Forensic Science

Teacher Edition

Oak Meadow

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Teacher Edition Introduction

This teacher edition is designed to help you guide your student through Oak Meadow's course, *Forensic Science*.

This single-semester course is a hands-on laboratory and project-based learning course that introduces students to a foundation of law and criminal justice, history of forensics, and modern scientific advances in the field. Hair, fibers, DNA, ballistics, serology, poisons, drugs, arson, explosions, fingerprinting, forgery, and entomology are studied in detail. The scientific method, data analysis, and powers of observation and critical thinking to solve a problem are addressed in all aspects of the course.

Course Disclaimer

Being enrolled in forensic science, it is important that both students and their parents/guardians are aware of the topics covered as part of this course. In this course, students will study several controversial topics, which include the following:

1. Crime scene situations and evidence
2. Fingerprint analysis
3. Hair and fiber analysis
4. Blood spatter evidence
5. Handgun and bullet analysis
6. The effects of a fired bullet on objects and people
7. Detection of alcohol and drugs (legal and illegal) associated with a criminal/crime scene
8. Detection of poisons in blood
9. Impressions from weapons, footprints, and bite marks
10. Handwriting analysis as it relates to the forgery of documents
11. Arson, explosives, and hazardous materials
12. Decomposition of a body and forensic entomology

13. Cybercrime and the use of mobile devices by criminals and detectives
14. Case studies on infamous crimes and serial killers

It is important that students are comfortable with these topics and understand that at several points during the study of these topics they may encounter graphic images, videos, and illustrations in order to further their understanding of certain topics. It is important to note that to convict criminals, one must first understand the circumstances of criminals, the crimes they commit, and the tools they use to commit them. This course is not a criminal's "how-to" guide, but the science behind how criminals are caught; and they are almost always caught!

Course Materials

This course will utilize the following items:

- This coursebook, which includes a full description of all course assignments.
- The textbook, *Forensic Science for High School* (Kendall Hunt Publishing, 2016), used as the primary source for lesson information. It is a comprehensive text tailored to high school students and we will cover almost all the text.
- Hands-On Laboratory (HOL) Forensic Science Kit, designed specifically for Oak Meadow. This kit includes many of the materials needed for the experiments.
- Additional activity and laboratory materials, as needed. See the appendix for a full list of lab materials.
- Scientific calculator, used in select lessons.
- Smartphone clip-on microscope, 60x zoom. If you don't have a smartphone, please discuss other options with your teacher.

The student's coursebook contains all the instructions and assignments for this single-semester course, which includes 10 lessons spread over 18 weeks. Throughout the course, students will be doing research and reading using additional online sources. A list of these curriculum resources can be found online at oakmeadow.com/curriculum-links.

This teacher edition includes not only factual answers to assignment questions, but also tips on how to assess student responses, and suggestions for ways to guide your student's learning. It includes all the text from the student coursebook except for the lab procedures.

In this teacher edition, answers are seen in **color**. When applicable, page numbers are included after the answer to indicate where the information can be found in the textbook, *Forensic Science for High School*.

When a student gets a factual answer wrong, you can share the correct answer and address any underlying misconceptions. Several incorrect answers related to a particular topic point to an area the student will benefit from revisiting.

For obvious reasons, it is best not to share this teacher edition with your student. Each student is expected to produce original work, and any incidence of plagiarism should be taken very seriously. If you notice a student's answers matching those of the teacher edition word for word, a discussion about plagiarism and the importance of doing original work is necessary. While students in high school are expected to be well aware of academic honesty, any discussion about it should be approached as a learning opportunity. Make sure your student is familiar with when and how to properly attribute sources (there's an extensive section on this in the appendix).

How This Course Is Set Up

This course is arranged into categories of the types of evidence typically found at a crime scene. There are activities, laboratory experiments, quick labs, and written and creative assignments. Written responses should be in complete sentences with proper punctuation, capitalization, paragraph mechanics, and grammar. Calculations need to show all work and include units.

Important note: You will notice that the student coursebook does not include images. This is by design to take into account students who may be sensitive to such material. Students are encouraged to use discretion if looking up case studies online. There is an abundance of highly graphic images online that in many cases do not serve any purpose in understanding how the crime scene was processed or how the evidence was analyzed. Highly graphic images may be desensitizing and are not in keeping with Oak Meadow's educational philosophy. Students are encouraged to focus on the information in the lessons and textbook and only seek additional images or information when directed to do so.

Suggested Lesson Timetable (based on 18 weeks of study)

Lesson	Topics	Time to Complete
1	Forensic Science and the Law	2 weeks
2	Evidence and the Crime Scene	2 weeks
3	Fingerprints	2 weeks
4	Blood and DNA	1 week
5	Hair, Fibers, and Glass	2 weeks
6	Drugs, Alcohol, Poisons, Arson, and Explosives	3 weeks
7	Firearms, Toolmarks, Impressions, and Forgery	2 weeks
8	Entomology and Human Remains	1 week
9	Computer and Mobile Devices	1 week
10	Careers and Final Project	2 weeks

A Note About the Workload

Please note that there are a wide variety of assignments included in this course to give many options for engaging with the material. Students vary greatly in terms of reading speed and comprehension as well as writing ability. Some may find the reading in this course takes longer than expected; others may find the written assignments take a great deal of time. In general, students can expect to spend about five hours each week on this course. If students need more time to complete the work, lessons can be modified to focus on fewer assignments, or students can be given the option to complete some of the written assignments orally. Modifications like these can allow students to produce work that is of a higher quality. Each lesson in this course can be customized to suit your student's needs.

Keep an eye on the workload as students progress through the course, and make adjustments so that they have time for meaningful learning experiences rather than rushing to try to get everything done.

Coursebook Introduction

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- Detection of poisons in blood
- Impressions from weapons, footprints, and bite marks
- Handwriting analysis as it relates to the forgery of documents
- Arson, explosives, and hazardous materials
- Decomposition of a body and forensic entomology
- Cybercrime and the use of mobile devices by criminals and detectives
- Case studies on infamous crimes and serial killers

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Should you or your parent have any questions or concerns regarding the materials being used in this course, please contact your teacher. Make a note in your course doc that you have read this course disclaimer and shared it with your parent/guardian.

Course Materials

This course will utilize the following items:

- This coursebook, which includes a full description of all course assignments.
- The textbook *Forensic Science for High School* (Kendall Hunt Publishing, 2016), used as the primary source for lesson information. It is a comprehensive text tailored to high school students and we will cover almost all the text.
- Hands-On Laboratory (HOL) Forensic Science Lab Manual and Lab Kit, designed specifically for Oak Meadow. The lab kit includes many of the materials needed for the experiments.
- Additional activity and laboratory materials, as needed. See the appendix for a full list of lab materials.
- Scientific calculator, used in select lessons.
- Smartphone clip-on microscope, 60x zoom, or access to a compound light microscope. If you don't have a smartphone or access to a microscope, please discuss other options with your teacher.

Oak Meadow has partnered with Hands-On Laboratories (HOL) to provide you a fully customized laboratory manual and lab kit to accompany this course. These labs are property of HOL and cannot be copied or distributed. Plagiarism of any material (HOL or Oak Meadow) is grounds for dismissal from the school.

Throughout the course, you will be using articles, videos, and other resources that will enhance your understanding of the material. All of these online resources can be found under the Forensic Science tab at www.oakmeadow.com/curriculum-links. You can bookmark this webpage for easy reference.

Important note: You will notice that this coursebook does not include images. This is by design to take into account students who may be sensitive to such material. Use discretion if looking up case studies online. There is an abundance of highly graphic images online that in many cases do not serve any purpose in understanding how the crime scene was processed or how the evidence was analyzed. Highly graphic images may desensitize you and are not in keeping with Oak Meadow's educational philosophy. You are encouraged to focus on the information in the lessons and textbook and only seek additional images or information when directed to do so.

Lesson

1

Forensic Science and the Law

Learning Objectives

At the end of this lesson you will be able to:

- Describe the basic types of law in the criminal justice system.
- Explain the major differences between the Frye standard and Daubert ruling.
- Recognize that technological problems often create a demand for new scientific knowledge.
- Explain the Locard Exchange Principle.
- Study how crime labs in the United States are organized and what services they provide.

> "In the criminal justice system, the people are represented by two separate yet equally important groups: the police who investigate crime and the district attorneys who prosecute the offenders."

ASSIGNMENT CHECKLIST

- ☐ Review laboratory safety procedures.
- ☐ Review course disclaimer.
- ☐ Answer Before You Begin questions.
- ☐ Read chapter 1 in the textbook.
- ☐ Read three case studies.
- ☐ Complete lesson assignments.
- ☐ Activity A: Locard Exchange Principle
- ☐ Complete either Activity B or C.
  - Activity B: Crime Labs Near You
  - Activity C: Binge-Worthy True Crime: The *CSI* Effect

Dun Dun.

