Assignments:

1. Forensic Files: The Wilson Murder, Analysis Worksheet
2. Blood Spatter Notes: Continued
3. Crime Case Studies
   a. Case Study #1
   b. Case Study #2
4. Bloodstain Practice
5. Lab #8 Distance Falling v. Surface Texture (Optional)
6. Lab #9 Direction of Travel and Angle of Impact
7. Three ‘Messy’ Blood Spatter Experiment (Optional)
8. Case Study: Unconvincing Circumstantial Evidence; Worksheet
9. Blood Detection Notes
10. It’s No Use Trying to Hide Blood … Worksheet
11. Forensic Files: Naked Justice; Questions
12. Case Study: Which Neighbor is a Killer? Worksheet
13. Case Study: The Death of Tammy’s Parrot Questions
14. Bloodstain Pattern Analysis Lab Quiz
FORENSIC FILES: The Wilson Murder

Instructions: Watch Forensic Files The Wilson Murder, and complete the Forensic Files analysis worksheet.  
https://www.youtube.com/watch?v=VXHFSHqwLmQ

1. What was the crime?
   Type of Crime:  
   Location:  
   Time/Year:  
   Victim(s):  
   Suspect(s):  

2. Use the chart to keep track of the evidence.

<table>
<thead>
<tr>
<th>Evidence</th>
<th>What did it tell investigators about the crime?</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

3. Which pieces of evidence were most important? Why?

4. What was the outcome of the case?
Blood Spatter Notes-Continued

Instructions: Take NOTES. Notes are available on google classroom under Unit 6-Blood Spatter 2

Spatter Pattern and type of Wound

• _______ Velocity Impact (_____ ft/sec) – _________-mist spatter pattern

• Size of Droplets – less than 1 mm
  – Ex. _______________________

• _________-Velocity Impact (_____ ft/sec)
  – Size – 1-4 mm
  – Ex. = _______________________

• _________-Velocity Impact (_____ ft/sec)
  – Size – 4 to 6 mm
  – Ex – blunt object impact (________________, ____________, etc)

Point of origin Angle of Impact

Examination of Directionality of Blood

• Shape provides clues to ___________________________ from which blood
  ________________________________
  – ____________________ drop (width _____ length) – fell straight down
    • Typical of dripping _____________ (passive)
  – ________________ drop (width _____ length) – possible to determine direction blood was
    ______________________
• When blood comes into contact with another surface, it adheres or __________ to it
  – Point of impact may appear __________ and __________ than rest of drop of blood spatter
• _______________ – keeps blood moving in direction it was traveling
  – As droplet moves ______ from source, it __________ and may produce a thinner, __________-like appearance
  • _______ points in direction of blood’s movement
  • _______________ or _______________ drops may appear in __________ of moving droplet of blood

This is the TAIL

ANGLE of IMPACT - the __________ angle formed between the __________ of the blood drop and the plane of the surface it __________.

\[
\sin \theta = \frac{W}{L} \quad \rightarrow \quad \text{get __________ angle of droplet from } W \text{ and } L\]
Angle of Impact (AOI) Calculations

- accurately measuring the _______ and ________ of a bloodstain, the impact angle can be calculated using the SIN ____________ below:

\[ \text{AOI} = \sin^{-1} \frac{W}{L} \]

- W – Width of blood drop
- L – Length of blood drop

**EXAMPLE**

Finding AOI

Calc the AOI

LENGTH = 5.9cm

WIDTH = 2.6cm

**SOLUTION:**

\[ \text{AOI} = \sin^{-1} \frac{2.6}{5.9} \]

AOI = \sin^{-1} (.44)

AOI = 26.2°
Lines of Convergence

- _________ of source can be determined if there are at least _________ drops of blood spatter.
- __________________ – found by drawing straight lines down the long axis of blood spatter and noting where they ____________
- ________ view of the location of the source

Point of Origin

- lies at a point in space _____________ the point of convergence.
  - Measurement of the impact angle allows for translation of the 2-D image _____________ into a 3-D one _____________.
1. First measure the ________________ from ______ blood stain along its central axis to the POC (distance = y)

2. Then take the TAN of the ______________ AOI.

3. Third, ________________ the TAN of the AOI by the _______________

4. Measure that ___________ from the floor up the ________________ axis and you will arrive at the Point of Origin (PO)

**FORMULA:** \( \text{PO} = \text{TAN} \ (\text{AOI}) \times y \)

---

**EXAMPLE**

**Finding PO**

**GIVEN:**

DISTANCE FROM BLOODSTAIN (to POC): 90cm
AOI (calculated from AOI formula): 30°

**SOLUTION:**

\[ \text{PO} = \text{TAN} \ (30°) \times 90 \text{cm} \]
\[ \text{PO} = 0.577 \times 90 \text{cm} \]
\[ = 52 \text{cm} \]

---

1. Falling directly to floor @ ________________ angle will produce circular drops, with secondary satellites being more produced in the surface hit is textured. – known as a ______________ fall.
2. _______________ spurts or gushes typically found on walls or ____________ are caused by the pumping actions of the __________.

