Read the Found Prints
A Lab on Fingerprint Analysis

The Mystery of Lyle and Louise
The Mystery of Lyle and Louise:  
Read the Found Prints:  
A Lab on Fingerprints Analysis

National Science Education Standards:

<table>
<thead>
<tr>
<th>Unifying concepts and processes</th>
<th>Systems, order, and organization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evidence, models, and explanation</td>
</tr>
<tr>
<td></td>
<td>Change, constancy, and measurement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science as inquiry</th>
<th>Abilities necessary to do scientific inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Understanding about scientific inquiry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science and technology</th>
<th>Understanding about science and technology</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Science in personal and social perspectives</th>
<th>Science and technology in local, national, and global challenges</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>History and nature of science</th>
<th>Science as a human endeavor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nature of scientific knowledge</td>
</tr>
</tbody>
</table>

Visit Us at:  
www.LyleAndLouise.com
# Table of Contents

- Introduction to Read the Found Prints. ........................................ 5
- Teacher’s Notes ................................................................. 7
- Teaching Timeline ............................................................... 9
- Solutions ................................................................. 11
- Background Information ...................................................... 13
- Glossary ................. 17
- The Investigation ............................................................... 19
- The Evidence ................................................................. 23
- Persons of Interest .......................................................... 24
- Pre-Lab Questions ......... 25
- Classifying Fingerprints Handout ......... 26
- Lab Procedure ......................................................... 29
- Data Collection and Calculations .......... 31
- Post-Lab Questions ......................................................... 32
- Mock Trial ................................................................. 33
A Lab on Fingerprints Anaysis

WELCOME to Read the Found Prints, a fingerprints analysis lab in the Mystery of Lyle and Louise. A brutal murder case is unfolding in a small Appalachian town. Already the case spans two crime scenes and five people are dead. Two of the victims, found in a cabin on Tumbling Water Land Development Company property, are believed to be two of the company’s owners. The third owner, John Wayne Gretzky, has now come under suspicion due to his close ties to the victims and a suspicious bite mark upon his arm. In search of evidence related to the murders, the investigation has expanded to TWLDC offices.

When detectives examine the offices, they find the office safe is empty and hanging open. They process the safe and discover one clear fingerprint upon the door. The print is then lifted and sent back to the lab for analysis.

In this lab, students will learn about the different classifications of fingerprints as well as several fingerprinting techniques, including rolling, dusting and lifting, and comparing and analyzing fingerprints. Then, analyzing the evidence fingerprint and compare it to the fingerprints of Lyle Mondelo, Louise Mondelo, and John Gretzky, students must form a hypothesis about who accessed the empty safe.

Once the lab results have been analyzed, students may conduct a mock trial to hold a suspect accountable for their actions.

Teacher’s notes can be found at the beginning of the manual and copies may be freely made of all materials for your students.
These notes are provided to assist in the preparation and execution of the laboratory experiment. A solutions key for the pre- and post-lab questions can be found on pages 85 and 92, respectively.

**Supplies**

First, inventory the supplies included in the lab kit. Supplies have been provided for up to six groups of students.

- Hinge lifters (30)
- Fingerprinting brushes (6)
- Dusting powder (1)
- Professional fingerprinting ink pads (2)
- Evidence fingerprint from the crime scene (6)
- Fingerprint cards from the suspects (6 sets)

**Other Supplies and Equipment Required**

- Lab gloves
- Overhead transparencies or clear glass surface, such as an available window or glass from a picture frame
- Weigh boat, petri dish, or paper bowl for powder
- Magnifying glass (optional)

**Running the Lab**

During the rolling prints portion of the lab, it is recommended that the teacher set up two fingerprinting stations in the classroom. Two or three students can use one ink pad at the same time. Send several students to roll prints with partners while the rest of the class works on the fingerprint handout. Once the entire class has finished rolling prints, each group can work on examining their prints.

During all print examination lab activities students can refer to the notes, or the teacher can make a list of unique characteristics and patterns on the board for student reference.

During the dusting for prints portion of the lab, students should wear gloves after leaving their print. To use the powder, pour a very small amount into a weigh boat, petri dish, or paper bowl, and have students dip their brush into the powder and shake off excess. Too much powder will obscure the prints.

**Safety Precautions**

1. Fingerprinting ink can be easily removed from hands with hand sanitizer and a paper towel. Soap and water will also work, but hand sanitizer is the quickest method.

**Notes**

Students will need a surface from which to lift prints. The best prints will come from a glass surface or an overhead transparency. It is recommended that teachers give each group a blank transparency so they can press their print to the sheet, then carefully lift one print. If preferred, teachers can also use a square of glass, such as the glass from a picture frame. If none of these options are available, teachers may use windows in the classroom. The dusting powder will easily wipe off of all suggested surfaces. Also, when instructing students on the proper print dusting method, they should be reminded to brush very lightly then gently blow excess dust off of the print so that they can see the quality of their print.
Teaching Timeline

**Groundwork**

Before conducting this laboratory exercise, the details of The Investigation should be shared with the class to provide the context of the crime. Covering this material once should be sufficient for all laboratory modules.

Schedule 1: This lab schedule is designed to take 5 days, with one hour of class time per day.

**Day 1:**

Cover the background material on Fingerprint Analysis. Emphasize unique characteristics and patterns.

Distribute lab procedures and talk about correct technique when rolling fingerprints.

Assign pre-lab questions as homework.

**Day 2:**

Before class, photocopy pages 25 - 27 for student use.

Perform Lab Procedure 1, Part 1.

Since all students cannot roll prints at the same time, students who are waiting to roll and examine their prints should work on the Classifying Fingerprints sheet. This knowledge will help them to easily analyze fingerprints.

Assign remainder of the Classifying Fingerprint handout for homework.

**Day 3:**

Instruct students to follow Part 2 of Lab Procedure 1.