Sound familiar? Chances are you have watched at least one crime show or movie. Perhaps your love for *Law & Order, CSI,* or a similar show is what led you to take this course. Most people seem to have an interest in the criminal system and how science is used to bring justice for the victims. The goal of this course is to take that natural curiosity and delve into each major type of forensic evidence to explore exactly how that evidence is analyzed and used in court. But first, let's take a look at the history of forensic science and the law.

This lesson will take about two weeks to complete.

Review of Laboratory Safety

Throughout the course, you will conduct home experiments that involve the use of potentially harmful chemicals. For example, in lesson 3, you will conduct a series of labs that use highly toxic chemicals for the chemical development of latent fingerprints. These labs are designed to give you a hands-on learning experience, but they need to be done in a safe manner. As such, it is important that we begin this course with a review of safe laboratory techniques.

1. Wear closed-toe shoes when working with chemicals.
2. Keep all other nonessential items, such as bags, papers, food, cosmetics, lotions, etc., out of the work space.
3. Never eat, drink, or chew gum when working on labs.
4. Before every lab, read the directions carefully before beginning. Make sure you understand the overall goal of the lab before you start the procedure.
5. Check all equipment and supplies to ensure they are clean and in working order before beginning.
6. Gather all equipment needed for the lab. Keep all other lab materials packaged and out of the work space.
7. Always wear safety goggles and gloves. They are provided in your lab kit.
8. Tie back long hair and loose clothing to keep them away from chemicals and flames.
9. Remove dangling jewelry.
10. Never touch, taste, or smell any chemical. To note odor, gently wave your hand over the opening of the container to direct the fumes toward your nose and smell carefully (wafting).
11. Never conduct your own experiments. Follow the directions provided and use materials for their intended use.
12. Hot glassware does not appear hot. Carefully check the temperature before touching.
13. Dispose of any unused or spilled chemicals by soaking them up with a paper towel and placing it in a trash can. Never dispose of chemicals down the sink or toilet.
14. Clean up your work space and all equipment after the experiment. Dispose of materials as noted above or place them back in your lab kit for future use. Since you are conducting these experiments at home, and presumably in your kitchen, it is critically important that you clean up your work space before anyone else uses the area or food is prepared.
15. Wash your hands after each experiment!

Enrolled students: Make note in your course doc that you have read these rules and understand them. If at any point during this course, you have questions on the laboratory directions or need assistance, you are urged to stop work and contact your teacher immediately.

Before You Begin

Consider the following scenario:

> 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 simple titration of the diluted product confirmed that it was, indeed, sulfuric acid, at a concentration of approximately 83 percent.
>
> 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 stores as 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.

Answer the following questions and explain your reasoning:

1. Was a crime committed?
2. If so, who would be at fault?

(Source: Ball, Barbara. *Forensic Science for High School*, 1st edition)

This scenario will help students begin to understand some of the many factors they will be examining in this course. They will revisit their answers to these questions at the end of the lesson.

Reading

Read chapter 1 (pages 4–35) in your textbook.

Case Studies

In each lesson of this course, case studies are used to help provide more insight to the topic being discussed. Sometimes these case studies are major cases or serial killers, other times they are little-known cases that still serve as a key example of the type of evidence being studied. Occasionally, these cases are extremely complex and involve several types of major evidence; several of these cases will be revisited in subsequent lessons.

1. **Richard Crafts**

Read the case study on pages 30–31.

2. **Casey Anthony and the Frye Hearings**

In a widely publicized trial, Casey Anthony was charged with first-degree murder of her two-year-old daughter, Caylee Anthony, in Orlando, Florida. The case gained media attention in part from Casey's mother, Cindy Anthony, reporting her granddaughter missing in a 911 call stating Caylee had not been seen for over a month and her daughter's car smelled like a dead body had been inside it.

Caylee's body was found five months later in a trash bag in the woods near the Anthony home. The trial began in 2011 with the prosecution arguing that Casey murdered her daughter because she no longer wanted to be a parent. Casey was caught in several lies to detectives and there was evidence that she enjoyed partying. The defense presented a story that Caylee drowned in the family pool and that Casey's father, George, disposed of Caylee's body.

The case hinged on the scientific credibility of the evidence presented at trial and went through weeks of Frye hearings before the judge. During these hearings, the evidence was critiqued to determine if it was "generally accepted" by the scientific community. The critical piece of evidence in question was a new technique used for analyzing the presence of a decaying corpse in Casey Anthony's trunk. The test results showed decomposition from a human body; however, this test had never been used in court before this trial and there were no peer-reviewed studies conducted. The judge ruled the evidence was allowed at trial based on other circumstantial evidence and computer searches on Casey's computer.

On July 5, 2011, the jury found Casey Anthony not guilty of first-degree murder. Following the trial, jurors stated that their critique of the scientific validity of the evidence is what resulted in them finding Casey not guilty.

(Source: "Casey Anthony Trial," crimemuseum.org)

3. **The Murder of Danielle van Dam**

On February 2, 2002, seven-year-old Danielle van Dam was reported missing by her parents. Her body was discovered on February 27th partially decomposed, unclothed, and there were several teeth missing, likely from some trauma to her face.

Neighbor David Westerfield was immediately identified as a suspect as he had gone camping in his RV during the time in question and when asked if he had any information about the girl's disappearance, Westerfield responded that she must have been kidnapped and murdered. Among the pieces of evidence used against David Westerfield were:

- Hairs consistent with the van Dams' dog found in Westerfield's RV
- Carpet fibers consistent with Danielle's bedroom found in his RV
- 14 hairs consistent with Danielle's found in his belongings in the RV

- Lack of fibers found in his home, suggesting that fibers found in the RV may have come from someone going directly from her house to his RV
- Lack of evidence (sand, soil, and vegetation from the dump site was not found on his shoes, laundry, shovel, or RV) suggesting he disposed of evidence and went on a cleaning frenzy

Westerfield was convicted of kidnapping and first-degree murder. He was sentenced to death in 2003 and is currently serving his sentence in California. However, the state of California ruled the death penalty unconstitutional in 2014, so it is presumed he will not face execution. This case is an example of the most fundamental forensics principle, the Locard Exchange Principle, bringing justice to a murderer.

(Source: "DNA expert: Blood on Westerfield's jacket matches slain girl's," cnn.com)

Assignments

1. Answer the following questions about the Richard Crafts case study.

   a. What would have been considered hearsay evidence at Crafts's trial?

   The hearsay in this case was the reports made by Helle Crafts's friends and family to police that she told them, "If anything happens to me, don't think it was an accident." While this prompted the investigation into her husband's connection with her disappearance, it is considered hearsay since it cannot be stated under oath by Crafts directly. [25, 30]

   b. Why is hearsay inadmissible in court? During what type of case is hearsay allowed?

   Hearsay is inadmissible in criminal court as it is secondhand testimony. Secondhand testimony means that, when in court, the credibility of the firsthand witness cannot be evaluated and is not present for cross examination. However, hearsay is permitted in civil court. [25]

2. Answer the following questions about the Casey Anthony case study.

   a. What is the importance of establishing evidence according to the Frye standard and Daubert ruling? What is the difference between the two?

   Frye and Daubert, in general, establish good science and prevent junk science or science that has not been peer reviewed from being admissible in court. The Frye standard applies only to new or novel scientific research methods and dictates what is admissible at trial. The Daubert Ruling was a revision of the Frye standard regarding admissibility of scientific evidence and specifically required peer review publications and general acceptance within the scientific community. [26–27]

   b. Is it the judge or the jury who should decide what evidence is admissible at trial?

   The judge decides at the start of a trial which evidence will be allowed. It is then left to the jury to make their conclusions based on the evidence that is presented. [27]

c. Does the result of Casey Anthony's trial mean that she is innocent? Explain.

Casey Anthony was found not guilty based solely on the junk science presented in court. The jury ruled that the science behind the results of the tests done on her trunk was not based on peer reviewed studies, and therefore was deemed "junk science." It is unknown if Casey is truly innocent or guilty since the jury could not make the connection based on the results presented at trial.

3. Why is it important that a forensic scientist's results be scientifically and legally sound?

The results of the forensic scientist must be scientifically and legally sound so they do not qualify as junk science and can be used in court. Therefore, the forensic scientist must provide proof of evidence, results, and conclusions via written report that is based on peer reviewed studies. In addition, these results are used to determine the suspect's guilt or innocence. The results of the forensic scientist can therefore determine life and liberty for the person at trial. [27]

4. Explain how the steps of the scientific method apply to an investigation.

All evidence must be examined according to the standard scientific method or hypothesis, testing, peer review publication, and general acceptance. [26–27]

5. Using the time line of forensic science (pages 8–17), select any three scientific discoveries and discuss how they overlap with other courses you may have taken.

Students should explain which discoveries they selected and have a logical explanation for how each overlaps with other courses. For example, in 1984 Professor Jeffreys discovered DNA is unique to each person (except identical twins); DNA is also studied in biology. An example of overlap between forensics and literature could be the 1841 short story, "The Murders in the Rue Morgue" by Edgar Allen Poe. [8–17]

6. It is very common in TV shows for the suspect to be read his rights when arrested. In reality, though, the reading of the Miranda rights may not happen as often as we are led to believe. When does an officer not have to read Miranda rights to an arrested person?