3. Splashes are shaped like exclamation points. The shape and position of the spatter pattern can help locate the position of the victim at the time of attack.

4. Smears are left by the bleeding victim depositing blood as he or she touches or brushes against furniture or walls.

5. Trails of blood can be left by a bleeding victim as he or she moves from one location to another. The droplets could be round or smeared or even appear as spurts.

6. Pools of blood form around a victim who is bleeding heavily and remains in one place.
Unit 5: Body Fluid Evidence

**Crime Case Studies: Blood Spatter Evidence**

Name: ___________________________ Date: ___________________________

**Case Study #1**

Late one night a 911 emergency operator received a frantic phone call from a female named Susan Wordsworth stating that “...her boyfriend had fallen down the stairs and hurt himself”. When paramedics arrived they found a 45 year-old advertising executive named Phil Bordman lying unconscious at the bottom of the stairs in his condo. Shortly, thereafter he is pronounced dead and the police are called to the scene. Police find a large pool of blood at the bottom of his stairs, while the following bloodstain patterns were found on a wall near the top of the stairs.

![Bloodstain Pattern]

Phil’s sister reported talking to him on the phone around 4:00 pm that day. He told her that he was going to end his relationship with Susan that evening. When Susan was questioned about this, she explained that she and Phil had spent an uneventful evening watching TV and made no mention of a breakup. She also said that Phil was going downstairs to get something to eat when she heard him yell, followed a few seconds later by a loud thud. She thought that he must have accidentally slipped and hit his head on the railing as he fell down the stairs. When police check the stair railing for blood they find nothing.

Using this story & diagram and your knowledge of blood spatter evidence, do you think Phil’s death was an accident? Explain why or why not.
Case Study #2

On April 30th, 1984, police rushed to a local farm after getting a frantic 911 call from Graham Backhouse. When they arrived he could barely stand, as he had several deep cuts on his face and left shoulder. Laying on the ground several feet in front of Backhouse’s back door lay his neighbor, Colyn Bedale-Taylor. Colyn had died from two gunshot wounds to his chest. Bedale-Taylor had a large knife in his hand at the time.

Graham said that Colyn had tried to murder him with the knife, and that after he had fought him off he frantically fled down the hall to get his gun while bleeding from the initial attack. Colyn continued to pursue Graham down the hall with his knife even after Graham told him he was getting his gun. Because Colyn kept coming after him, Graham told police he had no choice but to shoot him twice. Afterwards, Graham called the police. Police found the following blood spatter evidence in Graham’s hallway floor and by his gun case...

From this story & diagram and your knowledge of blood spatter evidence, do you think Graham killed Colyn Bedale-Taylor in self-defense? Explain why or why not.
Bloodstain Practice

Instructions: Complete the worksheet

1. Calculate the angle of impact for the bloodstains below:

2. What may have caused this type of stain?
Below is lab #8 it is **not required for you to do**, however you may find it enjoyable and this a hands on activity may give you a better understanding of Blood Spatter Analysis. Encourage a family member to help you. Additionally, be innovative on how to complete the lab and creating your own “blood like substance.”

Below are other recipes to create fake blood; especially since the instructions ask for paint and you may not have paint. This recipe calls for materials you may have in your kitchen.

**FAKE BLOOD**

**YIELD:** Makes about 1 cup

**INGREDIENTS**

- 3/4 cup corn syrup
- 1/4 cup water
- 1/2 teaspoon red food coloring
- 5 drops blue food coloring
- 2 drops green food coloring
- 1 tablespoon corn starch

**PREPARATION**

In a small bowl, whisk together the corn syrup and water. Add the red, blue, and green food colorings and whisk until well combined. Whisk in the corn starch and let the liquid sit for 10 minutes to thicken.

**Realistic Fake Blood**

The Spruce Crafts / Rain Blanken

For a realistic look, the blood needs to have more color than pure red. A corn syrup base gives this recipe a good thickness, but it is also sticky.

**Mix Together**

- 2 tbsp Corn syrup
- 4 drops of red food coloring
- 1 tsp cocoa mix

**COMPLETE LAB #9**
Lab #8 – Distance Falling v. Surface Texture

The size, shape, location, number, and distribution of blood spatter, if examined properly, can help you determine valuable reconstruction information. The following exercises will allow you to experiment with various aspects of bloodstain pattern analysis.

