

Forensic Science

Teacher Manual



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Introduction

This teacher manual 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 manual 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.

In this teacher manual, 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 manual 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 manual 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 of the student's coursebook).

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.

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.

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.

ASSIGNMENT SUMMARY

- 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

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**
2. **Casey Anthony and the Frye Hearings**
3. **The Murder of Danielle van Dam**

See the student coursebook for information on each case study.

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

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.

Reading

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

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

Case Studies

See the student coursebook for information on each case study.

1. **Ronald Cotton**
2. **Jeffrey MacDonald**
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.**

ASSIGNMENT SUMMARY

- 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

4. O. J. Simpson**5. JonBenét Ramsey**

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.

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 need 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, conversations 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 <https://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.

See the student coursebook for the procedure for this activity.

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.)

- 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
- 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?
- 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.

Lesson

3

Fingerprints

Learning Objectives

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

- Define the three basic properties that allow individual identification by fingerprints.
- Obtain an inked, readable fingerprint for each finger.
- Recognize and classify the three general ridge patterns.
- Apply the primary Henry-FBI classification system to fingerprints.
- Tell the differences among latent, plastic, and visible fingerprints.
- Develop latent prints using physical and chemical methods.
- Classify lip prints.

Before You Begin

1. It is important to note that during this lesson you will be asked to create a set of prints, lift latent prints from various surfaces, and use physical and chemical techniques to develop prints. Several identification systems will be used to compare fingerprints.

Your teacher will not keep or reproduce any of the prints. Due to privacy laws, parental permission is required for participation in this lesson's experiments. Please have your parent or guardian send your teacher an email indicating participation is permitted.

An email from the parent to the teacher providing permission is required for all students under the age of 18.

2. Before opening your textbook and doing any reading for this lesson, complete this activity. Using an uninflated latex balloon and one of the ink strips in your lab kit, gently roll one of your fingertips in the ink. Apply the same finger to the balloon surface, near the center. Repeat with a

ASSIGNMENT SUMMARY

- Complete the Before You Begin section.
- Read chapter 4 plus pages 260–262 in the textbook.
- Read five case studies and answer questions.
- Complete lesson assignments.
- Lab 1: Classification of Fingerprints
- Lab 2: Dusting and Lifting Fingerprints
- Lab 3: Latent Detection Methods

different fingertip on the other side of the balloon. Be careful not to smudge or twist the prints. Then inflate the balloon and tie off the end.

What do you observe? What do you notice about your fingerprints? Answer these questions and provide a photo of your balloon print in your course doc.

Students should note that their prints are enlarged when the balloon is inflated. Students will notice that their prints have certain swirls, arches, or loops. They should notice that both prints are different, even if it's just slight differences. Look for a photo of their results.

Reading

Read chapter 4 (pages 78–103) in your textbook.

Read a portion of chapter 9 (lip prints, pages 260–262) in your textbook.

Case Studies

See the student coursebook for information on each case study.

- 1. Will and William West**
- 2. Donald and Ronald Smith**

Read the case study on pages 101–102 in your textbook. Answer questions 1 and 2 on page 102.

- 1. In both cases, the men have similar names and nearly identical appearances.**
- 2. This case highlights the importance of fingerprint evidence since the suspects were identical twins who could only be distinguished based on their fingerprints.**

