>5. COUNTY:</td>
<td>6. OLS LAB NUMBER:</td>
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<td>Chemical Terrorism Agent(s)</td>
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<td>Phone:</td>
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</tr>
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<td></td>
</tr>
<tr>
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<tr>
<td>Organization:</td>
<td>Date:</td>
<td>Time:</td>
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<td>Address:</td>
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<td>Received by:</td>
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<td>13. SAMPLE STORAGE CONDITIONS:</td>
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January 22, 2004

Figure 1-14. Sample chain of custody form.
Trace Evidence

• very small amounts of certain physical evidence are found at the crime scene.
  – include gunshot residue, a tiny amount of blood, a single hair, or paint.

• Remember Locard’s exchange principle: *contact between a victim and a suspect or between a suspect and a location results in a transfer of material.*

*Figure 1-15. This soda may provide trace evidence.*

• In an effort to prevent contaminating or destroying the evidence, field investigators do not remove trace evidence, if possible, from the object that bears it. Ex. a soda can may be collected and sent to the crime lab for testing because fingerprints were visible on the can. Additional tests might reveal lip prints and saliva on the rim and drugs dissolved inside the can.
Evidence Submission Form:

- Used to submit evidence for lab processing and analysis
- On the form:
  - Items of evidence are listed with a brief description of each item
  - Testing procedure requested.
Evidence may also be compared to known samples to determine the kind of weapon or to build a timeline of events.

- **Reference samples** - samples from a known source; used as a basis of comparison. Ex. a white powder is found at a crime scene.
  - The white powder is identified as cocaine mixed with some inorganic substances and there isn’t enough information to link the substance to a suspect.
  - If a suspect is apprehended with traces of white powder in his pocket, the powder can be compared to the cocaine mixture found at the crime scene.
  - If the two samples are consistent, the suspect may be arrested.
• If the evidence is determined to possess class characteristics:
  – **common to a group of objects or persons**
  – it cannot be directly connected to one person or source.
  – Ex. blood type, fibers, and paint.
• When evidence exhibits **individual characteristics:**
  - evidence—can be identified with a particular person or a single source
  - Ex. nuclear DNA (hair follicle, blood cells, or semen)
  - Tool marks and fingerprints because of the uniqueness of their patterns.

The large piece of glass fits exactly to the bottle; it is individual evidence.
Class vs. Individual Evidence

Which examples do you think could be individual evidence?
Federal Rules of Evidence (Admissibility of Evidence)

FRYE V. UNITED STATES

• In 1923, in the case of Frye v. United States, James Frye was convicted of second-degree murder.
• He had confessed to the murder, but later retracted his confession.
• Frye appealed his conviction on the grounds that the lie detector test he had taken proved he was telling the truth.
• He also had an expert prepared to explain the scientific methods used to determine the outcome of his lie detector test.
Federal Rules of Evidence
(Admissibility of Evidence)
FRYE V. UNITED STATES

• Nonetheless, the trial court refused to allow the expert’s testimony.
• Frye’s argument provided great detail of the science behind how the lie detector test functioned.
• The Supreme Court upheld the lower court’s decision, stating one of the most famous opinions ever sent down by federal court.
• This case led to what is now commonly called the Frye Standard.
• According to the Frye Standard, evidence, procedures, and equipment presented at trial must be generally accepted by the scientific community.
Federal Rules of Evidence
(Admissibility of Evidence)
Daubert v. Merrell Dow Pharmaceuticals

• Jason Daubert and Erik Schuller, minor children born with birth defects.
• Their mothers were prescribed Bendectin, an anti-nausea medication, during their pregnancies.
• The women thought that the Bendectin had caused their sons’ birth defects.
• The lawsuit against the manufacturers of Bendectin, Merrell Dow Pharmaceuticals, was filed in 1993 and named the children as the petitioners.
• The case was heard by the U.S. Supreme Court.
Federal Rules of Evidence
(Admissibility of Evidence)
*Daubert v. Merrell Dow Pharmaceuticals*

• The Court ruled: the trial judge had ultimate decision-making power regarding expert testimony at trial. The ruling suggests criteria for evaluating the science used to support evidence presented by an expert:

1. Has it been tested?
2. Has it been peer reviewed?
3. What is the rate of error?
4. Is it generally accepted?
DR. CARL COPPOLINO

As science continues to advance, so do the tests and equipment used to analyze and process evidence.