You will need:

- a blood-like substance: mix 2 tablespoons of red tempura (washable) paint with 2 tablespoons of water
- eyedropper
- a ruler or tape measurer
- 5 different surfaces: coffee filter, typing paper, newspaper, counter top, paper towel, tile floor, scrap of fabric, etc.
- a helper

Directions:

1. Fill the eyedropper with the paint mixture.
2. Hold the eyedropper above the first surface. Have your assistance measure a distance of 3 inches between the eyedropper and the surface.
3. Release a single drop of the liquid and let it fall to the target.
4. Repeat steps 1 and 3 at least four more times. Drop two from heights under 48 inches and 2 from over 48 inches. Each drop should be on a different surface.
5. When each drop has dried, measure and record the diameter of the stain.

Evaluate the collection methods by answering the following questions:

<table>
<thead>
<tr>
<th>Drop #1:</th>
<th>Surface Type</th>
<th>Height</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop #2:</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Drop #3:</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Drop #4</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Drop #5:</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
</tr>
</tbody>
</table>

On a piece of graphing paper, graph the distance falling versus the diameter for each bloodstain.

How does surface texture affect the size and shape of a bloodstain?

Record observations of the bloodstain’s edges on the five target surfaces.

Surface #1:

Surface #2:

Surface #3:
Surface #4: 

Surface #5: 

How does the distance of a blood source from its target surface affect the appearance of a bloodstain? Record your conclusions:

Lab #9: Direction of Travel and Angle of Impact

By analyzing the direction of travel and angle of impact of the following bloodstains, you can determine important elements of reconstruction.

You will need:

- a colored pen or marker
- a calculator with the sine function
- a ruler with millimeters

9A: Direction of Travel

Evaluate each of the four bloodstains below. With a colored pen draw an arrow in the direction from which each of the four bloodstains were spattered.
9B: Angle of Impact

Now that you have identified the direction of travel for each bloodstain, calculate the angle of impact. The angle of impact of a bloodstain can be determined by measuring its length and width. The length and width are applied to a trigonometric formula:

\[
\text{Sine of impact angle} = \frac{\text{width of bloodstain}}{\text{length of bloodstain}}
\]

Here's an example:

\[
\frac{12}{18} = 0.667
\]

\[
\sin^{-1}(0.667) = 42^\circ \text{ Angle of Impact}
\]

Record your calculations and the impact angle below:

Bloodstain 1: width: ________  length: ________  angle of impact: ________

Bloodstain 2: width: ________  length: ________  angle of impact: ________

Bloodstain 3: width: ________  length: ________  angle of impact: ________

Bloodstain 4: width: ________  length: ________  angle of impact: ________
The lab below is not required for you to do, however you may find it enjoyable and this a hands on activity may give you a better understanding of Blood Spatter Analysis. Encourage a family member to help you. Additionally, be innovative on how to complete the lab and creating your own “blood like substance. There are additional recipes to make fake blood listed on page 11 of this packet.

This lab is messy so complete in an area that has easy clean up, and use paper to cover for protection. Additionally, wear attire that is dark in color or you do not mind staining.

The conversion for meters to feet is 1 meter = 3.28084 feet. If you do not have a protractor you can use the link provide below to make a paper protractor (for angles do your best and estimate).

https://www.google.com/search?q=making+a+protractor&rlz=1C1CHBF_enUS895US896&oq=making+a+protractor&aqs=chrome..69i57j0l7.79778j0j7&sourceid=chrome&ie=UTF-8#kpvaibxe_K227XryMfDrL1QGrp5iQGc38

Three ‘Messy’ Blood Spatter Experiments

Name: __________________________ Date: ______________

In this activity you will discover how distance, angle and velocity create distinctive blood spatter patterns.

Be forewarned and be prepared! There is a strong likelihood that you will get ‘simulated blood’ either on your skin or clothing. It is strongly recommended that you wear ‘old clothes’ to class on the day you conduct these experiments or pick a ‘brave soul’ in your lab group who doesn’t mind getting messy in the name of science!

Materials: simulated ‘blood’ see ‘recipe’ below: cornstarch, corn syrup, red & green food color, white glue, eyedropper, two large pieces of paper or cardboard, tape, meter stick/measuring tape, a protractor, baseball bat, tennis ball, large sponge, large ball or coconut or type of melon, pie plate, safety goggles, latex gloves, lab apron/old clothes.

Simulated Blood Recipe

- Add 4 tablespoons of cornstarch to 2/3 cup of water and mix thoroughly.
- Add 2/3 cup of corn syrup and mix well again.
- Place 3 tablespoons of this mixture in a dish and add 3-5 drops red food coloring.
- Add a few drops green food coloring to reduce pinkish color. If too light - add more red food coloring. If too pink - add more green food coloring.
  (Keep in mind: blood is dark red/reddish brown).
- Add white glue, starting with 1-2 teaspoons, to keep the mixture from becoming too transparent. Check flow by stirring and rapidly raising your spoon. A good batch of simulated blood has a heavy, watery look as it is stirred.
- Add additional corn syrup or white glue as needed to even out the entire effect.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Experiment #1: Free Falling Blood Spatter Evidence at Various Distances

-> Get a simulated blood sample and allow a single drop to fall onto a large piece of paper at each of the following distances: 1 meter, 2 meters, 3 meters.

