

Forensic Science Coursebook



Oak Meadow

Oak Meadow, Inc.
Post Office Box 1346
Brattleboro, Vermont 05302-1346
oakmeadow.com



Table of Contents

Introduction	vii
Course Disclaimer	
Course Materials	
Lesson 1 Forensic Science and the Law	1
Activity A: Locard Exchange Principle	
Activity B: Crime Labs Near You	
Activity C: Binge-Worthy True Crime: The CSI Effect	
Lesson 2 Evidence and the Crime Scene	9
Activity A: How Accurate Are Eyewitness Accounts?	
Activity B: Crime Scene Sketching and Evidence Collection	
Lesson 3 Fingerprints	19
Lab 1: Classification of Fingerprints	
Lab 2: Dusting and Lifting Fingerprints	
Lab 3: Latent Detection Methods	
Lesson 4 Blood and DNA	29
Activity A: Blood Pattern Analysis	
Option 1: Release Height	
Option 2: Angle of Impact	
Option 3: The Effect of Movement	
Option 4: Arterial Blood	
Option 5: Hand Preference	
Activity B: Who Robbed the Bank? Suspect CODIS Analysis	
Lab: Extracting DNA from a Banana	

Lesson 5 Hair, Fibers, and Glass	43
Activity: Virtual Microscope	
Lab 1: Fabric and Fiber Observation	
Lab 2: Observation of Human and Animal Hairs	
Lab 3: Analysis of Glass	
Lesson 6 Drugs, Alcohol, Poisons, Arson, and Explosives	55
Activity A: The Great Drug Debate	
Activity B: Calculating Blood Alcohol Concentration	
Lab 1: Arson Investigation	
Lab 2: Explosives and Explosive Residue	
Lesson 7 Firearms, Toolmarks, Impressions, and Forgery	65
Activity A: Shoe Prints in the Snow	
Activity B: Toolmark Challenge	
Activity C: Analyze Your Own Handwriting	
Activity D: Simulated Forgery (Group Project)	
Activity E: Gun Control Laws	
Activity F: Comparing Bite Marks	
Lesson 8 Entomology and Human Remains	73
Activity A: Ulna Height	
Activity B: The Baked Potato Corpse	
Activity C: Estimating PMI	
Activity D: Forensic Anthropology and Modern Refugees	
Lesson 9 Computer and Mobile Devices	79
Activity A: Cyberstalking, Harassing, and Bullying Discussion	
Activity B: Satellite Imaging	
Lesson 10 Careers and Final Project	83
Activity A: Revisit the CSI Effect	
Activity B: Careers in Forensic Science	

Activity C: Mock Crime Scene

Activity D: Infamous Case Study

Appendix	89
Lab Materials List	90
Academic Expectations	93
Original Work Guidelines	94
Finding Reputable Sources.....	94
Plagiarism.....	94
Citing Your Sources	95
Citing Images	96



Introduction

Course Disclaimer

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

- Crime scene situations and evidence
- Fingerprint analysis
- Hair and fiber analysis
- Blood spatter evidence
- Handgun and bullet analysis
- The effects of a fired bullet on objects and people
- Detection of alcohol and drugs (legal and illegal) associated with a criminal/crime scene
- 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

It is important that you are comfortable with these topics and understand that at several points during our study of these topics you may encounter graphic images, videos, and illustrations in order to further your 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!

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 (cost: \$8), 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 <https://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.”

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.

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

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)

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?
 - b. Why is hearsay inadmissible in court? During what type of case is hearsay allowed?
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?
 - b. Is it the judge or the jury who should decide what evidence is admissible at trial?
 - c. Does the result of Casey Anthony’s trial mean that she is innocent? Explain.
3. Why is it important that a forensic scientist’s results be scientifically and legally sound?
4. Explain how the steps of the scientific method apply to an investigation.
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.
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?
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).
8. Why would a suspect enter a plea of nolo contendere?
9. What must a defendant prove to be found not guilty by reason of insanity?

10. Revisit your answers to the Before You Begin section above.
 - a. Was a crime committed? Explain your reasoning.
 - b. Who was at fault, the man who took a drink or the person who did not label what was in the bottle?
 - 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?

Activity Choices

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

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

Activity A: Locard Exchange Principal

The Locard Exchange Principal 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 Principal 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.

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.

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.

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.

FOR ENROLLED STUDENTS

When you have completed this lesson, submit the following work to your Oak Meadow 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 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

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.