As a class, discuss the patterns and unique characteristics that were found. Discuss the importance of rolling prints correctly for analysis.

Read through the procedures for Lab 2 so students can be prepared for the following day.

**Day 3, after class:**

Ensure that you have a surface for students to dust fingerprints. The best surfaces to use are windows, dry erase boards, or overhead transparency sheets.

**Day 4:**

Perform Lab 2.

**Day 5:**

Instruct students to follow the procedure for Lab 3. Students should complete their data collection sheet. Discuss student theories about the case.

Instruct students to complete the post-lab questions at the end of class or for homework.
Teaching Timeline

Schedule 2: This lab schedule is designed to take 3.5 days, with 1.5 hours per class.

Day 1:
Cover the background material on Fingerprint Analysis. Emphasize unique characteristics and patterns.
Distribute lab procedures and talk about correct technique when rolling fingerprints.
Assign pre-lab questions as homework.

Day 2:
Before class, photocopy pages 25 - 27 for student use.
Perform Lab Procedure 1, Parts 1 and 2.
Since all students cannot roll prints at the same time, students who are waiting to roll and examine their prints should work on the Classifying Fingerprints sheet. This knowledge will help them to easily analyze fingerprints.
As a class, discuss the patterns and unique characteristics that were found. Discuss the importance of rolling prints correctly for analysis.
Assign remainder of the Classifying Fingerprint handout for homework.

Day 2, after class:
Ensure that you have a surface for students to dust fingerprints. The best surfaces to use are windows, dry erase boards, or overhead transparency sheets.

Day 3:

Day 4: (This will not take up the entire 1.5 hours of this day)
Finish Lab 3. Students should complete their data collection sheet.
Discuss student theories about the case.
Instruct students to complete the post-lab questions at the end of class or for homework.
1. What are the three basic categories used for fingerprint analysis?
   
   **Loop, arch, whorl**

2. Describe the pattern of one of the three basic categories.
   
   *Answers will include definitions for loop, arch, or whorl.*

3. What is minutiae? What are some examples of minutiae?
   
   **Characteristics of the ridges. Examples: ridge ending, bifurcation, delta, lake, short ridge, crossover.**

4. What is a known print?
   
   *A print that is collected from the subject, usually by an ink impression or scanning.*

5. What is the most commonly found fingerprint at a crime scene?
   
   **Latent**

6. How do forensic technicians analyze an incomplete print lifted from a crime scene?
   
   *Computer software creates a digital image. The print can be enhanced by removing the background and clarifying the details within the print.*

7. Name one popular classification system.
   
   **Roscher system, Juan Vucetich system, and the Henry classification system.**

8. What is AFIS?
   
   *The Automated Fingerprint Identification System. It automatically searches electronically stored fingerprints and generates a hit list once a fingerprint is scanned.*
Post-Lab Solutions

1. What is the proper technique for rolling a fingerprint? Where do you start and end on each finger?
   Describe process. Rolling from “awkward to comfortable”, pressing lightly, rolling from edge of nail to other edge

2. When rolling prints from your left hand, which way do you roll your fingers and thumb?
   Fingers: Counter Clock-wise, Thumb: Clock-wise

3. Describe the proper technique for lifting a print.
   Describe process. Apply a very small amount of powder to the brush, dust powder lightly across print, press the lifter lightly to the print without rubbing, lift straight up

4. What was the most common unique characteristic you recorded from the fingerprints that you examined?
   Answers will vary.

5. Of all the fingerprints you examined, what was the most common overall pattern?
   Answers will vary.

6. What technique or process did you use when comparing prints to given fingerprint cards?
   Answers will vary.

7. Who did the evidence fingerprint belong to?
   Unknown. The print did not belong to Lyle or Louise. John Wayne Gretzky has been ruled out as a suspect.
FINGERPRINTS are impressions of the friction ridges on the finger that are transferred onto a surface by some substance or by oil and perspiration that naturally exists on the body. Friction ridges exist on finger pads, and the patterns are determined by the dermal papillae (located between the epidermis and dermis layer of the skin). Because these patterns are unique to each individual, friction ridge patterns can be used as a means personal identification.

Fingerprinting has been used in forensic science for over one hundred years, however, there are known documents which show that several different countries, such as China, have used fingerprinting for signing legal documents as far back as three thousand years. In 1880, Henry Fauld was the first to record how the skin ridge pattern could be used as an infallible proof of personal identification. His hypothesis was rejected by the British Government, and, in 1883, the country adopted the Bertillon system instead. This identification system used anthropometry (height, reach, width of head, and length of the left foot) as a means of identification. Sir Francis Galton, a British scientist and statistician, published three texts and a Royal Institution paper that described the anatomy of the finger and fingerprint recording procedures. Galton’s paper also provided convincing arguments, based upon statistical population analysis, that no two prints were identical and that the prints remained unchanged throughout the individual’s lifetime. The British Government later adopted a fingerprint system based on Galton’s work to supplement the Bertillon system. The United Kingdom Fingerprint Bureau was founded in Scotland Yard, a division of the London police, in 1901. In that same year, the US New York City Civil Service Commission adopted the first systematic and official use of fingerprints for personal identification.

One of the most famous cases solved by fingerprint analysis, often called the greatest art theft in the 20th century, occurred when Leonardo da Vinci’s painting, Mona Lisa, was stolen from the Louvre Museum in Paris on August 21, 1911. The suspect left a clear fingerprint on the glass casing. Police officer Alphonse Bertillon spent many months examining a compilation of prints, but no match was found. Two years later, police arrested Vicenzo Peruggia in connection with the crime after determining that his thumbprint matched a print found at the crime scene. In many similar cases, fingerprints have become critical evidence for finding the suspect.