When the person being arrested will not be questioned, the Miranda rights will not be read. Miranda rights apply only when a suspect is to be questioned by a law enforcement officer. [24]

7. In a few short sentences, describe what typically happens to a suspect after a person is arrested and charged with a crime (from being identified as a suspect to the trial date).

In general, upon arrest, if the person is to be questioned, they will be read their Miranda rights. Then arraignment is held before a judge and bail is set, the person is read their charges, and appointed a public defender. The suspect enters a plea and future court dates are set. The preliminary hearing is done before a judge without a jury and the evidentiary hearing is also done at this time; however, felonies are presented before a grand jury instead of a judge at a preliminary hearing. The judge or grand jury (depending on the nature of the crime) will then decide if there is enough evidence for trial. If so, the suspect is indicted, and the trial date is set. [23–24]

8. Why would a suspect enter a plea of nolo contendere?

   The plea of *nolo contendere* means the suspect enters a plea of no contest. The accused does not deny the facts or claims to the crime, or does not understand the charges. [24]

9. What must a defendant prove to be found not guilty by reason of insanity?

   The defendant did not know that what they were doing was wrong or would harm another. [24–25]

10. Revisit your answers to the Before You Begin section above.

    a. Was a crime committed? Explain your reasoning.

       Answers will vary.

    b. Who was at fault, the man who took a drink or the person who did not label what was in the bottle?

       Answers will vary.

    c. Suppose the victim died of his injuries. Does this change your opinion? If this is to be viewed as a crime, what category of crime does this fall under and what are the charges?

       Answers will vary. Students will likely report that if this is now a death, it would be considered a felony and be charged as involuntary manslaughter. [21–22]

Activity Choices

Complete Activity A and then choose between Activity B or C.

- Activity A: Locard Exchange Principle
- Activity B: Crime Labs Near You
- Activity C: Binge-Worthy True Crime: The *CSI* Effect

Activity A: Locard Exchange Principle

The Locard Exchange Principle states that every time you make contact with a person or object there is an exchange of materials. This exchange is what forensic scientists use to collect trace evidence and possibly track a person's daily movements.

Let's take a closer look at your schedule and how the Locard Exchange Principle could be applied to what you did today.

Before you begin

1. Make a list of all activities you did since waking up today until this very moment.
2. As you went through each of the above activities, what did you come in contact with?

3. Did you leave any evidence of where you were?
4. Were you observed by others who would be able to provide eyewitness accounts of your activities?
5. Now, focus on the present. As you sit right now, what are you in contact with? What possible transfer of material could have taken or is taking place? Make a list.
6. How could you have prevented any transfer if you had thought about it first? What transferred materials could be traced to you directly?
7. Is it difficult not to leave a trace? Do you think premeditated contact can diminish identifiable transfers? Give some hypothetical examples where destroying evidence might leave more that could identify you. Compile your responses for this activity into a two-paragraph response.

Students should provide a detailed list of what they did, what they came in contact with, what evidence may have been left, and who may have observed them. Students should reflect that it is incredibly difficult to not leave any trace evidence, even when premeditated. Arson is a good example of attempting to destroy evidence but leaving more evidence behind.

Activity B: Crime Labs Near You

When a crime has been committed in your town, where does the evidence from the crime scene go to be analyzed? Start by googling your state (or country if you are outside the U.S.) to find out where the publicly operated state crime labs are located. How many labs are there within your state? What services do they provide? Create a map showing their location and the types of evidence handled at each location.

Students will provide a map (via poster, PowerPoint, or other means) that shows their state, the location of nearby crime labs, and a list of what evidence is handled at each lab. A quick Google search for crime labs in each state produces a Google Map image with the locations; students will have to click around to determine what evidence is examined at each of those locations.

Activity C: Binge-Worthy True Crime: The *CSI* Effect

Chances are you are taking this course because you have been impacted by what is called the "*CSI* Effect" (pages 28–30). We are going to put your ability to understand Hollywood's depiction of a crime versus real forensic science to the test. For this activity, select a podcast series or documentary/true crime series. You will listen/watch the complete series this week. Note that you should check the rating and obtain parental permission prior to viewing. Below are some suggested series:

Podcasts:

- *Dr. Death*
- *Dirty John*
- *Over My Dead Body*
- *Serial*

Netflix series:

- *The Staircase*
- *Amanda Knox*
- *Evil Genius*
- *Making a Murderer*
- *The Innocent Man*

There are many others. If you select another, it should focus on just one crime, not a different crime in each episode. Notify your teacher which series you select before beginning.

As you watch/listen, complete the following:

1. Take detailed notes on the elements of the crime and crime scene, victim(s), suspect(s), investigation details, and the trial(s). Include these notes in your course doc for this lesson. Consider organizing your notes into a table or chronological list of details.
2. Provide your opinion on this case. Do you think the evidence supports the results of the trial?
3. What is the current status of this case? You will revisit the case at the end of this course, so make sure your notes are detailed enough that you will not have to relisten/watch at the end of the course.

Students must notify the teacher at the start of the lesson which program they select. Students should produce an organized and detailed table or list of notes, based on the prompts above. Look for quality of work that is consistent with watching the entire series, not just the first few episodes. If they select an older documentary, students will also need to complete their own research into the current status of the case.

Further Study

(This is an optional activity.)

There are many great books related to forensic science that will not only make your understanding of this course deeper, but are page turners too! Here are some great options, if you are interested:

- *Stiff: The Curious Lives of Human Cadavers* by Mary Roach
- *Death's Acre: Inside the Legendary Forensic Lab, the Body Farm, Where the Dead Do Tell Tales* by William Bass and Jon Jefferson
- *Silent Witnesses: The Often Gruesome but Always Fascinating History of Forensic Science* by Nigel McCrery

There any many more. Let your teacher know what you have read or are currently reading that relates to forensic science.

SHARE YOUR WORK

When you have completed this lesson, submit the following work to your teacher:

- Acknowledgment of lab safety rules
- Acknowledgment of the course disclaimer
- Answers to Before You Begin questions
- Assignment responses
- Activity A: Locard Exchange Principle
- Choice of Activity B (Crime Labs Near You) or Activity C (Binge-Worthy True Crime: The *CSI* Effect)
- Optional extra credit: Further Study

Lesson

2

Evidence and the Crime Scene

Learning Objectives

At the end of this lesson you will be able to:

- Explain the difference between indirect and direct evidence.
- Describe what is meant by physical evidence and give examples.
- Describe the difference between individual and class evidence.
- Create a final crime scene sketch and identify potential evidence.

> "I always go in with an open mind . . . I don't even believe what the police tell me . . . I let the evidence speak for itself."
>
> **Dr. Henry C. Lee (a leading forensic scientist who has gained fame working on high profile and cold cases)**

ASSIGNMENT CHECKLIST

- ☐ Read chapters 2 and 3 in the textbook.
- ☐ Read five case studies and answer questions.
- ☐ Complete lesson assignments.
- ☐ Activity A: How Accurate Are Eyewitness Accounts?
- ☐ Activity B: Crime Scene Sketching and Evidence Collection

In this lesson, you will gain an understanding of how crime scenes are secured as well as the types of evidence investigators look for when processing a crime scene and working an investigation. It often takes several iterations of testing and analysis for a crime to be fully processed and for investigators to understand what occurred. Information and samples collected take teams of scientists many months or years to analyze and test, depending on the nature of the crime.

Crimes can go unsolved due to lack of sufficient evidence. Innocent people can be convicted on inaccurate evidence. Juries can be swayed based on how evidence is presented in court. Likewise, heinous crimes can be solved, and criminals caught, on just one piece of crucial physical evidence, if preserved and analyzed correctly. It all starts at the crime scene. Let's take a closer look at how important evidence is to solving a crime.

You have two weeks to complete this lesson.

Reading

Read chapter 2 (pages 38–53) in your textbook.

Read chapter 3 (pages 60–72) in your textbook.

Case Studies

1. **Ronald Cotton**

Ronald Cotton was wrongfully accused and convicted of a crime he did not commit, based partially on an eyewitness account that later proved to be inaccurate.

In July 1984, an assailant broke into two apartments on separate occasions in Burlington, North Carolina. He cut phone wires, attacked and raped the women living there, searched through their belongings, and stole money. After photo identification by one of the victims, Ronald Cotton was arrested for the crimes. The prosecutor's evidence consisted of the following:

- Testimony by the other victim after seeing a lineup
- A flashlight found in Cotton's home that resembled one the assailant used
- Rubber from Cotton's tennis shoe that was found to be consistent with rubber found at the crime scene
- The photo ID from the victim

It was not disclosed at the trial, but the second victim had picked out another man from the lineup. Cotton's attorney filed an appeal based on this information. At the second trial, the second victim had decided that Cotton was indeed the assailant. Also during the second trial, a prison inmate, Bobby Poole, confessed to fellow inmates that he was the one who had committed the crimes. The judge refused to have this information submitted into evidence.

