Blood is a type of biological evidence frequently found at crime scenes that can be used to connect a suspect to a victim or object. Blood stains found at a crime scene can play a large role in eliminating or identifying a person as a potential suspect.

The two major components of blood are plasma and formed elements. 55% of the total blood volume is plasma, the fluid portion of blood, consisting of carbohydrates, lipids, hormones, inorganic salts, serum proteins (such as antibodies), and clotting elements. 45% of the total blood volume is formed elements, consisting of red blood cells (erythrocytes), white blood cells (leukocytes), and platelets. The red blood cells, through the use of a protein called hemoglobin, are responsible for transporting oxygen to the tissues of the body, and, in turn, removing carbon dioxide from tissues. The white blood cells (0.1% of blood volume) play an important role in immune response and antibody production in the lymph nodes. Platelets (3.9% of blood volume) are responsible for initiating and participating in blood clotting.

The two main elements of blood used in forensic labs, with the exception of those performing DNA testing, are red blood cells and serum proteins. On the surface of the red blood cells are chemical structures called antigens that are grouped into systems determined by their relationship to one another. A commonly used antigen group system is the ABO group, which was used until the 1990s for blood typing. Serum proteins, such as antibodies, are frequently used for various tests. An antibody activates or destroys a specific antigen, which allows for particular reactions to occur when certain groups of antigens and antibodies are mixed.

In 1901, Karl Landsteiner discovered that blood could be distinguished by its group, or type, in what became known as the ABO group system. It was not until the early 1970’s, however, that forensic scientists began to utilize these ABO blood groupings for clues that could help link blood to a specific individual. Blood type is considered class evidence because it is not unique to an individual the way that fingerprints are. The 4 blood antigen classifications are AB, A, B, and O. AB means that the blood has both A and B type antigens while O means that the blood has neither A nor B antigens. In addition to these antigens, the Rh factor helps to distinguish blood samples. This is either positive (Rh antigen present) or negative (Rh antigen not present) and appended after the A/B/O indicator, which means that there are 8 possible blood types (AB+, AB-, A+, A-, B+, B-, O+, O-).

Blood types vary greatly within the human population, but the rates of occurrence correlate strongly with race. Although blood typing can help link an individual to blood evidence, there are better ways to match an individual to a blood sample.

<table>
<thead>
<tr>
<th>Type</th>
<th>African</th>
<th>Asian</th>
<th>Caucasian</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>O+</td>
<td>47%</td>
<td>39%</td>
<td>37%</td>
<td>53%</td>
</tr>
<tr>
<td>O-</td>
<td>4%</td>
<td>1%</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
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</tr>
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<td>0.1%</td>
<td>1%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

In 1984 Alec Jeffreys and his colleagues at Leicester University discovered that certain portions of the DNA structure of some genes (DNA markers) are as unique to an individual as fingerprints. Researchers have since developed different variations of the original Jeffreys technique. These new techniques are called DNA profiling, or DNA typing. Forensic labs favor DNA analysis over ABO blood typing because it allows investigators to identify the person to whom the blood belongs. Blood detection tests are still performed in the field to identify a substance, but DNA analysis is the preferred confirmatory test once the substance has been identified as blood.

One of the most sensational cases involving DNA typing of blood evidence was the O.J. Simpson case.
Blood Detection

On June 12, 1994, Nicole Brown Simpson and Ronald Goldman were murdered in an alley near O.J.’s home. A five drop blood trail was found near the bodies, and three additional blood stains were identified on the rear gate of O.J.’s Ford Bronco. These stains were collected, and analysis revealed that the blood belonged to O.J. Simpson. Results indicated a one out of fifty-seven billion statistical chance that Simpson was innocent.

When an investigator is confronted by a stain that looks like blood at a crime scene, it is difficult to know for certain that the stain is blood. After careful documentation, the investigator may quickly identify blood through a presumptive test at the scene. These tests are called presumptive because if a test result is negative, blood is absent, but if a test result is positive, blood is presumed to be present. As numerous compounds may cause false positive reactions, a confirmatory test must be performed following a positive presumptive test. Confirmatory tests provide much more accurate results, but take longer to perform and require samples to be sent to a lab for analysis.