Fingerprints are unique to an individual, and, therefore, can be used as a personal identification. Over the many years of the use of fingerprints in forensic science, no two identical fingerprints have been found. According to Sir Francis Galton, the chance of two individuals having an identical print is 1 in 64 billion. Fingerprints are unique, not because of their shape or pattern, but by the relative locations of the minutiae (characteristics of the ridges). Some examples of minutiae include: ridge endings, bifurcations, lakes, short ridges, islands, and crossovers. Fingerprints will remain unchanged during an individual’s lifetime, although scarring, such as burns or deep tissue damage, may obscure the minutiae. General ridge patterns allow for prints to be systematically classified. The three basic identifying patterns used for fingerprint analysis are loops, arches, and whorls.

Loops appear in sixty to sixty-five percent of the population and are comprised of ridgelines that enter on one side, turn around in a curve, and exit out the same side. The pattern area of the loop is surrounded by two diverging ridges. A loop consists of a core (center of the pattern) and only one delta. This mark looks like the Greek letter delta (△) and is a triangulation, or a dividing, of the ridges. By definition, the existence of a core and exactly one
Fingerprint Analysis

delta makes a pattern a loop. There are two types of loops: loops that open towards the little finger are called ulnar and others that open toward the thumb are called radial.

Arches appear in about five percent of the population and consist of ridgelines that enter from one end and flow out the other side, usually forming a wavelike pattern. Arches have neither a core nor a delta. Any pattern without a delta should be considered to be an arch pattern. Arches are the most simple fingerprint, but they are very uncommon, especially on the little fingers. The arch type is either plain or tented. Plain arches have only a gentle rise, while tented arches have a sharp rise in the center.

Whorls are displayed in thirty to thirty five percent of all prints and consist of ridgelines that are generally rounded in shape and make at least one complete circuit. Any fingerprint pattern that contains

---

### The Henry Classification System

It is necessary for fingerprint analysis to have a method of classification. There are several different classification systems used in the world. The most popular ten-print classification systems include the Roscher system (implemented in Germany and Japan), the Juan Vucetich system (used in Argentina), and the Henry Classification System (used in most English-spoken countries).

The Henry Classification System uses the loops, whorls, and arches approach. The primary classification of the Henry system categorizes ten-print fingerprints into one of the primary groups, with 1,024 possible groups.

As seen in the table below, each finger is numbered from one to ten beginning from the right thumb, numbered one, and ending with the left pinky, numbered ten. Depending on the presence or absence of the whorl pattern, each finger is assigned a value.

If a whorl pattern is present on fingers number one and two they are assigned a value of 16, three and four a value of 8, five and six a value of 4, seven and eight a value of 2, and the last two, nine and ten, a value of 1.

If loops and arches are present they are given the value of 0. Then the odd numbered fingers and even numbered fingers values are summed separately. To the total value of each, odd and even, the value 1 is added. The sum of odd finger value + 1 is divided by the sum of even finger value + 1, which gives the fraction that represents the primary group ratio. On the table, a sample individual has whorl patterns on the right index finger, right ring finger, left index finger, and left pinky. As displayed below, that individual would have a 3:26 (or 3/26) grouping ratio.

<table>
<thead>
<tr>
<th>Assigned Number</th>
<th>R Thumb</th>
<th>R Index</th>
<th>R Middle</th>
<th>R Ring</th>
<th>R Pinky</th>
<th>L Thumb</th>
<th>L Index</th>
<th>L Middle</th>
<th>L Ring</th>
<th>L Pinky</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value (if Whorl is present)</td>
<td>16</td>
<td>16</td>
<td>8</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Example</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Henry Classification Formula**

\[
\frac{\text{Sum of Odd finger value} + 1}{\text{Sum of Even finger value} + 1} = \text{Grouping Ratio}
\]

**Grouping Ratio for Example**

\[
0 + 0 + 2 + 0 + 1 = 3 \\
\frac{16 + 8 + 0 + 0 + 1 + 1}{26} = \frac{26}{26} = 1
\]
at least two deltas will be a whorl pattern. Whorls are very common, especially on the thumb, index, and ring fingers. There are four types of whorls: central pocket loop whirls, plain whorls, double loop whorls, and accidental whorls. Plain whorls consist of one or more ridges that make a complete circuit with two deltas; if an imaginary straight line is drawn from one delta to the other, at least one circular ridge within the inner pattern of the circuit will intersect the line. Central pocket loops consist of one or more ridges that make a complete circuit with two deltas; if an imaginary straight line is drawn from one delta to the other, none of the circular ridges within the inner pattern will intersect the line. Double loop whorls are made up of two separate loops on one fingerprint, with their own set of two deltas. Accidental whorls contain two or more different patterns, but are not arches and are not covered by other categories.

There are four different types of fingerprints: known prints, patent prints, plastic prints, and latent prints. Known prints are deliberately collected from the subject by an ink impression or scanning. There are two types of ink impressions, rolled and flat (also known as plain). Most often the rolled type of impression is used to ensure that all details of the ridges are obtained. A rolled impression of the fingers is taken by coating the finger pad with ink and rolling the finger from one side of the nail cuticle to the other. The thumbs are rolled towards the center of the body (e.g. right thumb is rolled from right to left) and the fingers are rolled away from the center of the body (e.g. the fingers on the right hand are rolled from left to right). Currently, most known fingerprints that are collected by the Government are scanned into the Automated Fingerprint Identification System (AFIS).

Patent (or visible) prints are made by fingers coated with a substance (e.g. blood, ink, dirt). Plastic prints are three-dimensional impressions made in pliable surfaces (e.g. wet paint, wax, soap). Patent and plastic prints can be easily located at a crime scene, as they are easily visible with an un-aided eye. On the other hand, latent prints are invisible to the naked eye and require enhancement that will make the print visible. Latent prints are impressions made by the transfer of natural oil or perspiration that are present on the finger. They are more commonly found at crime scenes than any other prints.