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 Angeles 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)

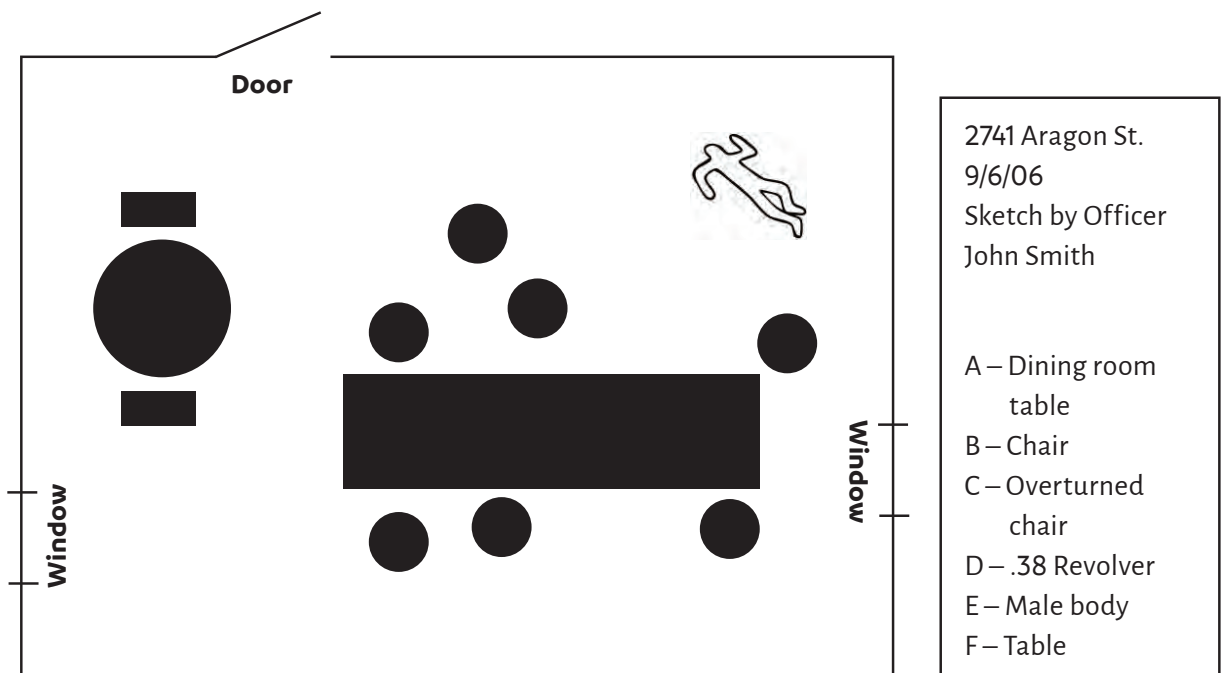
Assignments

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

- c. How does this relate to individual versus class 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.
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.

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.
 - b. A bloody knife has been found in the backyard of a murder suspect.
 - c. Tire impressions are left in soil near the crime scene.
7. What does MO mean?
8. Identify at least three important elements that are missing from the following crime scene sketch.



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.