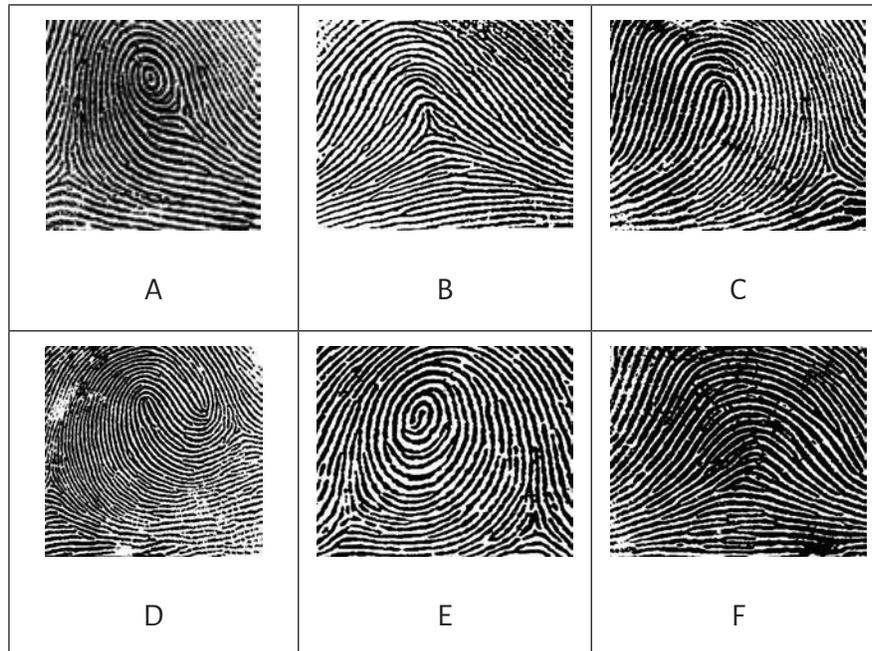
- 3. Madrid Bombings**

Read the case study on pages 102–103 in your textbook. Answer questions 1–3 on page 102.

- 1. Both prints have the same tented arch classification.**
 - 2. The center of the prints varies, along with the area above the tent.**
 - 3. This case highlights the importance of using fingerprint evidence in conjunction with other evidence. It is unlikely that fingerprint evidence alone can convict a person if all other evidence does not support the conclusion.**
- 4. Hamm Kidnapping**
 - 5. Night Stalker**

Assignments

1. Classify each of the following prints as loop, whorl, or arch.



- A. Whorl**
 - B. Arch (tented)**
 - C. Loop (radial)**
 - D. Loop (ulnar)**
 - E. Whorl**
 - F. Arch (plain)**
2. Examine the fingerprint below carefully. Identify the following fingerprint minutiae.
 - A. ridge ending**
 - B. eye or enclosure**
 - C. bifurcation or fork**
 - D. dot**
 3. Who created the method of using body measurement for a means of identification?
Alphonse Bertillon
 4. Who instituted a numerical classification system of all fingerprints and what is the basis for determination?

Edward Henry and the presence of whorl patterns

5. Explain the importance of each aspect of the Will West case study and the need for modern biometrics.

This was a case of two men being similar in all ways, even in name, so using the Bertillon System for identification would not distinguish the two men. Modern biometrics and fingerprinting, however, would allow for unique and personalized identification.

6. What are the three components of a fingerprint?

water, salt, and organic compounds

7. Why is the testing order for fingerprint evidence important? Describe a first-use method and a chemical method that would only be used as a last resort, and explain why these would be used in that order.

Testing order is important as you may damage the fingerprint and lose the evidence if the wrong method is selected. A good first-use method is iodine fuming, followed by ninhydrin. Silver nitrate would be used last as it will wash away traces of fatty oils and proteins. (92)

8. All fingerprints have class characteristics such as loops, whorls, arches, cores, deltas, bifurcations, ridges, spurs, etc. Why, then, are fingerprints considered individual evidence rather than class evidence?

Although fingerprints all have the same class characteristics, their arrangement is unique to each person, therefore, they can be used as individual evidence.

9. Explain what the IAFIS is and how it is used. How is the final fingerprint verification made using this system?

IAFIS stands for Integrated Automated Fingerprint Identification System and was phased in by the FBI in 1999. It is a computerized record keeping system for all fingerprints and will check for a match. The final verification is still done manually to confirm the IAFIS positive identification.

10. Fingerprints are being used in unique ways to solve crimes. Watch the TED Talk video below and comment on what you foresee as being pros and cons to this new technology applied to fingerprint analysis. (Links to all online resources can be accessed from <https://www.oakmeadow.com/curriculum-links/>.)

Your Fingerprints Reveal More Than You Think (Simona Francese, April 2018)

Students might note that this type of investigation adds time, cost, and is newer, which means it needs peer reviewed studies to help make it more credible in court. The pros are that you can get a lot of information from just a small, unclear fingerprint.

Lab 1: Classification of Fingerprints

Complete this lab experiment in your HOL lab kit. All lab instructions are found in the HOL lab manual.