Development of latent prints can be achieved through chemical, powder, lighting, and photographic methods. The method of treatment depends on the surface where the print is located. Prints on non-absorbent surfaces (e.g. mirror, tile, and painted wood) can be developed by treatment with powders or cyanoacrylate (Super Glue). The powder type used varies based upon the background of the print. Some examples are black powder, magnetic-sensitive powder, and fluorescent powder. Super Glue fuming has become a popular test for non-absorbent surfaces. In this test the cyanoacrylate ester in the super glue interacts with a latent print to give it a white appearance.
Fingerprint Analysis

For porous surfaces (e.g. cloth, paper, and cardboard) chemical treatments are utilized, such as iodine fuming, ninhydrin, or physical developer (silver nitrate-based reagent). Iodine fuming is the oldest method used for visualizing latent prints. Iodine crystals are heated in a chamber with the latent print and the iodine fumes that form combine with the oils in the latent print to make it visible. Iodine prints, however, are not permanent and are, thus, quickly documented and photographed. Many new chemical treatment processes are now available. Latent prints may also be developed through fluorescent techniques. Some of the techniques include the use of an argon ion laser (natural fluorescence by components of perspiration and blood), alternate light source, Reflected Ultraviolet Imaging System, and dyes and powders as discussed above. The most widely used fluorescence technique in labs and crime scenes is the alternate light source. An alternate light source is any high intensity light source, other than a laser, that filters the origin light and induces luminescence at the wavelength known to excite the latent print.

After the prints are detected and developed they must be preserved for future inspection and evidence. A photograph is taken before any attempts at preservation are made. If the object that the prints are located on is small, then the object is preserved in its entirety. Conversely, if the object is too large, the prints can be preserved by a lifting technique after the prints have been developed with a powder. The most commonly used type of lifter is a wide adhesive tape, similar to Scotch tape. After the powder has been transferred onto the tape it is placed onto a labeled card that provides a greater contrast with the powder and allows for detailed examination of the print.

Usually, when fingerprints are lifted from a crime scene they are not in a perfect condition making analysis of the print difficult. Photographed or scanned fingerprints from a scene can be inputted into computer software to create a digital image. Through the use of digital imaging, a developed print that is obscured can be further enhanced by removing the background and, thus, clarifying the details within the print. Digital imaging is utilized extensively in forensic laboratories and is especially valuable in examining latent prints.

Currently, many countries use the Automated Fingerprint Identification System (AFIS) to classify fingerprints. AFIS is a computer system that automatically searches electronically stored fingerprints and generates a hit list once a fingerprint is scanned. AFIS has become a successful tool in the capture of many unknown criminals. Through AFIS, finding a matching fingerprint for a single print found at a scene takes only hours instead of months or years.

Fingerprints are among the best and most convincing of all types of physical evidence for identifying people with locations or objects. Although fingerprint analysis can be the key to many unsolved crimes, it is not infallible. Thus, fingerprint analysis must be done conscientiously as there can be great room for error. The AFIS can assist in giving a hit list of potential suspects, but the examiner must still analyze and confirm the potential match.

Most fingerprint experts work under federal agencies, such as the Federal Bureau of Investigation, the Drug Enforcement Administration, the Secret Service, and the Bureau of Alcohol, Tobacco, Firearms, and Explosives. Depending on the specialty, they collect, examine, analyze, compare, and classify using the Henry System, as well as the Automated Fingerprint Identification System (AFIS). Fingerprint analysts also testify in courts to clarify the evidence. As the fingerprint specialist career has advanced, certain professional criterion has been developed. The Latent Print Certification Board of the International Association for Identification (IAI) has developed and administers a certification test for latent print examiners. This certificate sets a standard for the profession. This certification, in addition to a bachelor’s degree, is often required by law enforcement agencies prior to employment.
Glossary

Minutiae: Characteristics of the ridges, which include ridge endings, bifurcations, lakes, short ridges, and crossovers.

Loops: Ridgelines that enter on one side, turn around in a curve, and exit out the same side.

Arches: Ridgelines that enter from one end and flow out the other side, usually forming a wavelike pattern.

Whorls: Ridgelines that are generally rounded in shape, where the ridges make at least one complete circuit.

Known Prints: Fingerprints that are deliberately collected from the subject by an ink impression or scanning.

Patent prints: Fingerprints that are made by fingers coated with a substance, such as blood, ink, dirt, etc.

Plastic prints: Fingerprints that are three-dimensional impressions made in pliable surfaces, such as wet paint, wax, soap, etc.

Latent prints: Fingerprints that are made by the transfer of natural oils or perspiration present on the finger. These prints are more commonly found at crime scenes than any other prints.

AFIS (Automated Fingerprint Identification System): A computer system that automatically searches electronically stored fingerprints and generates a hit list once a fingerprint is scanned.

Quality Prints Diagram

- NOT ROLLED FULLY
- TOO LIGHT
- INK UNEVENLY DISTRIBUTED
- TOO DARK
- ACCEPTABLE
Nine days ago, during the night of a sudden summer thunderstorm, the Mondelo family car went over the side of Backbone Mountain and caught fire on impact. Three bodies were found in the wreckage; an adult woman, a teenage male, and a female child. All were burned beyond recognition. The three victims were identified as Louise Mondelo and her children, Wally and Jan, by personal effects that survived the fire.

Pictures of the scene were recorded but, due to the rainstorm, the crash was initially believed to be simply a tragic accident and was not treated as a crime scene. When Lyle Mondelo could not be reached and was found to be missing, he became a possible suspect, and the wreckage was thoroughly processed. The scene was substantially disturbed and some evidence was undoubtedly lost however, upon retracing the path of the vehicle, investigators found several pieces of broken glass lying in the roadway. Becoming increasingly more suspicious of foul-play, the broken glass fragments were packaged and retained. In addition, investigators cut and removed a section of charred carpet from the vehicle for further laboratory analysis. The bodies, as part of an ongoing criminal investigation, were kept in the county morgue.