At the conclusion of the second trial in November 1987, Cotton was convicted of both rapes and sentenced to life plus 54 years in prison.

Cotton continued to claim that he was innocent and repeatedly asked for appeals. In 1994, Cotton got two new lawyers who filed a motion for DNA testing. The evidence sample from one of the victims was too degraded and did not give any information, but samples from the other were intact enough to be tested. The sample did not match Cotton, and so he was ruled out as the perpetrator. At the request of the defense, the DNA was submitted to the North Carolina convicted violent felon database; it matched that of the inmate Bobby Poole.

Cotton was released in 1995 after spending almost 11 years in prison for a crime he did not commit. He was officially cleared of all charges and offered $5,000 as compensation.

(Source: innocenceproject.org)

2. Jeffrey MacDonald

Read the case study on pages 67–68.

3. Amanda Knox

Read the case study on pages 68–71. Answer questions 1 and 2 on page 71.

1. **The crime scene was originally processed by police not trained in murder scenes; police allowed roommates into the room and they broke down the door; the scene was secured only after all the roommates and boyfriends had broken the door, observed Meredith's body, and likely contaminated the scene; body temperature was not taken so time of death could not be determined; evidence was not packaged and stored correctly so it could not be used at trial.**
2. **The crime scene should have been secured from the start with roommates not allowed in at all and evidence packaged correctly.**

4. O. J. Simpson

Orenthal James Simpson ("O. J.") was an accomplished football player, sports commentator, and actor well known in the 1990s. On June 12, 1994, O. J.'s ex-wife Nicole Brown and her friend Ronald Goldman were found murdered outside Brown's condo in Los Angeles. Nicole Brown had been brutally stabbed in the head and neck with defense wounds on her arms. Reconstruction of the crime scene indicated that Goldman likely arrived sometime during or shortly after Brown was murdered and was also stabbed to death.

O. J. Simpson was identified as a suspect and asked to turn himself in to the Los Angles Police Department, which led to a high-profile chase in June 1994 of Simpson in his white Ford Bronco. Simpson pleaded not guilty to both murders and a highly publicized trial began in January 1995.

Key evidence in this case included the following:

- DNA from Simpson, Brown, and Goldman found on a glove at the crime scene and in Simpson's Ford Bronco
- A match to the glove at the crime scene found behind the guest house on Simpson's property
- A bloody sock at Simpson's house contained Brown's blood (discredited by Dr. Henry Lee, medical expert for the defense who argued contamination during collection of evidence)
- Blond hairs were found on Simpson's glove; African American hairs were found on Goldman's shirt
- Bloody footprints at the crime scene matched Simpson's shoe size and were a match to a rare, expensive type of shoe; it was never proven that Simpson owned such a pair of shoes

Much of the DNA and physical evidence was argued by the defense as invalid due to lack of PPE during collection and alleged cross-contamination.

On October 3, 1995, Simpson was acquitted of all murder charges. However, from 1996 to 1997, a civil case by the families of Brown and Goldman was brought against O. J. for the wrongful deaths. The jury

in the civil trial found Simpson liable for the wrongful death of Ronald Goldman and battery of Nicole Brown. He was ruled to pay $33.5 million in penalties to the families.

(Source: "O.J. Simpson acquitted," history.com)

5. JonBenét Ramsey

On December 25, 1996, a six-year-old beauty pageant contestant was reported missing from her home in Boulder, Colorado. According to JonBenét's mother, Patsy Ramsey, she woke up to find a note on the stairs that demanded $118,000 in ransom. Police were contacted (despite instructions in the ransom note) and responded to the scene of a kidnapping. This was a highly publicized case; however, several serious mistakes were made in the initial response to the scene that had significant impact on the ability to ultimately solve the case:

- An appropriate chain of command was not followed.
- The home was not secured; this meant that others were allowed into the house, which led to possible cross-contamination.
- Not all areas of the home were initially investigated (including the basement).
- The parents were the sole focus of the investigation instead of considering all plausible options.
- The body of JonBenét was found inside the house eight hours after she was reported missing but was not found in the initial search of the home.
- She had been struck in the head, sexually molested, and strangled by garrote.
- The body was moved from the original location before any evidence was collected.

Critical evidence in this case included the following:

- Paint brush used in strangulation
- Broken basement window in the room where body was recovered
- A suitcase found alongside the body with fibers from JonBenét's clothing on the interior
- Footprints in the basement that suggested two intruders and did not match any family member
- DNA extracted in 2003 that suggested unknown male blood in a sample found on JonBenét's underwear

This is a highly unusual cold case that was reopened in 2010 by state and federal investigators. In 2008, the parents were formally announced by the DA's office as no longer suspects in the case. Unfortunately, Patsy Ramsey died of ovarian cancer in 2006.

(Source: "JonBenét," crimemuseum.org)

Assignments

1. What skills have you learned in your previous courses that apply to how these case studies are critically reviewed? In other words, is it enough to read the case studies as is, or do you need to think deeper and apply your prior skills and knowledge to understand what is presented?

   Answers will vary.

2. Do you think the compensation offered to Ronald Cotton for his wrongful imprisonment was fair? Explain your reasoning and offer insight on why you do or do not support the compensation.

   Answers will vary. It is likely that students will feel that the compensation was unfair and prejudiced.

3. Recall the O. J. Simpson case study, and answer the following questions:

   a. How can someone be found not guilty in criminal court, but guilty of the same crime in civil court?

      The two cases have different burdens of proof. In a criminal case, you must prove guilt beyond a reasonable doubt.

   b. How did the evidence play a role in this case?

      Not all evidence was processed and ready at the time of the criminal trial, so it was not presented.

   c. How does this relate to individual versus class evidence?

      The shoe print is an example of class evidence being used as individual evidence.

4. Why is securing a crime scene a crucial first step in responding to the scene of a crime? Provide support from one of the case studies in your answer.

   If the scene is not secure, it is impossible to tell the original condition of the scene and link evidence to the suspect(s) and/or crime scene. A good example of this is how the JonBenét Ramsey scene was not secured for hours following the initial response, which is largely why the case remains unsolved today.

5. Consider the following crime scene scenario. Identify how the crime scene was contaminated and what was done correctly.

   An early-morning janitor spots a body through an office door and immediately calls the police. The first officer to arrive enters the room and walks around the body, accidentally stepping in the blood and tracking it through the room, leaving a bloody shoe print on the floor. He quickly wipes his shoe on a jacket and checks the body for a pulse. Finding none, he calls for additional help. As he waits, he views the crime scene. Spotting a torn and crumpled paper on the floor, he smooths it out and pieces it together. Some blood, apparently from the body, is on the note, making it difficult to read, so he replaces it where he found it. The second officer to arrive at the scene puts up barrier tape and isolates the scene, preventing the janitor and office manager from coming in. The forensic technician soon arrives to process the scene.

The site was contaminated by the first officer stepping in the blood, wiping blood on the jacket, and touching/moving the paper. The second officer correctly secured the scene.

6. Consider the following types of evidence found at a crime scene. Classify each as individual or class.

   a. Some blond hairs were found on the gloves of a suspected kidnapper who has brown hair.

      Hair is considered class evidence, unless DNA has been extracted.

   b. A bloody knife has been found in the backyard of a murder suspect.

      Blood type is class evidence; DNA from blood is individual.

   c. Tire impressions are left in soil near the crime scene.

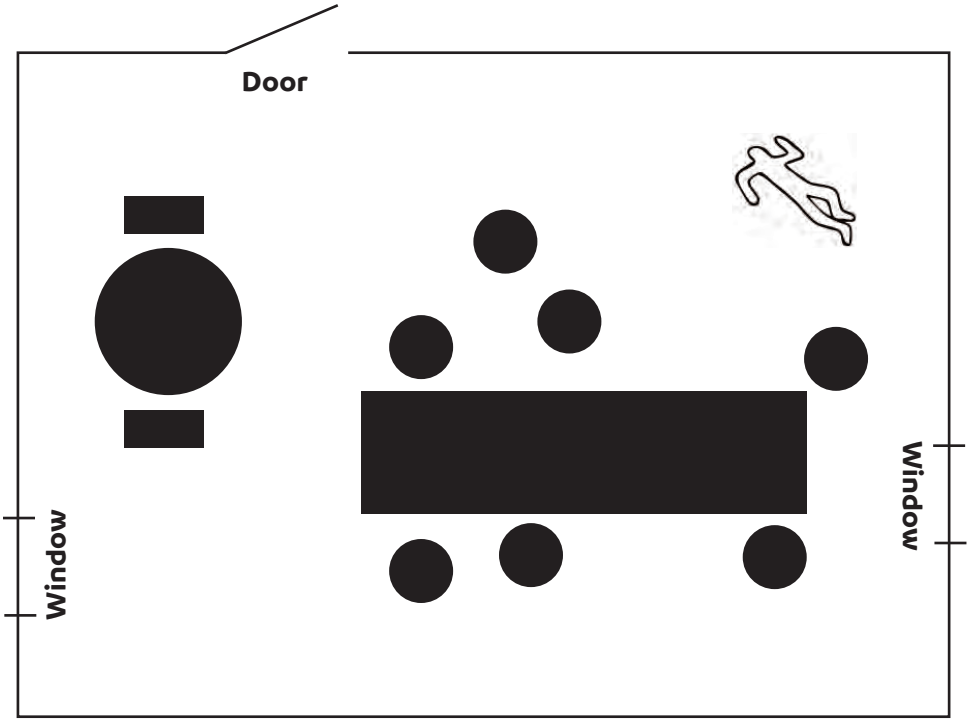
      Tire impressions are individual evidence.