Experiment

Follow the procedure for the Classification of Fingerprints experiment. Complete all four exercises:

- Exercise 1: Classifying Individual Prints
- Exercise 2: FBI Cards
- Exercise 3: NCIC and Henry Classification Systems
- Exercise 4: The FBI Needs Help!

1. Gather all materials for this lab. You will need to ask a friend or family member to help.
2. Answer all experimentation questions for all sections.
3. Provide photos of your fingerprint cards.

Exercise 1

Students will complete the data table, similar to the one below. They may not be able to get all these details, but should at least be able to identify the pattern correctly.

Print	Pattern	Subtype	Further Description
a	Whorl	Central pocket	Inner (12–16)
b	Whorl	Double loop	Inner (12–14)
c	Loop	Ulnar	(14–16)
d	Loop	N/A	(17–19)
e	Loop	N/A	(15–17)
f	Loop	N/A	(6–8)
g	Loop	N/A	(6–8)
h	Whorl	Central pocket	Outer (5–7)
i	Arch	Tented	–
j	Whorl	Plain	Meet (1–2)
k	Arch	Plain	–
l	Whorl	Plain	Inner (5–7)
m	Loop	Ulnar	(16–19)
n	Whorl	Double loop	Outer (9–11)

Exercise 2

Students will provide a copy of their print card. Look for rolled fingerprints, rectangular in shape, not just a straight up-and-down print.

Exercise 3

Data Table 2: NCIC Classification of Criminal Suspect

Code:	P	I	A	T	X	M	2	2	X	X	5	7	D	O	A	A	P	O	0	1
Finger:	Right thumb	Right index	Right middle	Right ring	Right little	Left thumb	Left index	Left middle	Left ring	Left little										

Data Table 3: Primary Henry Fingerprint Classification

Primary Henry Classification	$\begin{array}{r} \underline{1 + 0} \quad 1 \\ 1 + 16 + 8 + 2 + 1 = 28 \end{array}$
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Data Table 4: NCIC to Henry Conversions

NCIC fingerprint classification codes	Henry classifications (primary)
COPO13PO17DIDI13PI18	$\underline{1 + 16 + 8 + 4} \quad 29$ $1 + 16 + 2 + 1 = 20$
14PI12PO161513PIPI18	$\underline{1 + 16 + 8 + 2} \quad 27$ $1 + 1 = 2$
POPIPOPM22PIDIDIPM19	$\underline{1 + 16 + 8 + 4 + 2} \quad 31$ $1 + 16 + 8 + 2 + 1 = 28$
DO1821POPOPIPO20PI15	$\underline{1 + 8 + 4} \quad 13$ $1 + 16 + 4 + 2 + 1 = 24$
PM14141313PMPM141716	$\underline{1 + 4} \quad 5$ $1 + 16 + 2 = 19$

Exercise 4

Data Table 5: Matching Codes to FBA Fingerprint Cards

NCIC Code Number	FBA Fingerprint Card Number
101	14
102	7
103	3
104	9
105	Extra card
106	8

Data Table 6: Creating NCIC and Primary Henry Fingerprint Classification Codes

FBI Fingerprint Card Number	NCIC Fingerprint Classification Code
10	PMPIPIPIPO16POIPMPI
15	DO1916PMPI201715PIPI

Note: Answers do not need to be exact but should be relatively close.

Lab 2: Dusting and Lifting Fingerprints

Complete this lab experiment in your HOL lab kit. All lab instructions are found in the HOL lab manual.

Note that the chemicals used in these experiments are potentially harmful. Wear safety glasses, gloves, and an apron at all times. Perform experiments in a well-ventilated area.

Read directions to all experiments all the way through before getting started.

Experiment

Follow the procedure for the Dusting and Lifting Fingerprints experiment. Complete both exercises:

- Exercise 1: Creating Prints
- Exercise 2: Dusting and Lifting Prints

For assistance on how to use a fingerprint brush, review the following video:

Forensic Education Basic Fingerprint Lifting

1. Gather all materials for this lab. You will need to ask a friend or family member for assistance.
2. Answer all experimentation questions for all sections.
3. Provide photos of each print you create or lift.

Exercise 1

Students will provide photos of plastic prints in clay showing the L-scale for reference.

Students will provide photos of ink rolled prints showing the L-scale for reference.