Presumptive tests are based on the peroxidase-like activity of hemoglobin contained in red blood cells. Peroxidases are enzymes that quicken the oxidation of a number of classes of organic compounds. There are two categories of presumptive tests: those that change color and those that cause a glowing reaction. In color change presumptive tests, a sterile swab is moistened with distilled water and placed in contact with a small sample presumed

<table>
<thead>
<tr>
<th>Presumptive Test</th>
<th>Indication of Positive</th>
<th>Situation Used</th>
<th>Reagents</th>
<th>False Positives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenolphthalein (Kastle-Meyer Test)</td>
<td>Bright pink color</td>
<td>On visible stains</td>
<td>Reduced phenolphthalein (phenolphthalin), hydrogen peroxide, in alkaline medium</td>
<td>Vegetable material (e.g. potatoes and horseradish)</td>
</tr>
<tr>
<td>Tetramethylbenzidine (TMB) / Hemastix</td>
<td>Green to blue-green color</td>
<td>On visible stains / Field tests</td>
<td>TMB, hydrogen peroxide, in acetic acid medium TMB, diisopropylbenzene dihydroperoxide, buffering material</td>
<td>Oxidizing agents, catalyst, and vegetable peroxidase Cosmetic substance</td>
</tr>
<tr>
<td>Luminol</td>
<td>Blue-white to yellowish green light</td>
<td>Latent blood</td>
<td>Luminol, sodium carbonate, sodium perborate</td>
<td>Plant enzymes, oxidizing agents, metals, and chlorine</td>
</tr>
<tr>
<td>Fluorescein</td>
<td>Fluoresce with alternate light source</td>
<td>Latent blood, vertical surface</td>
<td>Reduced fluorescein (fluorescin), hydrogen peroxide</td>
<td>Copper, hypochlorite</td>
</tr>
</tbody>
</table>
to be blood. A drop of both a presumptive reagent and hydrogen peroxide is then added to the swab. An immediate color change indicates the possible presence of blood. Alternatively, a presumptive test may be performed by placing a thread or fragment of the dried material on a spot plate and adding the above reagents as in the swab test.

When performing the presumptive test, a substrate control test is required which will confirm that the test result is not brought about by the material that the stain was on. This is done by taking a swab of the original, unstained surface (as close as possible to the stain) and adding all similar reagents as the non-substrate control swab. Results for all presumptive tests must be recorded immediately before the sample is oxidized by air exposure, as this may result in a false-positive reading.

A phenolphthalein test, better known as the Kastle-Meyer test, is now one of the most frequently used presumptive color tests. In a positive reaction, reduced phenolphthalein will turn bright pink in an alkaline solution. This occurs because the phenolphthalein is oxidized by hydrogen peroxide in the presence of hemoglobin. Phenolphthalein reagents, however, have been known to give false positives when vegetable materials are present. As a result, after the evidence is collected and transported to the lab, a confirmatory test is performed.

The Hemastix test is another commonly used presumptive test for blood. This test is performed with commercial Hemastix strips, plastic strips with a reagent-treated filter paper at one end. Tetramethylbenzidine (TMB), the reactive reagent on Hemastix strips, is another well-known presumptive reagent. This, product designed as a urine dipstick test, has been adapted to be used in the field for the detection of blood. To perform this test a swab is moistened with distilled water and placed in contact with the stain. The swab is then placed onto the tip of the dipstick; if blood is present, the Hemastix strip will turn green.

In some cases bloodstains can not be seen under normal lighting and viewing, such as a stain that has been cleaned up by the suspect. Therefore, before performing any tests, a high intensity light source is used to detect latent bloodstains. If a stain cannot be visualized with a light source, Luminol or Fluorescein tests may be used.