7. What does MO mean?

   MO is *modus operandi*, which is the characteristic method of operation of a criminal.

8. Identify at least three important elements that are missing from the following crime scene sketch.

   Elements missing include a north-pointing arrow, scale, dimensions of items in the room, measurements of the sides of the room, the revolver, and the letters in the key are not shown on the figure.



2741 Aragon St.
9/6/06
Sketch by Officer
John Smith

A – Dining room table
B – Chair
C – Overturned chair
D – .38 Revolver
E – Male body
F – Table

Activity A: How Accurate Are Eyewitness Accounts?

In this activity, you take on the role of interrogator. Your goal is to challenge your own eyewitnesses on their accounts. Ideally, you want two or three people to unknowingly participate in your scenario. You want to be able to compare eyewitness accounts of multiple people from the same event to see where inaccuracies may lie.

Before You Begin

Think of a scenario you want to create. For instance, you might let the dog loose during dinner, bring in the mail in an overly dramatic way, or even stage a fake altercation with a sibling. Be creative, but safe. The scenario is entirely up to you. The idea is to create a scene that is out of the ordinary. Plan the exact time, place, what you (and if you have any accomplices) will be wearing, etc. What is the script for the encounter?

The Scene

Come up with a short disruption of some sort (five minutes or so) and then act it out for your two or three unknowing participants. Don't announce what you are doing. Really try to play it off as a real thing. Consider filming the event. This will help you recall exactly the events and what was said. Submit your video with your lesson for extra credit.

Follow Up

Let some time pass (at least an hour) before you let your participants in on the gag. But here is where the real lesson starts! Each of your participants needs to complete a series of questions related to your staged event. Ask them to identify the following, without input from anyone else. Tailor the questions to your scenario; you will likely need to modify or add your own questions.

1. What is today's date?
2. At what time did the event occur?
3. What was the weather at the time?
4. What was everyone wearing?
5. Describe the height, weight, hair style, eye color, etc., of those involved.
6. Describe the actions or events that took place.
7. What, if any, conversation took place? How long did it last? What was said?
8. How confident are you in your recounting of what happened?

Putting It All Together

Compare the responses from your participants.

1. Were they accurate? If not, identify the inaccuracies.
2. How accurate do you think their answers would have been if they were not asked to recall information until tomorrow? Next week?
3. How accurate do you think their answers would have been if the events had taken place in a darkened room or outside at night? How does the situation influence a person's ability to recall information?

Review

Follow up this activity by watching these three TED Talks. Links to these resources can be found at www.oakmeadow.com/curriculum-links.

Why Eyewitnesses Fail (Thomas Albright, November 15, 2016)

Social Influence and Eyewitness Testimony (Elizabeth Brimacombe, December 22, 2014)

How Reliable Is Your Memory? (Elizabeth Loftus, September 23, 2013)

Provide a detailed description of your initial staging, scene, results, and answers to the questions in this activity. What would you do differently if you were to do this activity again? Write approximately three or four paragraphs. Provide photos and video if possible.

Answers will vary. Students are strongly encouraged to provide photos and video to help improve memory and the summary of results. Students should also provide references to the three videos they watched and what they learned about testing someone's memory.

Activity B: Crime Scene Sketching and Evidence Collection

The initial processing of a crime scene is that of sketching and photographing the scene. This is done before any evidence is collected or the body is searched and studied for clues. The sketch and photographs, in many cases, are the most important components of the trial to assist jurors in understanding the conditions at the time of the crime and connect the evidence to the story of what happened.

There are two phases of crime scene sketching: the rough sketch and the finished sketch. Most commonly, the sketches are done from a bird's eye view (directly above). An elevation view is also used, which shows the view from the side and must be accompanied by noting a cardinal direction. The address, date, and time must be noted on the sketch. The first step to a rough sketch is to outline the floor plan using immovable, permanent features of the building or landscape (walls, trees, etc.). The sketch will begin with the general dimensions of the space as well as the orientation to due north, as it would appear on a map. Distances to roads, other buildings, or vehicles are measured and noted. Key

components of the scene, such as the body or weapon, are located and measured in reference to the permanent features. Orientation of these features is accurately depicted (i.e., body facing up versus down or weapon pointed northeast, etc.).

The scene is then walked in a circle or grid pattern, working toward the center. Furniture, blood spatter, or any other items of interest are included with distance from each item to two permanent reference features. Since it is unknown at the time of the rough sketch what items or features may or may not be important, everything must be carefully documented and measured. Letters or numbers are assigned to each item and then a key is provided. The appearance and orientation of all items are documented and photographed. Photographs are given numbers to correlate back to what is identified on the sketch.

Other details, such as odors, sounds, or other facts not encompassed by the sketch are also noted. The level of detail needs to be sufficient to refresh your memory as you may be required to testify at trial. The final sketch is prepared back at the lab or offices in a controlled environment. It is neatly done and drawn to scale. It may be done by hand or with the use of computer programs.

Let's test your ability to turn a rough sketch into a final sketch.

Materials

- graph paper
- ruler

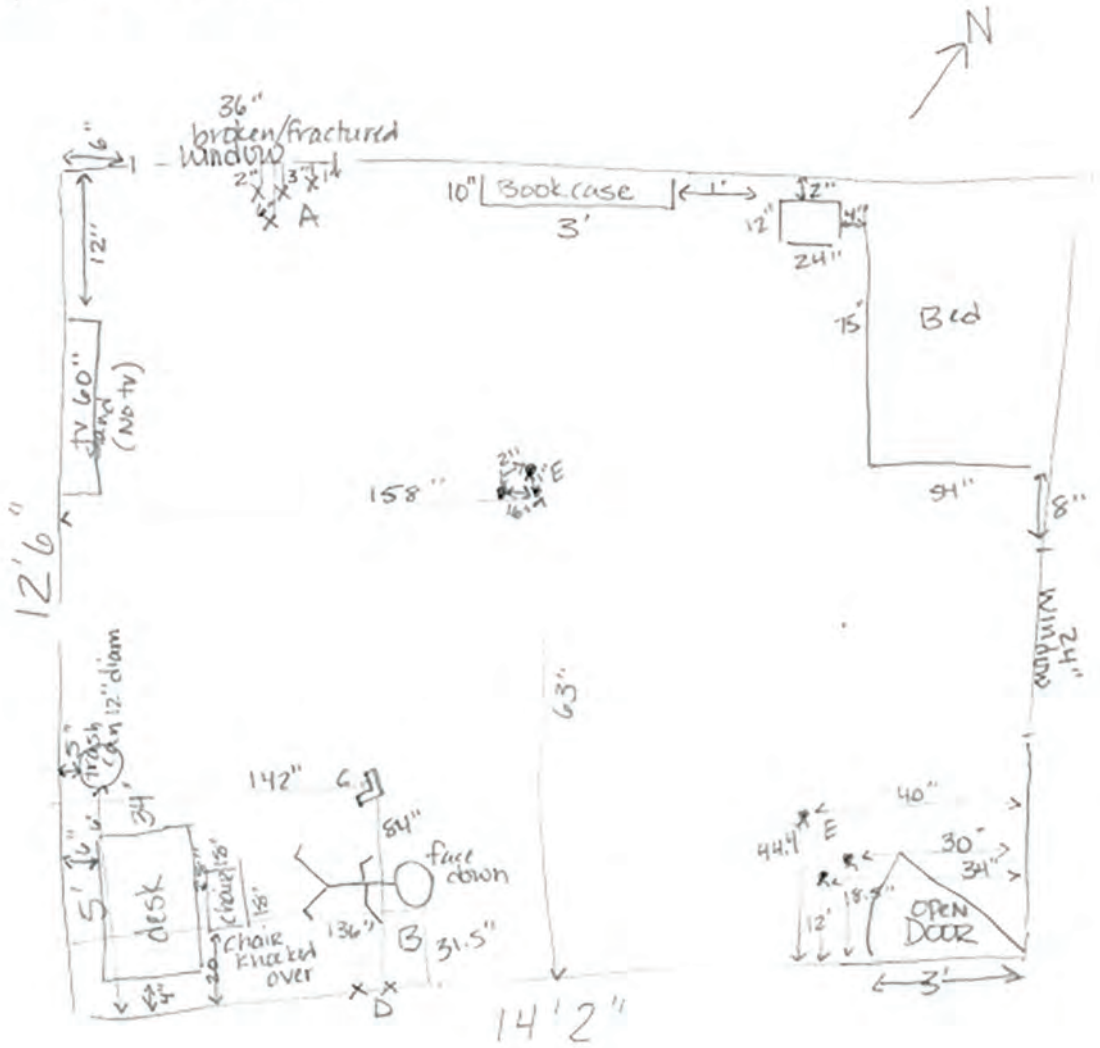
Procedure

1. Review the rough sketch provided.
2. Using the graph paper, create a scaled final sketch. Note that your sketch should fill the page, so select an appropriate scale. For example, if you use one square as equal to one foot, you will end up with a sketch far too small to be useful. Consider that this final sketch would be used at trial and you would be called to testify. Providing a final sketch of poor quality or poor scale could result in the entire case being lost.
3. Note the location of any "evidence" and include those measurements in your sketch.
4. Indicate the exact location and size of features. Provide orientation within the crime scene.
5. Correct any mistakes from the rough sketch. Anything missing or not clarified in the rough sketch must be called out in a separate table.
6. Include the address, date, and your name.
7. Include items of "evidence" listed with an assigned letter or number and reference key.
8. Create a table of the evidence items you feel may be relevant to the investigation and suggest what information could be obtained. For example, dusting for prints, sending to DNA lab, etc.