-> In the space below, draw and label a diagram of the stain that is left behind by each ‘simulated blood’ droplet.
**Related Questions:**

1. Create a single statement that draws a conclusion about this experiment.

2. How could the information from this experiment help the forensic scientist in a criminal case?

---

**Experiment #2: Blood Spatter Evidence at Various Angles**

-> Get a simulated blood sample and drop a single drop onto a large piece of cardboard/paper at each of the following angles: $90^\circ, 50^\circ, 30^\circ, 10^\circ$. Use a protractor for this and ensure that each angle is relative to the ground.

-> In the space below, draw and label a diagram of the stain that is left behind by each 'blood' droplet.

---

**Related Questions:**

1. Create a single statement that draws a conclusion about this experiment.

2. How could the information from this experiment help the forensic scientist in a criminal case?
Experiment #3: Blood Spatter Evidence at Various Velocities/Force

Warning!
This is a very messy demonstration - be careful!

-> Get a large sponge and soak it thoroughly with simulated blood. Place this 'blood' soaked sponge on a pie plate on the ground. Create a cylinder from large pieces of paper and place around pie plate.

-> Have someone drop a tennis ball onto the sponge in center of pie plate. Have them hit it with as much force as you can. You can hit it once or twice, but no more.

-> Repeat this again - replace the paper cylinder around pie plate & add more 'blood' to sponge, however this time the blood-soaked sponge should be hit using a large ball or coconut.

-> In the space below, draw and label a diagram of the blood stain that is left behind by each type of blow.

Related Questions:

1. Create a single statement that draws a scientific conclusion about this experiment.

2. What does the blood-soaked sponge represent in this experiment?

3. How could the information from this experiment help the Forensic Scientist in a criminal case?
**Instructions: Read the following Case Study and complete the worksheet that follows**

**Unconvincing Circumstantial Evidence**

On the evening of May 21, 1939, the dead body of a widowed 64-year-old man named Walter Dinivan was found in his living room. The murderer had attempted to strangle Walter, but when this failed they killed him by crushing his skull with a hammer.

Investigation of the crime scene revealed that a large sum of money had been stolen from a small safe owned by the victim. In the victim’s kitchen, an unknown fingerprint was found on a drinking glass. In the victim’s living room, a crumpled brown paper bag was found on the floor soaked in the victim’s blood. As well, numerous cigarette butts found in the living room were collected and analyzed since it was determined Walter Dinivan did not smoke. Tests upon the cigarette butts revealed that the smoker had blood type AB+.

When family and acquaintances of the victim’s were interviewed, someone by the name of Joseph Williams came to the interest of police. Williams had told police that he had been angry with Dinivan as he had refused to give him a small loan of cash. Interestingly, a background check on Williams revealed that days after Walter Dinivan had been murdered, Williams had paid off part of a debt he owed the bank. Williams refused to provide a sample of his fingerprints and since there was no solid evidence against Joseph Williams he could not be forced to cooperate.

Without any other suspects, police decided to keep Joseph Williams under surveillance. One night when Williams went into a pub the police investigator who had asked him for his fingerprints went into the pub to speak to him. The police officer gave Williams the impression that he was there for a social call as he bought him a drink and some cigarettes. At the end of the evening, the investigating officer gathered the ashtray containing all of Williams’ cigarette butts. Analysis of these butts indicated that Williams was blood type AB+.

Joseph Williams was brought in for questioning in the hopes that the evidence that they had collected thus far would lead Williams to confess. Williams did not confess, however, he did allow police to search his home. The only thing that investigators found of significance was a large stash of brown paper bags that were identical to the bag found in the victim’s home. When Williams was confronted with this, he angrily denied the allegation that he murdered Walter Dinivan and offered to give police his fingerprints. Williams’ right thumbprint matched the unknown print found in Dinivan’s home.

Joseph Williams was finally arrested and put on trial for the murder of Walter Dinivan. Williams pleaded not guilty and his defense lawyer convinced the jury all the evidence found was purely circumstantial (Identified evidence). The jury found John Williams not guilty of the murder charge.

Sadly, shortly after the verdict was announced, a drunken Joseph Williams confessed to a local reported he had in fact murdered Walter Dinivan. The reporter did not reveal this confession until after Joseph Williams had died in 1951.
WS: Unconvincing Circumstantial Evidence: Related Questions

Multiple Choice: (5 points)

1. The blood type of the killer could be determined from the cigarette butts found at the crime scene because the___.
   a. blood found was a very rare blood type
   b. saliva found indicated the killer was a secretor
   c. blood from the killer was found upon the victim
   d. DNA from both the killer and victim was present

2. Why was the determination that the killer of Walter Dinivan had blood type AB+ an important piece of evidence?
   a. No other blood type could be determined.
   b. Only 3% of the population has this blood type.
   c. No fingerprints were found at the crime scene.
   d. Over 42% of the population has this blood type.