Luminol is highly sensitive, and is known to detect blood that has been diluted up to 1 in 10,000,000 times, unless a solvent such as bleach was used. It works similar to other color tests in that Luminol and an oxidizer (hydrogen peroxide) are applied to the bloodstain. This results in the oxidation and chemiluminescence of Luminol, producing a blue-white to yellowish green light when the treated area is darkened. Although the Luminol reagent is known to negatively impact some serologic testing processes, it does not affect most subsequent blood typing or DNA analysis. Still, the dilution of blood through the use of Luminol can make some genetic analyses difficult, and Luminol has been known to produce false positive results with plant enzymes, oxidizing agents, metals, and chlorine.

Fluorescein has been used to detect blood since as early as 1910. Reduced Fluorescein (fluorescin) is applied to a suspected stain and will fluoresce when an alternate light source is used. Unlike Luminol, Fluorescein is capable of revealing bloodstains that have been cleaned using solvents such as bleach. Additionally, Fluorescein is thicker than Luminol and, therefore, can be applied to vertical surfaces.
Blood Detection

It is crucial that bloodstains found at a crime scene are documented, collected, tested, preserved, and analyzed correctly, as failure to perform each task properly can weaken or destroy potential evidence. The testing procedure is designed to reveal if the stain is blood, whether it came from an animal or human, and, if it is of human origin, how closely the blood can be linked to an individual.

The results of the presumptive test can assist the investigator in collecting the bloodstains. If the test was negative, only two or three samples from the stain must be collected. Investigators collect the stain sample by, preferably, transferring the whole item, or extracting the blood using one of several methods. The most common method involves taking a sterile, moistened swab or thread and rolling/swabbing the bloodstain. The swab or thread is then completely dried and placed in a paper bag, envelope, or box. Another well-known method is tape lifting the bloodstain. Fingerprint tape can be taken and used to carefully lift the bloodstain, which is then placed on vinyl acetate backing.

Proper evidence packaging is crucial to protect against loss, contamination, deterioration, cross-transfer between the samples (suspect/scene/item/victim), and biohazards.

All biological materials must be completely dried and placed in their own separate, correctly labeled, paper bags. Plastic bags are only used for transporting moist blood evidence for no more than two hours. If moist biological evidence is left in any plastic container there is a great possibility of microorganism growth which may alter the evidence, degrade DNA, and/or inhibit future testing. Collected bloodstains should be refrigerated, unless the bloodstain was found in soil, then it should be frozen so that microorganisms present will not degrade the DNA.

The evidence collection bags must be labeled properly with a description of the evidence, the source location, agency, chain of custody, case/item numbers, health hazards, and storage conditions (room temperature, frozen, refrigerated). The protocols for evidence collection are very detailed and beyond the scope of this manual, however, it is important to remember that evidence which is improperly collected may be suppressed in court, which may cause the case to be dismissed.

After the evidence is collected and transported to the lab, a confirmatory test must be performed. Confirmatory tests are often microcrystalline tests that are based on the formation of hemoglobin-derived crystals under heated conditions. Microcrystalline tests involve the addition of specific chemicals to blood so that crystals with hemoglobin derivatives will be formed. This crystal formation is then observed microscopically. The two most common confirmatory tests are the Takayama and the Trichmann tests.

The Takayama test is performed by the addition of an alkaline solution with a specific structure of hemoglobin to the stain on a microscope slide. If blood is present, pink crystals will be observed as the slide is heated. The Trichmann test is performed by adding a small amount of chloride-containing glacial acetic acid to the stain on a microscope slide, and, if blood is present, small crystals are observed as the slide is heated. As with presumptive tests, the analysis of controls, specifically a positive control, is required for comparison.

Once a stain has been confirmed as blood, the forensic serologist must determine whether it is of human or animal origin. The standard test used in this determination is the precipitin test. The precipitin test is characterized by the formation of a precipitate due to an antibody that reacts with its corresponding antigen. Human antiserum, containing antibodies that specifically react with human antigens, reacts with human blood to form a precipitate.