Rough Sketch

Case: 2017-10-21-001
5555 N. Main St.
Brattleboro, VT
October 21, 2017
possible homicide

Victim: Dustin Prince
Investigator: Sgt Oaks Meadows
Asst By. <your name>



A - broken glass
B - Dustin Prince; deceased
C - revolver
D - bullet holes
E - shell casings

Sketches should be neat and include appropriate scale. Look for the date, time, address, and investigator information. Confirm all features of the room and scene were included.

Students should generate a table similar to the one below.

Item	Suggested Method of Analysis
Blood; blood spatter	DNA; direction of shooting
Victim	Autopsy to determine cause of death
Bullet holes	Bullets sent for ballistics analysis
Glass	Lip prints or fingerprints

Students should point out that the exact location of the bullet holes relative to the site features was not given.

Further Study

(These activities are optional.)

1. Every crime and case is unique. Some are so heinous or bizarre that they capture the public's attention. Research the following case studies. Provide a background of the victim, crime scene, suspect(s), evidence, and trial. Clearly state how this relates to what was studied in this lesson.
    - Enrique Camarena
    - Manson murders
2. Explore the Innocence Project (innocenceproject.org). Select a case and summarize it. How was the wrongful imprisonment compensated? Do you feel the outcome was fair to all parties involved?
3. You may also look further into the Ronald Cotton case by reading *Picking Cotton: Our Memoir of Injustice and Redemption* by Jennifer Thompson-Cannino, Ronald Cotton, and Erin Torneo, and providing a short summary on the case and book.

SHARE YOUR WORK

When you have completed this lesson, submit the following work to your teacher:

- Answers to case study questions (case study #3)
- Answer to lesson questions
- Activity A: How Accurate Are Eyewitness Accounts?
- Activity B: Crime Scene Sketching and Evidence Collection
- Optional extra credit: Further Study

Lesson 6

Drugs, Alcohol, Poisons, Arson, and Explosives

Learning Objectives

At the end of this lesson you will be able to:

- Classify the types of illicit drugs and their negative effects.
- Discuss the federal penalties for possession and use of controlled substances.
- Explain the need for confirmatory tests.
- Describe various laboratory techniques and instrumentation used to analyze for the presence of illicit drugs, arson, and explosive residues.
- Discuss the connection of blood alcohol levels to the law, incapacity, and test results.
- Describe physical evidence at the scene of a suspected arson or explosion.
- Understand how explosives are classified.

ASSIGNMENT CHECKLIST

- ☐ Read chapters 7 and 8 in the textbook.
- ☐ Read six case studies and answer questions.
- ☐ Complete lesson assignments.
- ☐ Activity A: The Great Drug Debate
- ☐ Activity B: Calculating Blood Alcohol Concentration
- ☐ Lab 1: Arson Investigation
- ☐ Lab 2: Explosives and Explosive Residue

Say ahhhhhhhhh! The dose makes the poison, so no harm in taking this tiny pill, right? Would you take something someone offered you without knowing exactly what it is or what its purpose is? Probably not, but chances are that at some point in your life you actually have, and likely from a family member or friend and without even thinking twice about it!

Medications, drugs, and poisons can look surprisingly innocent and even be designed to look like harmless candies. In this lesson, we will look at several cases of poisonings, explore what blood alcohol content really means, and take a short detour into arson and explosive investigations and how crimes can be solved using clues, even when it appears there was total destruction of the crime scene.

This lesson will take three weeks to complete.

Reading

Read chapter 7 (pages 176–208) in your textbook.

Read chapter 8 (pages 218–235) in your textbook.

Case Studies

1. The Drugs Made Me Do It

Read the case study on pages 188–189. Answer the following questions:

1. Is an individual responsible and culpable for criminal acts performed under the influence of drugs, including alcohol?
2. What is your opinion on insanity defense for someone under the influence of drugs while performing criminal acts?

2. 52 Years for Selling "Incense"

Read the case study on pages 207–208. Answer questions 1–3 on page 208.

1. **This case is significant because although the suspects were not selling an illegal drug, they were selling a synthetic product that was chemically similar to cannabis and was therefore considered analogous.**
2. **The DEA had jurisdiction over this case since the charges involved possessing, packaging, and distributing a synthetic substance that was similar to an illegal drug and was distributed nationally.**
3. **This case was tried in a federal court since the charges included defrauding the FDA.**

3. Georgie Markov and the Poison Umbrella

This case reads more like a scene from a James Bond movie. Agents of the Bulgarian secret police assassinated Georgi Ivanov Markov in September 1978. Markov had defected to London from Bulgaria years before and was broadcasting programs critical of the Bulgarian regime.

On September 7, as Markov was waiting at a bus stop at Waterloo Bridge, he felt a sharp jab in his right thigh. He turned to see a man behind him with an umbrella, who apologized with a foreign accent. Markov thought nothing more of it, but the next morning he was admitted to the hospital with a high fever and vomiting. Despite being given massive amounts of antibiotics, Markov died three days later.

During an autopsy, examiners found in Markov's thigh a small platinum-iridium pellet, 1.7 mm in diameter, with two tiny holes precisely drilled at right angles to each other. The design of the pellet and the circumstances of Markov's death led investigators to believe that this was a poison pellet fired by some device in the umbrella. Markov was a healthy, husky, six-foot-tall man, but the pellet could not have contained much poison. No telltale metabolites were found in his body.

By a process of elimination, ricin became the suspected probable poison; the assassin used perhaps as little as 2 mg. Tests on a pig corroborated this assumption. Coincidentally, investigators learned that, in the previous year, another Bulgarian defector has been jabbed outside a Paris metro station. He had fallen ill but recovered. A surgeon extracted an identical pellet from his body. He had been jabbed in a muscle in his upper back, away from major blood vessels, which may be why he lived.

(Source: "The Curious Case of the Poisoned Umbrella: The Murder of Georgi Markov," *The View East*)

4. **Viktor Yuschenko**

Read the case study on page 222 (see blue textbox).

5. **Aleksandr Litvinenko**

Read the case study on page 223. Answer questions 1 and 2 on page 223. Provide references for your answer to question 2.

1. **This case highlights radiation poisoning and the ability to track the source using a Geiger counter.**
2. **The results of the inquiry indicated that President Putin approved the poisoning murder of Litvinenko.**

6. **Oklahoma City Bombing**

In 1995, Timothy McVeigh parked a truck packed with explosives outside the Alfred P. Murrah Federal Building in Oklahoma City. The bombing ripped a massive hole in the building and killed 168 people. Until September 11, 2001, the Oklahoma City bombing was the worst terrorist attack on U.S. soil.

Optional extra credit

Watch the Netflix documentary, *Oklahoma City*. Write a brief two- or three-paragraph summary of what you learned, or draw, sketch, or create a response to the details of this crime.

Assignments

1. Poisonings are not just crimes of the past; they are still going on today. Briefly research the poisonings of Sergei and Yulia Skripal in 2018. What happened in this case?

   Sergei and Yulia were poisoned in March 2018 by Russian operatives with the Novichok nerve agent. Sergei was a former Russia agent who became a double agent for the UK. Both Sergei and Yulia made a full recovery.

2. What would be considered a confirmatory test for the presence of drugs or poisons in a sample of blood? Describe how this test works.