The small town of Highland Park was shocked, since nothing this terrible had ever happened in the area. Tips from neighbors and friends poured into the police department, but none of the tips were eyewitness accounts or provided specific information regarding the car accident. Lyle was the likely suspect but was nowhere to be found. An all-points bulletin was issued for everyone to be on the lookout for Lyle Mondelo. He was presumed armed and dangerous and to be driving a missing, blue, 1993 Ford Ranger with Tumbling Water Land Development Co. logos. Four days ago, Lyle Mondelo’s credit card was used to purchase gasoline and food at a gas station in Texas.
The Investigation

When contacted, business associate John Wayne Gretzky told investigators that Lyle had been slipping into a deep depression because of trouble at their jointly owned business, Tumbling Water Land Development Company. Gretzky also hinted that there had been problems in the Mondelo family. At this time, investigators noticed that John had a large bite mark on his upper arm. When asked about the wound, Gretzky claimed to have been bit during a bar fight the night before and allowed the bite to be photographed. He was not held or charged with any crime.

Background Investigation

With no additional leads, policed launched a full investigation into the Mondelos. Louise Wilson and Lyle Mondelo had met at college while receiving Business Degrees in Management. They married in college and moved to Highland Park, Louise’s hometown, after graduation. The town was still ailing at the time, suffering from the shut down of the mines a little over a decade ago. Although at first Lyle thought their business prospects in the small town were poor, he soon discovered that money could be made developing land for the private lodges and ski resorts that employed most of the residents.

After returning to Highland Park, Louise ran into her old high school sweetheart, John Wayne Gretzky. While talking to him, Louise learned that he was also a developer. Glad to see an old friend, and thinking that a favorable business relationship could develop, Louise asked John to meet with her and Lyle over dinner. Lyle and John soon became friends, rather than compete for business against each other, the three decided to join together and start Tumbling Water Land Development Company.

A year after Tumbling Water was founded, Louise conceived her first child, Wally. Friends of the Mondelos said that Lyle suspected Louise of being involved with drugs, but that the friends believed she was involved with John Wayne Gretzky again. Two weeks before the crash, Louise Mondelo filed for divorce. Friends say she told them that she suspected Lyle of being involved with drugs, but that the friends believed she was involved with John Wayne Gretzky again. Two days later after filing for divorce, Louise requested a restraining order against Lyle, stating that Lyle had harassed her and the children. Louise also told police that she was afraid that Lyle might try to take the children away.

Tumbling Water became prosperous and was able to buy several hundred acres of land adjacent to Blackrock River, a prime recreational waterway. Soon thereafter, Louise had another child, Jan, and took leave from the office to work from home while she raised the two children. Friends say that Louise never really went back to Tumbling Water, even after the children were older and in school. Their friends also suggested that Lyle and Louise’s relationship was healthier with them not working together.

Tumbling Waters’ lawyer told investigators that she began preparing bankruptcy papers for the company about a year ago; the ski resort was dragging out negotiations for a property purchase, and the company’s other business deals weren’t making enough profit to keep the business afloat. Soon after being asked to begin the bankruptcy filing, though, she said an unexpected deal was made to build a number of fishing cabins on the Blackrock River land. That was enough to keep the business going, and after that, Tumbling Water began making deals at a steady rate.

A potentially related case recently touched on the Mondelos’ lives. Three weeks ago, a crystal methamphetamine lab was discovered in an abandoned camper on Tumbling Water land. Louise’s nephew, Mitch Wilson, and John Wayne’s brother, Larry Gretzky, were found in the lab and indicted for possession with intent to sell the 6 kilograms of meth found in the lab. Two days later they were both released on bond, posted by Lyle Mondelo and John Gretzky. Mitch and Larry gave no names of possible suppliers or dealers.

When attempting to contact Mitch Wilson and Lar
ry Gretzky for questioning about the car accident, police discovered that they had both skipped town along with Larry’s girlfriend, Mary Bradey. Authorities believed that their disappearance could be related to the accident, and they were described as possibly armed and dangerous in the warrant posted for their arrest.

Two days ago, an abandoned blue Ford Ranger with out-of-state plates was found on a strip of New Mexico highway. The pickup was dirty and a headlight was broken, but investigators noticed a Tumbling Water Land Development Co. sign on the back tailgate. Forced entry was apparent. Upon access to the truck, investigators discovered several pieces of trace evidence and sent it to Highland Park for analysis.

At the Scene

This morning the bodies of two deceased victims were discovered in a remote fishing cabin on property owned by Tumbling Water Land Development Company. The cabin, isolated from view of the main road and deeply buried in the thick woods, lies along the bank of the Blackrock River and is accessible only by a gravel road cutting into the forest. Soon after the bodies were discovered, the small cabin was surrounded by police tape and investigators combing the scene in search of evidence.

Detective Murray, the lead investigator in the case, explained, “A Girl Scout on a hiking trip found the victims about an hour and a half ago. There are two bodies inside, both in advanced stages of decom; PMI undetermined. The female vic was identified as Louise Mondelo, the same woman identified in the car that ran off Backbone Mountain and caught fire during the storm last weekend. The bodies are in bad shape, but hopefully we’ll get a positive ID when DNA analysis comes back.”

Inside the cabin the smell of advanced human decay was overwhelming. The overturned chairs and tables led investigators to conclude that a violent struggle had taken place. The smaller body, dressed in a blouse and jeans, was found near the phone in the kitchen. The larger corpse was dressed in a man’s polo shirt and slacks lying in the corner to the left of the door, and blood covered the walls and floor around him. Investigators collected maggots from the corpses to help establish a time of death and collected DNA samples from both victims. While processing the scene, flesh was discovered scraped across the stone of the fireplace, and blood and skin were found on a piece of firewood lying near the woman’s body. Samples of both were collected for analysis. The wounds upon the head of the female victim appeared consistent with the firewood, but a definitive determination was difficult to make due to the state of decay. Outside of the cabin, a set of tire tracks were found deeply rutted in the mud and grass. As none of the investigators had driven near that area, dental stone molds were cast of the tracks and pictures were taken to preserve evidence.
During the investigation of John Gretzky, the Highland Park detectives visited the office of the Tumbling Water Land Development Company. When they walked through the office, they noticed that the safe is open and empty. Upon looking closer, the detectives found fingerprints on the door of the safe. As the only two people with authorized access to the office safe were Lyle and Louise, all suspicious prints were lifted for further examination.