Following the identification and characterization of the bloodstain, it must be analyzed to associate it to a particular individual. Blood factors, such as the ABO group, or DNA typing can assist in linking a bloodstain found at a scene to an individual.
Though forensic scientists currently have various tests that can be used to detect and analyze blood, advancements are continually being made. Blood is a complex system and scientists are constantly discovering new information and techniques to handle this evidence.
The Mystery of Lyle and Louise

GROUP SYSTEM WHICH HAS BEEN WIDELY USED SINCE THE EARLY 40'S. THIS SYSTEM USES BLOOD TYPE TO LINK BLOOD TO AN INDIVIDUAL. THIS SYSTEM HAS NOT BEEN WIDELY USED SINCE THE 1990'S.

Confirmatory Tests: These tests are often microcrystalline tests that are based on the formation of hemoglobin-derived crystals under heated conditions. A confirmatory test would prove the presence of blood, but it is much more costly and time-consuming than a presumptive test.

DNA Typing: A classification system that has been predominantly used since the 1990's. It is based on research that proves that certain portions of the DNA structure are as unique to an individual as fingerprints. This system can accurately link one person to a blood sample.

Formed Elements: Formed elements make up forty-five percent of the total blood volume. The formed elements are red blood cells, white blood cells, and platelets.

Plasma: Plasma is the fluid portion of blood which makes up fifty-five percent of the total blood volume. Plasma consists of carbohydrates, lipids, hormones, inorganic salt, serum proteins (such as antibodies), and clotting elements.

Red Blood Cells: Red blood cells are responsible for transporting oxygen to the tissues of the body and removing carbon dioxide from the tissues.

Presumptive Tests: These tests can confirm the absence of blood with a negative result. A positive result indicates the probable presence of blood, but, due to false positives, a positive presumptive test result must be confirmed with a confirmatory test.
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 Mystery of Lyle and Louise

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, police 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, and 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 and John of having an affair at the time, and the two nearly divorced. The couple worked out their relationship with the help of a marriage counselor.

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.

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.

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 decomp; PMI undetermined. The female victim 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.
An abandoned, blue Ford Ranger bearing the Tumbling Water Land Development Co. logo was found in New Mexico with its gas tank completely empty. As the New Mexico authorities examined the truck for potential evidence, they found suspicious smudges on the driver’s side floor. At first glance, the smudges appeared to be mud, but upon closer examination, one investigator noted that he could see traces of a reddish substance mixed in with the mud. Therefore, thinking the stain could possibly be blood, he photographed the evidence and removed the suspected area of carpet to allow it to be examined at the lab.
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 Mondelo’s 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.

An unknown woman of similar height and build has been identified as Louise Mondelo. Although her identity is uncertain, this other woman was found either driving the Mondelo family car with two children preliminarily identified as Wally and Jan, or in a remote fishing cabin with a man who has been preliminarily identified as Louise’s husband Lyle Mondelo.
Pre-Lab Questions

1. What are the two major components to blood?

2. What test did forensic scientists use to link blood to an individual until the 1990’s?

3. What test is now used extensively to link blood to an individual?

4. Why are blood detection tests still important in current investigations?

5. How do investigators find bloodstains that are not immediately visible under normal lighting?

6. Why are presumptive tests performed before confirmatory tests?

7. If a presumptive test has a positive result, can investigators guarantee that blood is present?
Lab Procedure

Lab 1: Presumptive Testing for Blood

1. Prior to performing presumptive tests on the evidence from the pickup truck, you will practice the presumptive tests using some positive controls, as well as some substances which also can give a positive result. Wear gloves when handling these chemicals.

2. Cut each card in half in the middle of the stain. This will allow you to repeat the experiment in case there is any confusion about the results.

3. Place the card half on top of a blank sheet of paper so that the reaction may be easily noted.

4. Add one drop of distilled water to the cotton swab and rub it into the stain upon the control card.

5. Add one drop of phenolphthalein solution to the cotton swab. If any color change occurs at this point then the reagent is contaminated and the test should be considered invalid.