   Answers will vary, but will include either IR, mass spec, or GC-MS. [201–206]

3. Briefly explain the classification of drugs as either illegal, illicit, OTC, or controlled substance.

   All drugs covered by law are considered controlled substances, some of which are illegal. Any legal or illegal drug taken for pleasure is referred to as an illicit drug. Those that can

be obtained at drugstores without a prescription are considered over-the-counter drugs (OTC). [176]

4. Briefly explain stimulant, narcotic, depressant, and hallucinogen, and give an example of each.

   Stimulant: substances that make the user feel better and more energetic; one example is crack cocaine [178–179]

   Narcotic: substances that relieve pain; examples include opium, heroin, and codeine [179–180]

   Depressant: substances that make the user feel extremely relaxed; one example is alcohol [180]

   Hallucinogen: substances that make the user feel disconnected; one example is LSD [177–178]

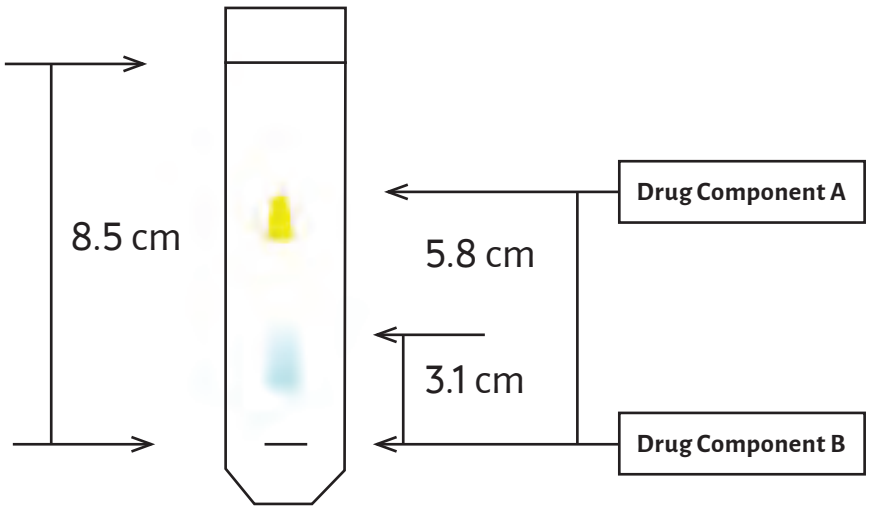
5. A new prescription drug is being tested by a major pharmaceutical company to determine the toxicity in humans. The drug is identified as having a LD50 in rats that is less than 1 mg/kg. What does this data mean?

   This means that at 1 mg/kg, 50 percent of the population of rats died.

6. Explain the phrase from the start of this lesson, "the dose makes the poison." Identify two substances that are useful in low doses to the human body, but can be poisonous in larger doses.

   Answers will vary. "The dose makes the poison" indicates that everything is toxic in some quantity.

7. An unknown white powder mixture has been submitted to your lab for analysis. You analyzed the components of the unknown powder hoping that the mixture might provide a clue about whether or not the substance is an illegal drug. Your results are below. Calculate the Rf value (see textbook page 188) of Drug Component A and Drug Component B. Then using the database table provided, indicate the likely drug mixture present.



DRUG	COMPONENT	Rf VALUE
Laced Marijuana	PCP	0.68
	Marijuana	0.40
Excedrin	Aspirin	0.72
	Tylenol	0.36
Laced Tylenol	PCP	0.68
	Tylenol	0.36

Drug A = 5.8/8.5 = 0.68 (PCP)

Drug B = 3.1/8.5 = 0.36 (Tylenol)

The substance is laced Tylenol.

8. Select one of the following *Forensic Files* episodes related to arson investigations. Discuss the evidence from the case and the resulting outcome. Do you feel the conviction was appropriate in this case?

   Option 1: Season 11, Episode 39, "Fired Up"

   Evidence included microscopic brass beads on the threading of the dryer vent; cat litter potentially used as an accelerant; no evidence of fire in the wife's lungs, indicating she was dead before the fire; evidence the wife aspirated blood, which also indicated death via major head trauma before the fire occurred. The husband was convicted of arson and manslaughter and sentenced to ten years. The jury could not determine exact cause of death, which meant he could not be charged with murder.

   Answers will vary on the opinion of the conviction.

   Option 2: Season 9, Episode 21, "Point of Origin"

   Evidence included fingerprints developed via ninhydrin on the paper used in the incendiary device. This was the major break in the case, along with the tracking of the fires relative to arson investigation conventions, before and after fire photos in his home, and the book John Orr was writing, which contained strikingly similar information to the real fires under investigation. John Orr was convicted of arson and 4 counts of first-degree murder and sentenced to 20 years without parole.

   Answers will vary on the opinion of the conviction.

Activity A: The Great Drug Debate

There are many issues regarding illegal and illicit drugs that fall on the political spectrum. You have likely heard of the "war on drugs." This is your opportunity to consider some other key aspects of the drug debate and sound your opinion.

For this activity, you will participate in an online debate with other students of this course. In order to prepare, do some quick research on the following topics. Make notes and be ready to discuss your findings and opinions.

Topic 1: Legalization of Drugs

Billions of dollars have been spent on the "war on drugs." Seventy-five percent of people in prison are there on drug or drug-related crime charges.

- Do we need more severe drug laws?
- Would legalization benefit society?
- Which drugs have already been legalized and where? What impacts has legalization had to that state/area?
- Should other drugs be legal?
- How would the cost of drugs be affected?
- How would the cost of drugs affect violent crimes?
- Should the state protect people from harm to themselves?
- What has history taught us about government control?
- Can the success or failure of drug laws in other countries help us decide?

Topic 2: Whose Problem Is It?

Is the illicit drug trade the fault of the supplier or the user? Support your opinion.

Topic 3: Drug Testing at Schools and Work

Some schools are administering urine tests to teenagers to determine if they have been using tobacco. Random drug testing of students involved in extracurricular activities has been affirmed by the U.S. Supreme Court, but opponents say such tests violate the students' rights.

This headline appeared in a local newspaper in October 2002:

Schools Add Tobacco to List for Student Drug Screening

Critics Say Tests Are Invasion of Kids' Privacy

- Do you think it is an invasion of privacy to be subjected to random drug testing at school or work?
- Do you think that tobacco products should be included in the drug testing programs?
- Is tobacco a drug?
- What constitutional amendment pertains to individual privacy?
- For states where marijuana has been legalized, should schools and workplaces still be testing for marijuana use?

After the class debate, write up an individual response to each topic based on what you learned and the ideas discussed.

Participation in a group discussion is required. Look for preparedness and contributions to the discussion. Answers will vary on the response paper. Reference citations should be included.

Activity B: Calculating Blood Alcohol Concentration

Blood Alcohol Concentration, or BAC, is the amount of alcohol in the blood at any given time, which determines the effects the alcohol is having. The body burns, or metabolizes, alcohol at a steady rate. The only thing that can lower BAC is time. A person will lose 0.015 per hour from their BAC if no further alcohol is consumed.

So what does it actually look like to have a BAC of 0.04 or of 0.13? Use the chart below as a quick guide. But remember, some people will feel, and seem, pretty normal even with a BAC of 0.12. It's important to remember that no matter how you feel, the alcohol is affecting your judgment, reaction time, and driving ability.

BAC	Effects
.30–.50	Death may occur at .37 or higher. BACs of .45 and higher are fatal to nearly all people.
.25–.30	Very drunk. May lose consciousness.
.15	Obviously drunk; staggering, weaving, irrational behavior.
.12–.15	Vomiting may occur. May be drowsy. Loss of critical judgment, impairments of memory and comprehension. Vision impaired.
.10	Loss of inhibition. Judgment and driving impaired. Clear deterioration of reaction time and control.
.08	Defines intoxication in most states.
.06	Judgment and driving somewhat impaired.
.05	Most people are mellow at this point. There can be some impairments and the ability to drive safely begins to be limited.
.04	Most people begin to feel relaxed, sociable, and talkative.
.02	Moderate drinkers may feel some relaxation and warmth.

(Source: alcohol.org)

What does all this mean? Everyone knows that it is unsafe to drink and drive, or to be under the influence of any amount of alcohol or drugs and drive.

Using the formulas on page 233 of your textbook, calculate the BAC in the following scenarios. Show your work.

1. What would be the approximate BAC of a 185-pound man who has consumed three shots (1.5 oz each) of Jack Daniel's (80 proof = 40 percent alcohol) in a half hour?

   $$\text{BACmale} = \frac{[0.071 \times (3 \times 1.5) \times 40\%]}{185} = 0.065$$

2. Is it okay for the man in the example above to drive home? Explain your reasoning.

   No, driving ability is becoming impaired.

3. A 120-pound woman has had four pints of beer (pint size, 16 oz, 5 percent alcohol) in two hours. What is her BAC?

   $$\text{BACfemale} = \frac{[0.085 \times (4 \times 16) \times 5\%]}{120} = 0.2267 - (2 \times 0.015) = 0.196$$

4. Mike is out drinking with friends. He weighs 190 pounds, and he has been out since 8:00 p.m. It is now 11:00 p.m., and Mike has had a total of five mixed drinks (2 oz each, 40 percent alcohol). What is Mike's BAC?

   $$\text{BACmale} = \frac{[0.071 \times (5 \times 2) \times 40\%]}{190} = 0.149 - (3 \times 0.015) = 0.104$$

5. How long does Mike have to wait before he can drive safely, if he stops drinking now? How long before all alcohol is out of his system?