- In 1963, William Farber was found dead in his home in New Jersey.
- Doctors thought that Farber had died from heart failure.
- Two years later, the wife of Mrs. Farber’s lover was also found dead in her home in Florida.
- At first, the family physician thought Carmela Coppolino had died of a heart attack.
- However, Mrs. Farber convinced prosecutors that Dr. Carl Coppolino had poisoned William Farber and Carmela Coppolino.
- Both bodies were exhumed and Coppolino had two separate trials.
• The first trial, in New Jersey, was for the murder of Farber; the second trial, for the murder of Coppolino’s wife, was held in Florida.
• Coppolino was acquitted of the first murder. The judge in the Florida case, however, admitted evidence from the toxicologist.
• The toxicologist used a newly developed test to screen for succinylcholine chloride, a paralytic.
• A toxicology analysis revealed elevated levels of succinic acid, the metabolite of succinylcholine chloride, in Carmela’s brain.
• At trial, the defense argued that this new procedure had not yet been widely accepted by the scientific community.
• The toxicology screening completed was an experimental test with little scientific backing by the toxicology community.
• In the Coppolino case, the court ruled that the fact that a technique, test, or procedure is new does not necessarily mean its findings are inadmissible in court.
• The expert witness, however, is responsible for providing scientifically valid testimony to support the findings.
• As a result, Coppolino was convicted of the second degree murder of his wife (see Figure 1-18).
The U.S. Constitution was signed in 1787.

- The Constitution set up the executive, legislative, and judicial branches of the U.S. government.

In 1789, Congress added 10 amendments to the U.S. Constitution.

- The 10 amendments to the US constitution are called the Bill of Rights.

The sixth amendment ensures that a person will be tried by an impartial jury of his or her peers.
The Bill of Rights

*Gives individuals the right:*

- To be presumed innocent until proven guilty
- Not to be searched unreasonably
- Not to be arrested without probable cause
- Against unreasonable seizure of personal property
- Against self-incrimination
- To fair questioning by police
- To protection from physical harm throughout the justice process
- To an attorney
- To trial by jury
- To know any charges against oneself.

- To cross-examine prosecution witnesses
- To speak and present witnesses
- Not to be tried again for the same crime
- Against cruel and unusual punishment
- To due process
- To a speedy trial
- Against excessive bail
- Against excessive fines
- To be treated the same as others, regardless of race, gender, religious preference, country of origin, and other personal attributes
The Bill of Rights
Ratified December 15, 1791

Article I
Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances.

Article II
A well regulated Militia, being necessary to the security of a free State, the right of the people to keep and bear Arms, shall not be infringed.

Article III
No Soldier shall, in time of peace be quartered in any house, without the consent of the Owner, nor in time of war, but in a manner to be prescribed by law.

Article IV
The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

Article V
No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the Militia, when in actual service in time of War or public danger; nor shall any person be subject for the same offence to be twice put in jeopardy of life or limb; nor shall be compelled in any Criminal Case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

Article VI
In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining Witnesses in his favor, and to have the Assistance of Counsel for his defence.

Article VII
In Suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by jury shall be preserved, and no fact tried by a jury shall be otherwise reexamined in any Court of the United States, than according to the rules of the common law.

Article VIII
Excessive bail shall not be required, nor excessive fines imposed, nor cruel and unusual punishment inflicted.

Article IX
The enumeration in the Constitution, of certain rights, shall not be construed to deny or disparage others retained by the people.