Exercise 2

Students will provide photos of six latent prints lifted and preserved on the fingerprint backing cards with date, location, lifted by, and sketch/remark section included. Fingerprint pattern should also be identified. Cards should be photographed with the L-scale for reference.

1. **Answers will vary. Students should explain why the surface was challenging. For instance, if the mirror was challenging, they may mention that it was difficult to develop the print on a reflective surface, or they had a difficult time dusting at a vertical angle. If the glass**

was the least challenging surface, they may mention it was easy to see through and the prints were easily visible on the clear surface.

2. It is important that the answer students give to this question matches the image provided in Photo Table 1. For the provided sample image in Photo Table 1, the pattern type is a whorl. The swirling pattern allowed it to be classified as a whorl instead of an arch or loop.
3. Students must explain how their technique improved. An example would be if the student said that their dusting technique improved because at the beginning they overpowdered the brush and as they became more familiar they were able to control the amount of powder on the brush.

Lab 3: Latent Detection Methods

Complete this lab experiment in your HOL lab kit. All lab instructions are found in the HOL lab manual.

Note that the chemicals used in these experiments are potentially harmful. Wear safety glasses, gloves, and an apron at all times. Perform experiments in a well-ventilated area.

Read directions to all experiments all the way through before getting started.

Experiment

Follow the procedure for the Latent Detection Methods experiment. Complete all three exercises:

- Exercise 1: Developing Latent Fingerprints with IKI Fuming
- Exercise 2: Developing Latent Fingerprints with Ninhydrin
- Exercise 3: Developing Latent Fingerprints with Cyanoacrylate

For assistance on how to use a fingerprint brush, review the following video:

Forensic Education Basic Fingerprint Lifting

1. Gather all materials for this lab. You will need to ask a friend or family member for assistance.
2. Answer all experimentation questions for all sections.
3. Provide photos of each experiment design and print you develop.

Exercise 1

Students will provide photos of their fuming chamber and developed prints.

Exercise 2

Students will provide photos of their fuming chamber and developed prints.

Exercise 3

Students will provide photos of their fuming chamber and developed prints.

1. Silver nitrate is a light-sensitive treatment, which is used to develop the chloride from salt in perspiration. When the silver nitrate combines with the perspiration in the print, the chloride reacts with the silver nitrate to form silver chloride. When the combination is then exposed to UV light, the developed print becomes reddish-brown to black in color. The silver nitrate is applied to the print by either spraying the area with silver nitrate or dipping it into silver nitrate to fully saturate the print. The saturated print is allowed to fully air dry before being slowly exposed to the UV light.

Silver nitrate is best used on porous surfaces, such as wood, Styrofoam, or paper. Developing a print with silver nitrate should be the last process done to the print as the silver nitrate will eradicate both fats and amino acids required for other development techniques. As with all development techniques, safety equipment must be worn when developing prints with silver nitrate.

2. The answers will vary by student. It is important that the answer the student gives to this question matches the image provided in the photo panels. For the provided sample image in Photo 1, the pattern type is a loop as the ridges enter and exit on the same side of the print.
3. The answer will vary by student. Students must explain their answers. A sample answer is as follows:

I found that cyanoacrylate was the most successful in developing latent prints as it provided the most detail in the skin ridge pattern. As cyanoacrylate was the most successful, it suggests that the prints developed contained a large amount of protein and therefore were very sweaty prints.

4. Sample answer:

If latent prints were identified on a leather belt, I would suggest that cyanoacrylate be used to develop the print. Cyanoacrylate is the method that I would choose as it is best for non-porous surfaces. Additionally, as a leather belt can be large, it is easy to develop a large number of prints on a surface at one time.

5. Sample answer:

If latent prints were identified on a purple sheet of paper, I would suggest using iodine for the development method. There are a variety of reasons for this choice. Ninhydrin creates a purple-colored print, which would be difficult to view on purple paper. Additionally, cyanoacrylate is best for nonporous surfaces, yet paper is a porous surface. Finally, iodine is ideal for prints on porous surfaces and creates a yellowish-brown colored print when developed, allowing for visualization against a purple-colored paper.

Further Study

(This is an optional activity.)

Repeat the Before You Begin activity but using lipstick to observe your lip print. Compare your print with someone else in your family or a friend. Provide photos of your results and a short write-up on how lip prints can be used as forensic evidence.