3. The police were able to prove that Joseph Williams had type AB+ blood from the___.
   a. saliva on his used cigarette butts
   b. DNA sample he was required to give
   c. fingerprint found upon a drinking glass
   d. blood sample he voluntarily gave police

4. After Joseph Williams initially denied any wrongdoing, what did he volunteer to give police investigators?
   a. His blood.
   b. His fingerprints.
   c. A polygraph exam.
   d. A psychological exam

5. Who revealed that Joseph Williams confessed to the murder after he was acquitted in court?
   a. A reporter.
   b. His lawyer.
   c. His mother.
   d. An ex-girlfriend.

Written Response: (2 points)

6. If this crime had occurred today, explain what technology could have been utilized to prove that Williams was guilty? (1 point)

   ________________________________________________________________

7. Identify the piece of evidence this technology could have been used upon. (1 point)

   ________________________________________________________________
**Numeric Response:** (4 points)

*Use the following information to answer the next question.*

**Types of Physical Evidence**
1. Identified
2. Individualized

8. Identify the type of physical evidence from above, with the crime scene evidence found at Walter Dinivan’s home, as given below. (4 points)

<table>
<thead>
<tr>
<th>Type of Evidence:</th>
<th>Brown paper bag</th>
<th>Cigarette butts</th>
<th>Payment on bank loan</th>
<th>Fingerprint on glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Blood Detection**

*Instructions: Take NOTES. Notes are available on google classroom under Unit 6-

**Luminol**
- Used to find ________ blood & _________ stains.
- _________ in the dark on contact with blood.
- The Luminol test for blood was developed by ________________ of Germany in _____.
- **Luminol is sensitive in the parts per ______________ range even for blood ________ old.**

Thus, If you have ___ drop of blood in 999,999 drops of ______, Luminol will glow!!

**Drawbacks**
- Luminol ______ up blood during its reaction and thus ____________ ________________!
- Other popular crime scene materials like ____________ and ______________ react – Further blood testing is a ________!
  The glow of _______ fades quickly, but the glow of _______ lasts longer.
  ___________ can tell if they have blood or something else.

**Phenolphthalein**
- Phenolphthalein is an ________________ compound with the formula ________________
- Physical: White Powder, ________________ in water, ________________ in alcohol.
- Chemical: Acid/base indicator, laxative.
- Human blood pH 7.35 (acid or base?)
- In pH 8.2-12 (_______)

* it turns colorless in acidic solutions and pink in basic solutions.

This link shows a Phenolphthalein Test: https://www.youtube.com/watch?v=ZvhN9DDm9iI

**Hydrogen peroxide**
- What do you use Hydrogen peroxide on/for?
• Why the bubbles?

Leucomalachite green

Malachite green is an organic compound that is used as a dyestuff and controversially as an ______________ in aquaculture. Malachite green is traditionally used as a _____ for materials such as silk, leather, and paper.

Below is a link to further describe Leucomalachite green
https://www.youtube.com/watch?v=9_fsHnkn02U

This link shows a Leucomalachite green Test:
https://www.youtube.com/watch?v=HMvmEEDSYTM

Benzidine

• Used in making Dyes and _______________ blood stains
• Benzidine has been linked to _______________ and _______________ cancer

Below is a link to further describe Benzidine:
https://www.youtube.com/watch?v=z9osQAM9rjk

This link shows a Benzidine Test:
https://www.youtube.com/watch?v=nWbPhP4OiM

All of these are presumptive test, meaning the analysis of “a sample to establish one of the following:

1. The sample is definitely not a certain substance.
2. The sample probably is the substance.

For example, the Kastle–Meyer test ‘(Phenolphthalein Test)’ will show either that a sample is not blood or that the sample is probably blood but may be a less common substance. Further chemical tests are needed to prove that the substance is blood.

Confirmatory tests are the tests required to confirm the analysis. Confirmatory tests cost more than simpler presumptive tests so presumptive tests are often done to see if confirmatory tests are necessary.”
https://en.wikipedia.org/wiki/Presumptive_and_confirmatory_tests
Unit 5: Body Fluid Evidence

It’s No Use Trying to Hide Blood...

The science of chemistry will be the focus of this section as Forensic scientists use various chemical tests to confirm the presence of blood. There are a variety of chemical tests that can be used by to identify blood, but only the two most two popular methods will be examined in this section. Answer the related questions after you’ve read the information below...