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

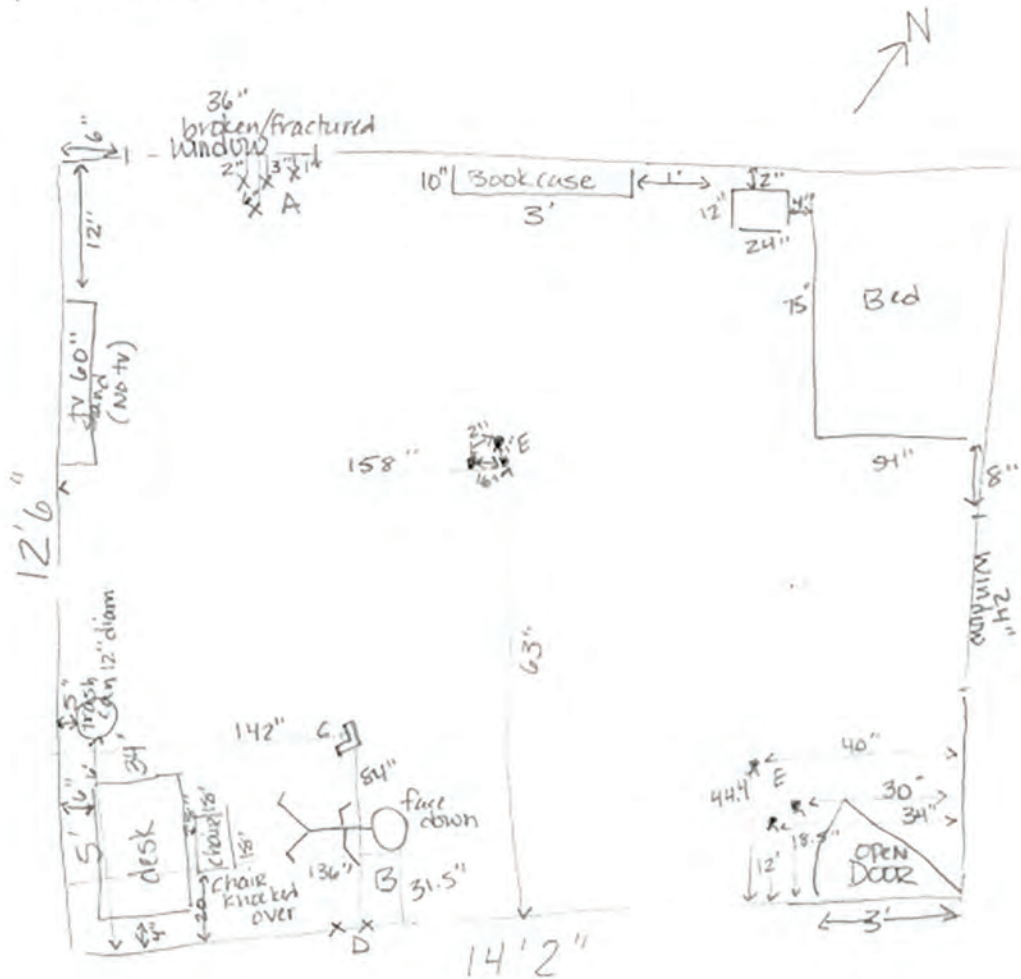
Procedure

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 Daks Meadows
 Asst By. <your name>



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

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.

FOR ENROLLED STUDENTS

When you have completed this lesson, submit the following work to your Oak Meadow 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

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.

“Physical evidence cannot be intimidated. It does not forget. It stays there and waits to be detected, preserved, evaluated, and explained.”

Herbert Leon MacDonell

(inventor of the MAGNA brush fingerprint device)

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

In this lesson, you will gain an understanding of the various techniques used to process and preserve fingerprint evidence at crime scenes. Fingerprints are unique to each person (even identical twins) and can be a critical piece of the evidence used to establish who was present at the scene and what may have transpired. However, fingerprints are often latent (not visible) and take a trained technician to find. If the wrong method of developing the prints is used, the evidence can be lost forever. If the crime scene is not secured properly at the initial processing, fingerprints can be destroyed. This often

hidden and delicate piece of evidence is where we begin our look at types of evidence commonly found at crime scenes.

But let's first take a look at the anatomy and characteristics of fingerprints and then put that to use in several chemical and physical methods of developing prints.

You have two weeks to complete this lesson.

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.

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 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.

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

1. Will and William West

Read the case study on pages 80–81 in your textbook.

2. Donald and Ronald Smith

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

3. Madrid Bombings

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

4. Hamm Kidnapping

In St. Paul, Minnesota, in the summer of 1933, William A. Hamm Jr., president of the Theodore Hamm Brewing Company, was kidnapped by four members of the Barker/Karpis gang while working in his office. Members of the gang demanded a ransom of more than \$100,000.

Hamm was taken to Wisconsin and forced to sign ransom notes before being moved to a hideout in Illinois while the gang members awaited the ransom payment. After the money was handed over, Hamm was released back in Minnesota for what seemed to be the perfect crime.

However, unknown to the criminals, the FBI Crime Lab got involved and a then state-of-the-art technology of latent fingerprint identification was used on the case. Alvin “Creepy” Karpis, “Doc” Barker, Charles Fitzgerald, and other members of the gang would have gotten away if it weren’t for their fingerprints left all over the ransom notes. The investigation of the Hamm kidnapping was the first time the silver nitrate method of fingerprint detection was used successfully to visualize latent prints from forensic evidence.

(Source: “A Byte Out of History: Latent Prints in the 1933 Hamm Kidnapping,” archives.fbi.gov)

5. Night Stalker

Richard Ramirez committed his first murder in June 1984. His victim was a 79-year-old woman who was sexually assaulted and brutally murdered. Eight months later, Ramirez began a murderous rampage that resulted in 13 additional murders and 5 rapes in the Los Angeles and San Francisco areas.

His modus operandi (MO) was to enter the home through an open window, shoot male residents, and rape his female victims. Media dubbed him the “Night Stalker” as he evaded police for over a year.