Article X
The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.
• The jury:
  – Listens to arguments by both the defense and prosecution.
  – hears information about physical and circumstantial evidence and hears testimony from witnesses.
  – uses all of this information to make an informed decision about the guilt or innocence of the person on trial.
  – is instructed to assume that the defendant is innocent until proven guilty.
• In criminal cases, the prosecution must prove, beyond a reasonable doubt, that the defendant committed the crime for the jury to return a guilty verdict.
ARREST

• Before a trial can begin, the suspect needs to be arrested and charged with the crime.

• The 4th amendment protects against unreasonable search and seizure.

• You can search if the suspect consents or if you have probable cause.
  – show probable cause by:
    • Gathering information from evidence, witnesses, informants.
When a suspect is brought in for questioning or arrested:

- Miranda rights are read.
  - You have the right to remain silent.
  - Anything you say can and will be used against you in a court of law.
  - You have the right to speak to an attorney, and to have an attorney present during any questioning.
  - If you cannot afford a lawyer, one will be provided for you at the government’s expense.
The roots of the Miranda decision

- March 2, 1963, 18-year-old Phoenix woman told police that she had been abducted, driven to the desert and raped.
- Detectives gave her a polygraph test, but the results were inconclusive.
- Tracking the license plate number of a car that resembled that of her attacker's brought police to Ernesto Miranda, who had a prior record as a peeping tom.
- The victim did not identify Miranda in a line-up but he was brought into police custody and interrogated.
- What happened next is disputed, but officers left the interrogation with a confession that Miranda later recanted, unaware that he didn't have to say anything at all.
• The confession was extremely brief and differed in certain respects from the victim's account of the crime. However, Miranda's appointed defense attorney (who was paid a grand total of $100) didn't call any witnesses at the ensuing trial, and Miranda was convicted.

• While Miranda was in Arizona state prison, the American Civil Liberties Union took up his appeal, claiming that the confession was false and coerced.

• The Supreme Court overturned his conviction, but Miranda was retried and convicted in October 1966 anyway, despite the relative lack of evidence against him. Remaining in prison until 1972, Ernesto Miranda was later stabbed to death in the men's room of a bar after a poker game in January 1976.

• As a result of the case against Miranda, each and every person must now be informed of his or her rights when arrested.

• [https://www.youtube.com/watch?v=2QiFg7MJL3E](https://www.youtube.com/watch?v=2QiFg7MJL3E)
BEFORE THE TRIAL
After a suspect is arrested:

• arraignment is held.
  – At the arraignment, the suspect is formally charged and a plea of guilty or not guilty is entered.
  – Depending on the type of crime, bail will be set.
  – In capital murder cases, bail is usually not set and the suspect must remain in jail until the trial.
BEFORE THE TRIAL
After an arraignment:

• pretrial conferences/discovery between defense & prosecution

• information is shared so that each can prepare arguments.

• If the prosecution is going to offer a plea agreement, it will do so during discovery.
  
  – A plea agreement often requires the defendant to plead guilty to a lesser charge in return for a lighter sentence.
BEFORE THE TRIAL
At the preliminary hearing,

Judge hears both sides; determines if there is sufficient evidence to take the case to trial.

• If enough evidence- court date is set for trial.

• If not enough evidence, the case is dismissed. In several states and in federal cases, such as capital murder cases, a grand jury hears from the prosecution and determines whether there is enough evidence to justify a trial.
AT THE TRIAL

• defense and prosecution present their cases to the judge and jury.
• Each is given a chance to call witnesses and to cross-examine witnesses.
  – Cross examination—attorneys question, and try to discredit, the opposing side’s witnesses.
Jury Deliberations:

In criminal cases, the verdict must be unanimous—everyone on the jury must agree with the verdict.

• If the verdict is “not guilty,” the defendant is released.
• If the verdict is “guilty,” the defendant must return to court on the date of sentencing.
Sentencing

• Before sentencing, the defendant will be remanded to a state or federal correctional facility.
• If an appeal is filed, attorneys may not present new evidence in appellate court. The arguments must focus on legal and procedural errors made in the original court.
• A may move to the U.S. Supreme Court if the case involves interpretation of the U.S. Constitution. However, most are decided before they go that far.