PHENOLPHTHALEIN: Confirming That It Is Blood

Trying to clean up every trace of blood after a violent crime can be next to impossible - especially if there was a great deal of blood. Often criminals will think that they have sufficiently cleaned up a room, but end up missing minute amounts of blood spatter. Forensic experts are aware of this and as a result one of the first things they will often do at a crime scene is to simply bring in a powerful light. This powerful light then can be used by investigators to find any small traces of dried blood that may be left at a crime scene. Dried blood will appear a deep burgundy or brownish-black in color. If an investigator does find a suspicious stain - no matter how small - a photograph is taken followed by a chemical test which is performed to confirm that it is indeed blood and not something else.

One chemical test that is used by many Forensic scientists involves the use of a PHENOLPHTHALEIN reagent test. Phenolphthalein reagent reacts in the presence of hemoglobin, which is found in all red blood blood cells. (Hemoglobin is a large quartenary protein in all red blood cells that carries O2 & CO2 to and from the lungs to body cells). In addition to carrying gases, hemoglobin breaks down any toxic hydrogen peroxide (H2O2) that builds up in the red blood cell.

Hydrogen peroxide is broken down into hydroxide ions (OH⁻), which are negatively-charged polyatomic ions. During a phenolphthalein test the two hydroxide ions (created by hemoglobin) are attracted to the hydroxide ions found in the colorless phenolphthalein. This produces water (H2O) and oxidizing phenolphthalein which is now a bright pink color. This chemical reaction is outlined below:

\[
\begin{align*}
1. & \quad H_2O_2 + \text{hemoglobin} \rightarrow 2 (OH^-) \\
& \quad \text{(in red blood cells)}
\end{align*}
\]

\[
\begin{align*}
2. & \quad 2 (OH^-) + C_{20}O_{4}OH \rightarrow C_{20}O_{4} + 2 H_2O \\
& \quad \text{phenolphthalein} = \text{colorless} \quad \text{oxidized phenolphthalein} = \text{bright pink}
\end{align*}
\]

If an unknown stain at a crime scene is suspected to be blood, a Forensic Investigator will take a Q-tip swab dipped in a phenolphthalein reagent, place it upon the stain in question and then look for a bright pink color to occur. This will indicate that it the substance is indeed blood. This chemical test is very popular for two reasons: it is fast and sensitive - it can detect blood at 1 part to 5 million. In other words, if there is one drop of blood in a container of 999, 999 drops of water, phenolphthalein will react quickly to produce a bright pink color.
Worksheet: It's No Use Trying to Hide Blood...

Name: ___________________________ Date: ___________________________

RELATED QUESTIONS...

1. After the commission of a violent crime, will a thorough cleaning of all surfaces previously covered in blood help to hide this type of evidence? Explain.

2. How & when is phenolphthalein used by Forensic scientists in the analysis of blood?

3. Police suspect that there was a violent murder committed inside a house and that the culprit cleaned up after the attack before burying the body. Suggest possible areas within the house that investigators could check for small traces of blood that the culprit may have missed while cleaning up.

4. State two reasons why phenolphthalein is often used by Forensic investigators.

5. Why does luminol work better on dried blood rather than 'new/fresh' blood?

6. Explain why investigators may spray a crime scene with HCl before using luminol.

7. Describe the steps that investigators would typically take when working with luminol at a crime scene.

8. Explain why luminol is NOT considered to be 100% accurate all of the time. Use three examples to justify your response.
FORENSIC FILES: Naked Justice

Instructions: Watch Forensic Files Naked Justice and answer the following questions.
https://www.youtube.com/watch?v=kDUdOAzK06U

1. What did investigators use to determine how far away the gun was when it was fired?

2. Where is the gun usually found when people shoot themselves?

3. True or false: The blood in Leann’s palm is consistent with a self inflicted gunshot.

4. True or false: People who have just fired a gun should have gunshot residue on their hands.

5. True or false: Phenolphthalein is a type of chemical test to identify blood.

6. What was found on Mick’s shirt cuff?

7. True or false: High velocity blood spatter can be created when a gunshot wound hits an area with blood and the fine mist of blood blows back toward the gun.

8. What did investigators use to find where Leann was when she was shot?

9. Why couldn’t the wound be self-inflicted?
Instructions: Read the following Case Study and complete the worksheet that follows

Which Neighbor is a Killer?

On April 30th, 1984, police rushed to a local farm after getting a crazed 911 call from Graham Backhouse. When they arrived, Graham Backhouse could barely stand as he had several deep cuts on his face and left shoulder. Lying dead on the ground in front of Backhouse’s back door was his neighbor, Colyn Bedale-Taylor. Colyn had died from two gunshot wounds to his chest and he had a large knife in his hand.

Graham said that Colyn had tried to murder him with the knife and that after he had fought him off he frantically ran down the hall to get his gun while bleeding from the initial attack. Colyn pursued Graham down the hall with his knife even after Graham told him he was getting his gun. Because Colyn kept coming after him with the knife, Graham told police he had no choice but to shoot him twice in self-defense. After Backhouse had shot and killed Colyn, Graham called police. Officers found the following blood spatter evidence on the floor of Graham’s hallway:
Extended details of case:
Backhouse attempted to kill his wife with a bomb that was planted in their car. The bomb was made of two sections of metal pipe, threaded with a detonator. The powder of 12 shotgun shells had been used as the explosive and it had been packed with around 4,000 lead pellets. It had been aimed upward through the driving seat.