   $0.104 - 0.015 = 0.089$ (1 hour)

   $= 0.74$ (2 hours)

   $= 0.059$ (3 hours)

   $= 0.045$ (4 hours)

   $= 0.029$ (5 hours)

   $= 0.014$ (6 hours)

   $= 0$ (7 hours)

6. A 165-pound man was involved in a car accident at 10 p.m. His BAC was measured at the time at 0.08, which he said was impossible because he had only two beers (pint size, 5 percent alcohol) just after work at 6 p.m. How many beers did he actually have?

   Step One: Solve for BAC at alleged time of consumption, 6 p.m. (4 hour time difference)

   $$\text{BACmale} = 0.08 + (0.015 \times 4)$$

   $$= 0.14 \text{ BAC at 6 p.m.}$$

   Step Two: Use BAC at 6 p.m. to solve for the number of drinks

   $$\text{BACmale} = \frac{0.071 \times [\text{Vol in oz}] \times [\%\text{alc}]}{\text{body weight}}$$

   $$0.14 = \frac{0.071 \times [\#\text{ drinks of beer} \bullet 16 \text{ oz}] \times 5}{165}$$

   $$\#\text{ drinks of beer} = \frac{0.14 \times 165}{0.071 \times 16 \times 5}$$

   $$= 4 \text{ beers}$$

7. Read the blurbs in the yellow boxes on pages 232 and 233. Do you agree that individuals found driving drunk/under the influence should be charged with murder and even sentenced to death? Do additional research to support your opinion, if necessary.

   Answers will vary, but should be supported by case studies with references provided.

Lab 1: Arson Investigation

Complete the following lab experiment in your HOL lab kit and lab manual.

Exploration

Read the Exploration section for the Arson Investigation lab experiment. Highlight important information or take additional notes as you read.

Experiment

Follow the procedure for the Arson Investigation experiment. Complete the exercise.

Exercise 1

1. **Charcoal lighter fluid**
2. **Lacquer thinner**
3. **Lacquer thinner and lamp oil**
4. **Charcoal lighter fluid**
5. **No, it does not. Charcoal lighter fluid is found in many homes. The presence in his home could be a coincidence, but it could also be the source of the accelerant used in the fire.**

Lab 2: Explosives and Explosive Residue

Complete the following lab experiment in your HOL lab kit and lab manual.

Materials

- bottle of distilled water

Exploration

Read the Exploration section for the Explosives and Explosive Residue lab experiment. Highlight important information or take additional notes as you read.

Experiment

Follow the procedure for the Explosives and Explosive Residue experiment. Complete the exercise.

Exercise 1

1. **Nitrates and nitrite are frequently found in the residue of the "low" explosives. Reagents used in these tests can safely be used at home.**
2. **Aluminum powder is often added to explosives to increase total energy and explosive effect. The aluminum test is reasonably easy to perform.**
3. **It is extremely sensitive to shock.**
4. **The components were once easily available and produced very powerful explosions.**
5. **Griess nitrite tests = pale orange**

   Griess nitrate tests = pale pink
6. **the speed of the combustion**

Data Table 1: Known Chemical Testing

Test	Color of Test Solution	Color of Water Control
Nitrite ion test using iron II sulfate	**Dark greenish or brownish**	**No change; very slight pink**
Nitrite test using Griess reagent	**Pale orange**	**No change; very slight pink**
Nitrate test using Griess reagent	**Pale pink**	**No change; very slight pink**
Aluminum ion test using aluminon reagent	**Pink**	**Yellow**

Data Table 2: Unknown Chemical Testing

Test	Result (Positive or Negative)
Unknown 1 – nitrite with iron II sulfate	**Negative**
Unknown 1 – nitrite with Griess reagent	**Negative**
Unknown 1 – nitrate with Griess reagent	**Negative**
Unknown 1 – aluminum	**Negative**
Unknown 2 – nitrite with iron II sulfate	**Negative**
Unknown 2 – nitrite with Griess reagent	**Negative**
Unknown 2 – nitrate with Griess reagent	**Positive**
Unknown 2 – aluminum	**Positive**

Further Study

(This is an optional activity.)

The widely popular Netflix series, *Narcos*, is based on the story of Pablo Escobar, who was arguably the biggest drug trafficking lord of all time. In 1989, Forbes magazine listed Pablo Escobar as the seventh richest man in the world. Escobar began his climb to wealth as a teenage car thief in the streets of Medellín, Colombia, and eventually moved into the cocaine-smuggling business. At the peak of his power in the mid-1980s, he was shipping as much as 11 tons of cocaine per flight in jetliners to the United States. Law enforcement officials estimate that the Medellín Cartel controlled 80 percent of the world's cocaine market and was taking in about $25 billion annually.

Escobar ruthlessly ruled by the gun: murdering, assassinating, and kidnapping. He was responsible for killing three presidential candidates in Colombia as well as the storming of the Colombian Supreme Court, which resulted in the murder of half the justices. All the while, Escobar curried favor with the Colombian general public by cultivating a Robin Hood image and distributing money to the poor.

In 1991, hoping to avoid extradition to the United States, Escobar turned himself in to the Colombian government and agreed to be sent to prison. However, the prison compound could easily be mistaken for a country club. There he continued his high-flying lifestyle, trafficking drugs by telephone and even murdering a few associates. When the Colombian government attempted to move Escobar to another jail, he escaped, again fearing extradition to the United States.

Pressured by the U.S. government, Colombia organized a task force dedicated to apprehending Escobar. The manhunt for Escobar ended on December 2, 1993, when he was cornered on the roof of one of his hideouts. A shootout ensued and Escobar was fatally wounded by a bullet behind his ear.

(Source: "Pablo Escobar," crimemuseum.org)

Watch this video of the DEA agents who took down Pablo Escobar.

Who Killed Pablo Escobar? Truth Told by DEA Agents

Write a one-page summary of what you learned and your personal reaction to this case.

Answers will vary.

SHARE YOUR WORK

When you have completed this lesson, submit the following work to your teacher:

- Answers to case study questions
- Responses to lesson assignments
- Activity A: The Great Drug Debate
- Activity B: Calculating Blood Alcohol Concentration
- Lab 1: Arson Investigation
- Lab 2: Explosives and Explosive Residue
- Optional extra credit (case study extra credit assignment and/or Further Study)

Appendix

Lab Materials List

The following materials are required for this course and will need to be provided by the student. In most cases, these are common household items. Please plan in advance so you have these materials on hand when they are needed. Other necessary materials are included in the lab kit.

LESSON	PROJECT	MATERIALS
1		No additional materials required.
2		graph paper ruler
3	Classification of Fingerprints	camera paper towels white paper soap
3	Dusting and Lifting Fingerprints	soda can camera drinking glass flashlight water bottle index card mirror scissors white paper paper towels Silly Putty or clay, soap, and tape
3	Latent Detection Methods	camera dish soap disposable plate heat resistant cup heat resistant tray or bowl lamp with incandescent bulb measuring cups microwave or teakettle to boil water oven mitt scissors pencil paper towels white paper tap water clear tape
4	Simulated Blood	corn syrup red food coloring water dropper bottle or airtight container

LESSON	PROJECT	MATERIALS
4	Blood Pattern Analysis	poster board, scrap paper, or index cards simulated blood popsicle stick protractor ruler/meter stick clipboard dropper bottle or straw tape syringe sine table rag
4	Extracting DNA from a Banana	ripe banana water salt dishwashing soap 5-in square of cheesecloth or coffee filter cold rubbing alcohol (isopropyl alcohol) toothpick or popsicle stick glass cup ziploc bag
5	Fabric and Fiber Observation	fabric samples (wool, silk, rayon, nylon, cotton, linen, acetate, and polyester) clip-on smartphone microscope tweezers
5	Observation of Human Hair	clip-on smartphone microscope scissors tweezers sample hairs ruler black paper white paper
5	Observation of Animal Hair	clip-on smartphone microscope microscope slides ruler clear nail polish black paper white paper sample human hairs sample animal hairs

LESSON	PROJECT	MATERIALS
5	Analysis of Glass Lab	distilled water camera corn oil hammer glass samples paperclip or toothpick nail or screw plastic sealable bag, quart size paper towels white paper tape
5	Fiber Analysis Burn Test (optional)	fiber samples (wool, silk, rayon, cotton, linen, acetate, and polyester) unknown blended fabric sample candle matches metal tweezers
6	Explosives and Explosive Residue	bottle of distilled water
7	Toolmark Challenge	five different common household tools (hammers, pliers, screwdrivers, etc.) play-doh or modeling clay, or scrap wood, board, or stiff cardboard comparing bite marks play-doh or modeling clay plastic baggie
8	Ulna Height	ruler tape measure graph paper
8	Baked Potato Corpse	several large russet potatoes in different sizes several large sweet potatoes in different sizes one large beet one large apple microwave oven thermometer
9		No additional materials required.
10		No additional materials required.