When questioned, John told the investigators that the safe was always locked when the office was empty and that he did not know the code to open the safe. Fingerprint analysts have determined that all of the prints were left by the same person.
Persons of Interest

The Mondelos

Louise Ann Mondelo, the 38 year old wife of Lyle Mondelo and mother of Wally and Jan, is also one of the owners of Tumbling Water Land Development Company. Friends say that Louise was in an unhappy marriage and had recently filed for divorce.

Lyle Christopher Mondelo, the 40 year old husband of Louise Mondelo and father of Wally and Jan, is a part owner of Tumbling Water Land Development Company along with his wife.

John Wayne Gretzky

John Wayne Gretzky is 41 years old. He is a friend and business partner of the Mondelos in the Tumbling Water Land Development Company. According to rumors, John Wayne and Louise had a brief affair when Lyle and Louise first moved to Highland Park. He is known around town to be a greedy businessman, and has been suspected of shady deals in the past.

Larry Gretzky and Mitch Wilson

Larry Gretzky and Mitch Wilson were recently indicted on charges related to their apparent operation of a methamphetamine laboratory. Larry was bailed out by his brother, John Wayne, and Mitch was bailed out by his uncle, Lyle Mondelo. Larry and Mitch failed to appear in court and are currently missing. Police are interested in locating them for questioning.
Pre-Lab Questions

1. What are the three basic categories used for fingerprint analysis?

2. Describe the pattern of one of the three basic categories.

3. What is minutiae? What are some examples of minutiae?

4. What is a known print?

5. What is the most commonly found fingerprint at a crime scene?

6. How do forensic technicians analyze an incomplete print lifted from a crime scene?

7. Name one popular classification system.

8. What is AFIS?
Classifying Fingerprints

The three major fingerprint patterns are loop, whorl, and arch.

<table>
<thead>
<tr>
<th>LOOP</th>
<th>WHORL</th>
<th>ARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Loop]</td>
<td>![Whorl]</td>
<td>![Arch]</td>
</tr>
</tbody>
</table>

Other fingerprint patterns include:

<table>
<thead>
<tr>
<th>DOUBLE LOOP</th>
<th>TETRARCH</th>
<th>CENTRAL POCKET LOOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Double Loop]</td>
<td>![Tetrarch]</td>
<td>![Central Pocket Loop]</td>
</tr>
</tbody>
</table>

Identify the pattern on the fingerprints below.

<table>
<thead>
<tr>
<th>Pattern:</th>
<th>Pattern:</th>
<th>Pattern:</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Pattern 1]</td>
<td>![Pattern 2]</td>
<td>![Pattern 3]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pattern:</th>
<th>Pattern:</th>
<th>Pattern:</th>
</tr>
</thead>
</table>
Classifying Fingerprints

Bifurcation: The forking, or dividing, of one line into two or more branches.

Core: The approximate center of the finger impression.

Delta: That point on a ridge at or nearest to the point of divergence* of two lines. Resembles a Greek delta (Δ)

*Divergence: The spreading apart of two lines which have been running parallel, or nearly parallel

Short break: Where a ridge stops and starts

Island: Ridges that split and come back together

Ridge end: Where a ridge stops and does not restart

Label the parts on the fingerprints below.
### Blank Fingerprint Card

**APPLICANT**

<table>
<thead>
<tr>
<th>LAST NAME</th>
<th>FIRST NAME</th>
<th>MIDDLE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SIGNATURE OF PERSON FINGERPRINTED**

**ALIASES**

**RESIDENCE OF PERSON FINGERPRINTED**

**DATE OF BIRTH**

**CITIZENSHIP**

**D.O.B.**

**SIGNATURE OF OFFICIAL TAKING FINGERPRINTS**

**SEX**

**YOUR NO.**

**SER.**

**PLACE OF BIRTH**

**FBI No.**

**RACE**

**SOCIAL SECURITY NO.**

**HEIGHT**

**MNU**

**WEIGHT**

**SOC**

**EYES**

**MISCELLANEOUS NO.**

**HAIR**

**FBI**

**LEAVE BLANK**

**CLASS**

**REASON FINGERPRINTED**

**REF.**

**LEFT FINGERS TAKEN SIMULTANEOUSLY**

- L. THUMB
- R. THUMB

**RIGHT FINGERS TAKEN SIMULTANEOUSLY**

- L. THUMB
- R. THUMB
Lab Procedure

Lab 1, Part 1: Rolling Prints

1. Wash hands thoroughly with soap and water and dry completely before beginning. Excessive oil from fingers or water on fingertips will affect the quality of the print.

2. Work in pairs or groups of three. One person will have their prints taken, while another will be rolling their prints. If working in groups of three, allow one person to have their prints taken, and the two other individuals will roll the prints for each hand.

3. Instruct the individual who is having their prints rolled to look away from the fingerprinting pad and paper, not to try to help in the fingerprinting process, and to relax.

4. Hold the individuals right hand at the base of the thumb with your right hand. Cup your hand over the individual’s fingers, tucking under those fingers not being printed.

5. When rolling the thumb in ink, remember that ink should cover the thumb from the edge of the nail to the other and from the crease of the first joint to the tip of the finger. Applying light and even pressure to the thumb, start at the edge of the nail and roll the thumb counter-clockwise (right to left) to the other nail.

6. Repeat this motion on the fingerprinting card. In the R. Thumb box, set down the individual’s thumb at the edge of the nail and roll counter-clockwise across the paper to the other edge. Be careful to lift each finger straight up after rolling to avoid smudging.