6. Add one drop of the hydrogen peroxide solution to the cotton swab.

7. A pink color should appear between 30 seconds and three minutes to indicate that the dried material is most likely blood.

8. If a pink color is not observed or appears after three and a half minutes have passed, the test is considered negative.

9. Record your results on your Data Collection Sheet.

10. Test all substances on the provided cards in the manner stated above, recording predictions and reactions of each one.

11. Test other teacher-provided substances in the same manner, adding the water, phenolphthalein, and hydrogen peroxide. Observe and record the reactions. HINT: If additional substances are to be tested, tests may be performed upon both ends of the provided cotton swabs. Compare your shade of pink to the swab from the positive control card if you are unsure if you are getting the right color to indicate a positive result.

Lab 2: Processing the Evidence

1. Obtain your evidence from your teacher, signing and dating in the appropriate location on the Chain of Custody portion of the Evidence label.

2. Carefully cut open your evidence, opening it at an end that is NOT sealed by evidence tape.

3. Examine your evidence. Measure the stain and record several detailed observations about your evidence, including size, shape, color, and any other pertinent details.

4. If available, use a digital camera to take three or four pictures of the evidence from different angles.

5. If available, use a magnifying glass to look closely at the carpet square for other materials on the fabric.

6. Sketch the evidence noting at least two areas of the stain to be tested upon your sketch.

7. Take a cotton swab and wet it with distilled water. Rub the cotton swab onto the first area of the stain to be tested.

8. Perform the presumptive test on the cotton swab. Add one drop of phenolphthalein and observe the reaction. Add one drop of the hydrogen peroxide solution. A pink color should appear between 30 seconds and one minute to indicate that the dried material is most likely blood. If a pink color is not observed or appears after three minutes have passed, the test is considered negative.

9. If possible, take a picture of the color change observed.

10. Repeat the test on the sample from another part of the stain.

11. Determine whether the substance on your evidence is blood.

12. Complete your Data Collection sheet.

13. When you have reached a conclusion, return your stain to the evidence wrapper and reseal it.
Lab 1:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Prediction: Positive or Negative?</th>
<th>Lab Observations (color of development, time to see pink)</th>
<th>Lab Result: Positive or Negative?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Control</td>
<td></td>
<td></td>
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<tr>
<td>Negative Control</td>
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<td>Substance #1</td>
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<td>Substance #2</td>
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</table>

Lab 2: Record 4 or 5 physical details about evidence:

________________________________________________________________________

________________________________________________________________________

Draw a sketch of your evidence. Include measurements.

<table>
<thead>
<tr>
<th>Description of evidence and the results you see.</th>
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<tbody>
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</tbody>
</table>
Post-Lab Questions

1. What did you observe when you tested the positive control card?

2. What did you observe when you tested the negative control card?

3. What common food items provided a false positive in the presumptive blood test?

4. Why do police officers perform a presumptive test in the field? Based on your experiments, why is it important to do a confirmatory test later?

5. What did you learn about correctly processing evidence? Why is this procedure important?

6. What did your group conclude about the stain on the carpet? Did your test detect the presence of blood?

7. Based on your knowledge of the crime(s), what is your hypothesis about the events surrounding the substance on the carpet of the truck?
Using this Kit in the Mock Trial

Stained with Suspicion contains information that could prove that there was blood mixed in with the mud in the truck. The evidence collected in this lab cannot prove conclusively that any specific person was present and cannot attest to the actions of that person. If everything in the lab was performed correctly you should have obtained the following information:

- The test performed upon the controls and other items should identify the different substances that may produce a false positive with the Kastle Meyer test. The test performed on the evidence should prove that blood was presumed to be present upon the carpet in the truck.
- The evidence does not prove that the blood in the truck came from the victims in the cabin, however, it is compelling that blood somehow ended up on the floor of an abandoned truck. Foul play could be involved.

If Blood Detection 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 blood detection analysis and evidence processing. 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 expert witness (the forensic scientist who processed and 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?