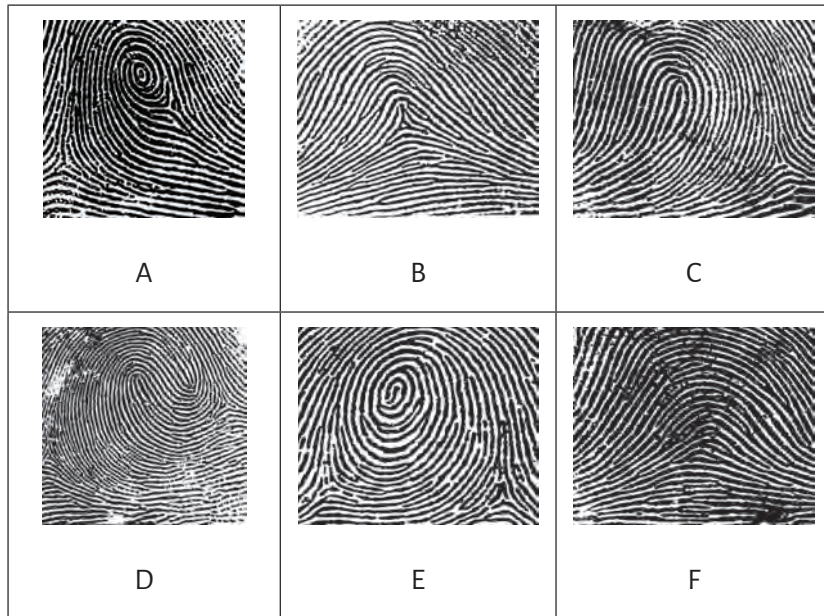
The break in the case came when the license plate of what appeared to be a suspicious vehicle related to a sighting of the Night Stalker was reported to police. The police processed the car for fingerprints and found one usable partial print. This fingerprint was entered into the Los Angeles Police Department’s new IAFIS computerized fingerprint system. The Night Stalker was identified as Richard Ramirez, who had been fingerprinted following a traffic violation years earlier. Police searched the home of one of Ramirez’s friends and found a gun linked to the murders; in addition, Ramirez had given the jewelry of the victims to his sister. Ramirez was convicted of 13 counts of murder, 5 attempted murders, 11 sexual assaults, and 14 burglaries. He was sentenced to death, but died of lymphoma in 2013 while awaiting execution.

Without IAFIS, it would have taken a single technician manually searching the 1.7 million fingerprint cards in LA roughly 67 years to come up with a match. The IAFIS system radically changed the use of fingerprint evidence.

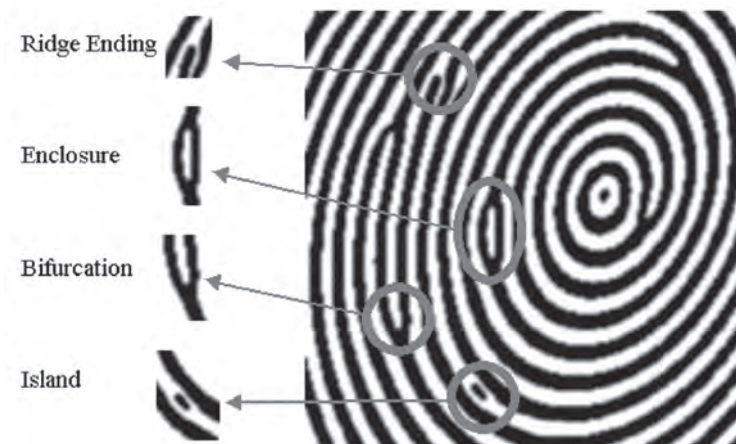
(Source: “Richard Ramirez, the ‘Night Stalker’ Killer, Dies at 53,” [nytimes.com](https://www.nytimes.com))

Assignments

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



2. Examine the fingerprint below carefully. Identify the following fingerprint minutiae.



3. Who created the method of using body measurement for a means of identification?
4. Who instituted a numerical classification system of all fingerprints and what is the basis for determination?
5. Explain the importance of each aspect of the Will West case study and the need for modern biometrics.

6. What are the three components of a fingerprint?
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.
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?
9. Explain what the IAFIS is and how it is used. How is the final fingerprint verification made using this system?
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)

Lab 1: Classification of Fingerprints

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

Exploration

Read the Exploration section for the Classification of Fingerprints lab experiment. Highlight important information or take additional notes as you read. It includes a lot of detailed information on how to read fingerprints.

Materials

In addition to the materials found in your lab kit for this experiment, you will need to supply the following:

- camera
- paper towels
- white paper
- soap

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.

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.

Exploration

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

Materials

In addition to the materials found in your lab kit for this experiment, you will need to supply the following:

- soda can
- camera
- drinking glass
- flashlight
- water bottle
- index card
- mirror
- scissors

- white paper
- paper towels
- Silly Putty or clay, soap, and tape

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.

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.

Exploration

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

Materials

In addition to the materials found in your lab kit for this experiment, you will need to supply the following:

- 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

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.

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.

FOR ENROLLED STUDENTS

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

- Responses to Before You Begin
- Answers to case study questions (case study #2 and #3)
- Answer to lesson questions
- Lab 1: Classification of Fingerprints
- Lab 2: Dusting and Lifting Fingerprints
- Lab 3: Latent Detection Methods
- Optional extra credit: Further Study