7. Repeat these steps for all fingers on the right hand, but change the direction you are rolling. For fingers on the right hand, make sure you are rolling clockwise (left to right) from edge of nail to the other.

8. For the left hand, start again with the thumb and follow the same steps, with the only change being the direction of rolling. When rolling the thumb from the left hand, roll in a clockwise direction. When rolling the rest of the fingers, roll in a counter-clockwise direction.

9. To record prints at the bottom of the card, apply a small amount of ink to the surface of each finger on the right hand. Holding the person’s wrist, simultaneously press their fingers flat on the card without rolling the hand. Additionally, ink a flat print of the thumb.

10. Repeat for the left hand.

Tips:

- Refer to the “Quality Prints Diagram” on the Glossary page for images of poor quality prints.
- Do not apply excessive pressure when rolling a fingerprint! Generally, the weight of the finger is the maximum pressure needed to clearly record a fingerprint.
- When you are having your prints rolled, do not try to help roll your finger or press it down. Look away and allow the other person to do all the work. When a subject tries to “help” with rolling their fingerprints the print is typically smudged or unevenly rolled.
- The direction of rolling is usually considered “awkward to comfortable”. The beginning position of rolling a fingerprint usually feels a little uncomfortable. If it feels comfortable at the beginning the print is likely being rolled in the wrong direction!
- The easiest way to clean ink from your fingers is by using hand sanitizer and a paper towel. Soap and water may also be used, but the ink is unlikely to come off as easily.

Lab 1, Part 2: Examining Prints

1. Once you have completed rolling your fingerprints, carefully examine your fingerprint cards and set them before you.

2. Look for the overall pattern (loop, whorl, or arch).

3. Examine the ridges of the fingerprint itself and look for places where the ridges merge together, split apart, where there is a hook off the main ridge, etc.

4. Fingerprint examiners look for 12-15 unique features per finger. Choose one of your fingerprints and find and record 10 to 12 unique features.

5. The Henry Classification System allows for a logical categorization of ten-print fingerprint records based on pattern types. The Henry System assigns a numerical value to each finger with a whorl pattern. Look at the chart on your Data Collection Sheet to see the values assigned to each finger if it
Lab Procedure

contains a whorl. Determine your Henry Classification number using the appropriate numerical value if a whorl is present. If a whorl is not present assign a zero to that finger. Add up the numbers on the top and the bottom (along with an additional 1 in both the top and the bottom) to get your Henry Classification number.

Lab 2: Dusting for Prints

1. Clean your hands thoroughly with hand sanitizer or soap and water. Make sure to dry your fingers completely.

2. Once fingers are clean and dry, touch your index and middle fingers from each hand to the side of your nose or on your forehead at the hairline.

3. Without touching anything else, press your fingers (the ones you touched to your face) onto a window, a dry erase board, or an overhead transparency sheet.

4. Take your brush and dip it into a small amount of dusting powder in your weighing boat. Lightly tap the brush over a piece of paper so that any excess powder falls off of the brush. NOTE: Excessive powder can contaminate the prints.

5. As lightly as possible, brush a small amount of powder across your fingerprints with short and quick strokes. NOTE: Excessive pressure will wipe away part of the print.

6. Carefully examine the four prints you dusted and select the best print to lift.

7. Peel apart the hinge lifter and press one side to the dusted print. Do not rub the hinge lifter on the print; press gently on the print in one solid motion to adhere to the dusting powder on your print.

8. Pull the tape away from the print in one quick and fluid motion, then carefully press the two ends of the hinge lifter together to preserve your print. Again, be carefully not to rub the print.

9. Write your name at the bottom of the hinge lifter.

10. In your group, trade hinge lifters with another group. Take out your fingerprinting card from the previous lab and fold over the top so that no one can see your name. Trade those with the same group that has your lifted prints.

11. In your group, without looking at the name, try to identify which lifted print matches which card. Look for unique features to help discern between the different prints.

12. Once you have matched the print to the card, examine the prints on the card and the hinge lifters.

13. On your data collection sheet, record at least 12 unique characteristics about your classmate’s fingerprints. If time permits, trade the prints and cards with another student and try to match the lifted prints to cards again.

Lab 3: Examining the Evidence

A print has been lifted from the safe at the office of the Tumbling Water Land Development Company, and investigators wish to identify to whom the print belongs. Detectives have pulled the fingerprint records of Lyle and Louise Mondelo, as well as the fingerprint records of John Wayne Gretzky.

1. Look at the evidence print. Determine the overall pattern.

2. Examine the ridges of the fingerprint itself and record at least 12 unique characteristics about the suspect fingerprint.

3. Next, look at the fingerprint cards of Lyle and Louise Mondelo and John Wayne Gretzky.

4. Use the knowledge you have gained about fingerprint patterns and a variety of unique characteristics to see if the evidence fingerprint matches any of the fingerprint cards.
### Fingerprint Analysis Data Collection Sheet

**My Fingerprints:**

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th></th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class</td>
<td></td>
<td>Class</td>
</tr>
<tr>
<td>Little Finger</td>
<td></td>
<td></td>
<td>Little Finger</td>
</tr>
<tr>
<td>Ring Finger</td>
<td></td>
<td></td>
<td>Ring Finger</td>
</tr>
<tr>
<td>Middle Finger</td>
<td></td>
<td></td>
<td>Middle Finger</td>
</tr>
<tr>
<td>Index Finger</td>
<td></td>
<td></td>
<td>Index Finger</td>
</tr>
<tr>
<td>Thumb</td>
<td></td>
<td></td>
<td>Thumb</td>
</tr>
</tbody>
</table>

Fill in the chart below with your own values and add them together to determine your Henry System score.

```
+1
+1
```

\[ \text{My Classmate’s Fingerprints:} \]