9th April 1984, Margaret Backhouse climbed into the driver's seat of her Volvo. When she turned the ignition key, the car exploded. She was left with severe injuries to her buttocks and legs. The police suspected that the intended victim was husband Graham. He told officers that he was the victim of a hate campaign and that a sheep's head had been stuck on a fence at the farm along with a note that read 'You next.' Backhouse was given 24 hour police protection.

18th April 1984, Backhouse requested that the 24 hour guard be removed following the fitting of a 'panic button in his house. The alarm system was connected to the local police station and on 30th April it was activated.

When the police arrived, they found the body of Colyn Bedale-Taylor, the 63 year old neighbour of Backhouse, who had died from a shotgun blast to the chest. In his hand was a Stanley knife. Backhouse was discovered lying in the lounge drenched in blood from knife wounds to the face and chest. His story was that Bedale-Taylor had arrived and told him that he had come to repair some furniture. When being told that there was no furniture to repair he had accused Backhouse of being responsible for the death of his son in a car crash in 1982. He then told Backhouse that he was responsible for planting the car bomb and attacked Backhouse with the Stanley knife. Backhouse had run back into the house and grabbed a gun. When Bedale-Taylor had refused to back off, he had shot him.

February 1985, Backhouse appeared at Bristol Crown Court charged with murder and attempted murder.

The forensic investigation had shown that Backhouse’s wounds had been self-inflicted and that Bedale-Taylor could not have been holding the knife when he died. His right palm was covered with his own blood, which could only have happened after he was shot and when he was not holding the knife.

The prosecution showed that Backhouse had debts of £70,000. Until March 1984 his wife had life insurance cover of £50,000 but this was increased by a similar amount. It was alleged that Backhouse had tried to kill his wife for the insurance money and, when that failed, he attacked Bedale-Taylor to shift police investigations away from himself. The jury preferred the prosecution version.

Monday 19th February 1985, after nearly six hours deliberation the jury found Backhouse guilty of both charges. He was given two life sentences.

Graham Backhouse died in prison in 1994.

http://www.murderuk.com/one_off_graham_backhouse.html
WS: Which Neighbor is a Killer?

Multiple Choice: (5 points)

1. Graham Backhouse claimed that Colyn Bedale-Taylor had attacked him with a(n) _____.
   a. ace
   b. gun
   c. knife
   d. shovel

2. How did Colyn Bedale-Taylor die?
   a. Lack of oxygen to the lungs.
   b. Two stab wounds to the heart.
   c. Blunt force trauma to the head.
   d. Two gunshot wounds to the chest.

3. The blood spatter evidence found in the hallway of Graham Backhouse's indicates that the blood had_____.
   a. broken up due to great force
   b. partially dried and then been smeared
   c. free fallen from a slow moving individual
   d. dropped from an individual short in stature

4. It is unlikely that Graham Backhouse had been pursued by Colyn Bedale-Taylor in the hallway because the blood spatter residue was_____.
   a. not circular
   b. not smeared
   c. too small in size
   d. too large in diameter

5. What type of blood spatter pattern should have appeared near Colyn Bedale-Taylor if Graham Backhouse had shot him in self defense as he claimed?
   a. A free falling blood spatter pattern.
   b. A partially dried blood spatter pattern.
   c. A high-velocity projected blood spatter pattern.
   d. A medium-velocity projected blood spatter pattern.
Numeric Response: (1 point)

Use the following photo to answer the next question.

**Blood Spatter Residue Pattern on Floor of Graham Backhouse’s Hallway**

![Blood Spatter Pattern](image)

**Types of Blood Spatter Patterns**
1. Free falling
2. Partially dried
3. High-velocity impact
4. Medium-velocity impact

6. From the list above, identify the type of blood spatter pattern from above that was found in the hallway of Graham Backhouse’s home. (1 point)

   Type of blood spatter found in the Backhouse hallway: __________

**Written Response:** (4 points)
7. Identify and describe two types of blood spatter residue patterns that should have appeared in the hallway of the crime scene according to Graham Backhouse’s statement to police. (4 points)

   ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________
Instructions: Read the following Case Study and answer the related questions.

The Death of Tammy’s Parrot
A Fictional Crime Case Study

Police received a hysterical phone call from an individual named Tammy Ingland who says her ex-husband tried to kill her during an argument. Tammy was well known to the police as the type of person who engaged in ‘attention-seeking behavior’ as she has a history of making prank calls to the police. However, despite Tammy’s long history, police officers must take this call seriously because the possibility exists that she could be in danger.