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th></th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class</td>
<td></td>
<td>Class</td>
</tr>
<tr>
<td>Little Finger</td>
<td></td>
<td></td>
<td>Little Finger</td>
</tr>
<tr>
<td>Ring Finger</td>
<td></td>
<td></td>
<td>Ring Finger</td>
</tr>
<tr>
<td>Middle Finger</td>
<td></td>
<td></td>
<td>Middle Finger</td>
</tr>
<tr>
<td>Index Finger</td>
<td></td>
<td></td>
<td>Index Finger</td>
</tr>
<tr>
<td>Thumb</td>
<td></td>
<td></td>
<td>Thumb</td>
</tr>
</tbody>
</table>

**Evidence Fingerprint:**

<table>
<thead>
<tr>
<th></th>
<th>Overall pattern or class:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unique features:</td>
</tr>
</tbody>
</table>
# Post-Lab Questions

1. What is the proper technique for rolling a fingerprint? Where do you start and end on each finger?

2. When rolling prints from your left hand, which way do you roll your fingers and thumb?

3. Describe the proper technique for lifting a print.

4. What was the most common unique characteristic you recorded from the fingerprints that you examined?

5. Of all the fingerprints you examined, what was the most common overall pattern?

6. What technique or process did you use when comparing prints to given fingerprint cards?

7. Who did the evidence fingerprint belong to?
**Mock Trial**

**Using this Kit in the Mock Trial**

Read the Found Prints contains information that could have placed Lyle or Louise Mondelo, or John Wayne Gretzky, at the office for the Tumbling Water Land Development Co. The evidence collected in this lab cannot prove conclusively that any specific person was or was not present at the scene and cannot attest to the actions of that person. If everything in the lab was performed correctly you should have obtained the following information:

- A fingerprint was found on the safe in the TWL-DC office that does not match any of the prints on the 10-print cards for Lyle, Louise, or John.

- This evidence does not prove that John was not present in the office, but the print is not a close enough match to confirm that he was the person who deposited the print onto the safe. A hypothesis may be formed about who performed the crime, but it was not Lyle, Louise, or John.

If Fingerprint Analysis is the only kit done in the Mystery of Lyle and Louise, a mock trial is unlikely to be useful, since prosecution has little evidence to try a suspect. Instead, leave the results as an exercise in fingerprint analysis. If other exercises were performed, a mock trial can help students take all of the evidence presented in the investigation and available from other kits into account and provide a more interesting and thorough trial. Information on running a mock trial follows.

**Before the trial**

If a more thorough social studies activity is desired, students may be instructed to read through the procedures for trial of criminal cases and the simplified rules of evidence. Additionally, lessons designed to familiarize students with the court system and judicial procedure may prove beneficial.

**Brainstorming**

Using the story and module evidence, list the facts of the case on the board.

Determine, as a class, who should be charged for each crime.

Put students into brainstorming groups. Give all groups five to ten minutes to develop hypotheses for each of the following:

1. Identify how each fact may support the case presented by the prosecution.

2. Identify how each fact may support the case presented by the defense.

3. Identify critical weaknesses in the reliability of each fact.

Review the brainstorming results as a class and instruct students to connect various facts and evidence to make logical assumptions about the case.

**Student Roles**

Allow students to select, or assign, various roles relative to the characters.

Additional students may serve as the court, filling the roles of judge, bailiff, and clerk. The judge must research court proceedings and make determinations of law, therefore the instructor may wish to take this role themselves. The bailiff is responsible for swearing in witnesses and keeping order in the court. The Clerk is responsible for recording the trial proceedings. You may wish to omit these roles or have these students work with the prosecution or defense during the planning stages. With large classes, students may also play the role of jury. Ju-
Mock Trial

rors must attend to the trial proceedings and also review the evidence and written documents prepared by the defense and prosecution to come to a conclusion about the case. They must then either meet outside of class and come to a unanimous decision, or each write a short paper justifying their own decision.

At least one student should act as an expect witness (the forensic scientist who processed analyzed the evidence presented); if multiple laboratory modules were utilized, several students should fill this role. This student must be very familiar with the laboratory procedures used to process the evidence and should also be aware of the ways the evidence can be mishandled and the precautions taken against evidence contamination and faulty methods, as these are likely to come up in court.

The remainder of students should split, approximately evenly, into the prosecution and defense teams. The student filling the role of the accused should work with the defense. Each side should assign their members as either lawyers or witnesses called. The lawyers are responsible for building their case, developing the questions to ask their witnesses, and for identifying key witnesses called by the other side to exploit during cross examination. Each side should also identify critical weaknesses in their own case and prepare counter-arguments for these weaknesses. As there are always surprises during trial, each side should prepare strategies to deal with the unexpected.

The prosecution must provide a reasonable series of events that are consistent with the facts of the case, a motive for the events that occurred, and prove beyond a reasonable doubt that the accused is guilty. The defense may present their own accounting of the facts or undermine the prosecution’s case by showing that the prosecution’s witnesses are unreliable, that the prosecution’s version of the events make no sense or is inconsistent, or by introducing reasonable doubt into the prosecution’s case.

Unlike a real trial, witnesses may help the lawyers build their case; their primary duty, however, should be to become intimately familiar with their testimony. Expert witnesses are especially useful when dealing with forensic evidence, and each side may wish to call their own or use the other side’s expert. The students playing the role of expert witness must become very familiar with that field and be able to field questions about the accuracy and limitations of the techniques.

Preparation

To ensure that students will be ready to argue their case, the prosecution and defense should answer the following questions:

1. What are the facts of the case?
2. Why did these things happen?
3. Who was involved?
4. Does sufficient evidence exist to participate in the courtroom?
5. What is key to you proving your point?

Additionally, witnesses should answer the following:

1. To what are you testifying?
2. What are the most important parts of your testimony to the prosecution? The defense?
3. What weaknesses are present in your testimony? If you are an expert witness, what are the limitations of the evidence presented that is relevant to your field?