When police officers arrived at Tammy’s apartment they discovered Tammy lying on the floor, though she was not seriously injured. A large volume of blood was found smeared all over Tammy’s hands, upper body and on many of the walls in her apartment. After looking through Tammy’s apartment a police officer discovered a parrot that had been stabbed to death. When asked about this parrot, Tammy began sobbing saying that her ex-husband killed her parrot after he assaulted her.

Officers became suspicious of Tammy’s story after close examination of her injuries by paramedics indicated that she had only a few small superficial cuts on her face and lower arms. Also, neighbors interviewed revealed that they had not seen Tammy’s ex-husband around the apartment in over a month and that they did not near any loud arguing from the apartment on the day in question.

Related Questions  answer these questions

1. Why did police become suspicious of Tammy’s story after discovering she had only a few superficial cuts on her lower arms? (2 pts)

2. What was the most probable source of the majority of blood smeared upon Tammy and on her apartment walls? (1 pt)

3. Why could microscopic analysis of the blood smeared at this crime scene help to identify the source? (2 pts)

4. All the red blood cells in the blood samples from the Tammy Ingland crime scene are nucleated. Knowing this information, briefly describe what most likely occurred at Tammy Ingland’s apartment before she called the police. (3 pts)
Bloodstain Pattern Analysis Lab Quiz

Multiple Choice

1. The amount of spatter from a blood droplet falling on a non-porous surface is _____ that of a drop of blood of equal size falling from the same distance onto a rougher, porous surface.
   a. the same as  b. less than  c. greater than

2. The pointed end of a bloodstain always faces _____.
   a. opposite its direction of travel  b. toward the direction from which the force came
   c. in its direction of travel  d. toward the position of the blood source

3. What characteristic will a blood droplet deposited at an angle of impact of about 90 degrees (i.e., directly vertical to the surface) exhibit?
   a. acute elongation (extremely elongated)  b. a tail showing the directionality
   c. elliptical in shape  d. approximately circular in shape

4. The pressure of the pumping of oxygenated blood out of an injury causes bright red colored blood to spurt out and form what pattern?
   a. cast-off  b. passive  c. arterial spray  d. Both b and c

5. A trail pattern leading away from the victim at a stabbing scene was most likely created by what?
   a. A victim’s arterial wound.  b. Blood dripping from the murder weapon or suspect.

6. Which of the following is important in the interpretation of bloodstain patterns?
   a. The direction of impact.  b. The surface texture.
   c. The angle of impact.  d. The amount of blood.  e. All of these.

7. Rough surfaces usually result in stains with what type of spatter?

8. What type of impact spatter would create a pattern consisting of large, separate drops with diameters of 5 millimeters?
   a. Low-velocity spatter  b. Medium-velocity spatter
   c. High-velocity spatter  d. Both a and c

9. Generally, bloodstain diameter _____ as height increases.
   a. decreases  b. remains unchanged
   c. increases  d. increases lengthwise, decreases widthwise
Bloodstain Pattern Analysis Lab Quiz

10. In general, as both the force and velocity of impact increase, what happens to the diameter of the resulting blood droplets?
   a. Increases  
   c. Decreases  
   b. Stays the same.  
   d. The diameter is unaffected by force and velocity.

11. Droplets of ____ are very small. They may not travel far and could be overlooked.
   a. High-velocity spatter  
   c. Medium-velocity spatter  
   b. Transfer patterns  
   d. Low-velocity spatter

True (A) or False (B)


13. The presence of bubbles of oxygen in hydrogen peroxide drops can differentiate blood from other types of stains.

14. Blunt force trauma is normally associated with medium-velocity spatter.

Matching

15. Angle of Impact
   a. An impact spatter pattern created by a force traveling at 100 ft./sec. or faster and producing droplets with diameters of less than 1 mm.
   b. An impact spatter pattern created by a force traveling at 5–25 ft./sec. and producing droplets with diameters between 1 mm and 4 mm.
   c. The acute angle formed between the path of a blood drop and the surface that it contacts.
   d. An impact spatter pattern created by a force traveling at 5 ft./sec. or less and producing droplets with diameters greater than 4 mm.
   e. A characteristic bloodstain pattern containing spurts that result from blood exiting under pressure from an arterial injury.

16. Arterial Spray
17. Medium-velocity spatter
18. Low-velocity spatter
19. High-velocity spatter

Matching

20. luminol
   a. This substance is a color test for blood. It turns pink in the presence of a base.
   b. This substance, though a good test for blood, is rarely used due to its being classified as a carcinogen.
   c. This substance produces bubbles when it comes into contact with the enzyme catalase found in blood.
   d. This substance causes blood to glow a faint blue.
   e. This substance, widely used by the FBI, turns green when it reacts with hemoglobin in the blood.
21. phenolphthalein
22. hydrogen peroxide
23. leucomalachite green
24. benzidine