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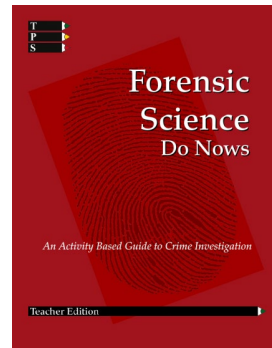
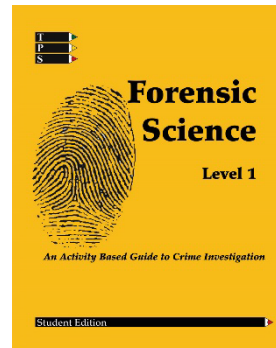
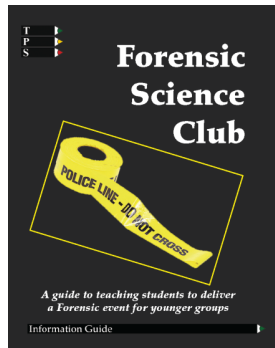
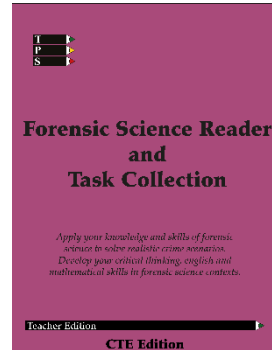
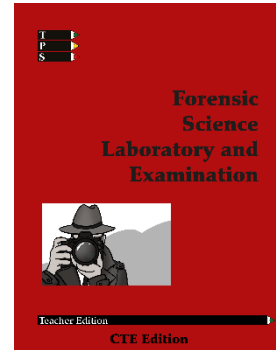
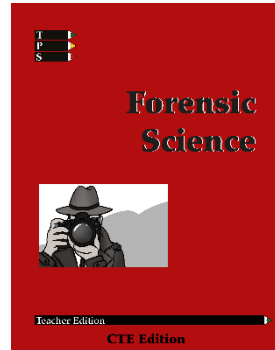
**Follow the link above and when prompted enter User ID & Password.
You will then be asked to agree the terms of the review before being presented with the menu.
Each course has its own sub-menu.**





A Forensic Science Program with a difference

Students learn best by doing



The program includes:

- Teacher /Student textbook
- Teacher /Student Laboratory and Examination Guide
- Teacher/Student Reader/Task Collection
- Student journal with write in pages, required annually
- Assessment generator
- Interactive software assessment tool
- Teacher PowerPoints



Scope and Sequence and Pacing Plan

The Teacher textbook edition includes the scope and sequence and pacing plan. These images show a section of each.

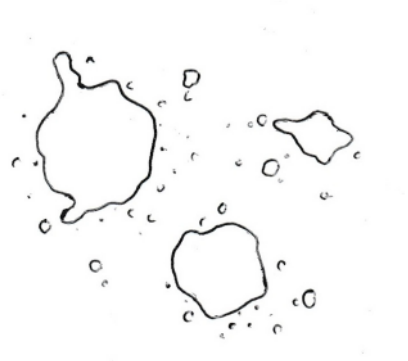
| TEXAS ESSENTIAL KNOWLEDGE AND SKILLS – FORENSIC SCIENCE – SCOPE AND SEQUENCE | | | |
|--|--|--|---|
| Key: C = Combined textbook, L = Lab and Exam guide, R = Reader | | | |
| Unit 6-8 | #Class Periods | Texas Essential Knowledge and Skills – Forensic Science | Textbook reference |
| <p>Career, History and Ethics</p> <p>The student explores the history of forensic science.</p> <p>The student analyzes legal aspects within forensic science.</p> <p>The student explores career options within forensic science.</p> | <p>8 class periods of 50 mins each</p> <p>+ 2 for Lab activities</p> <p>+ 2 for Reader activities</p> <p>+ 1 for online assessment</p> <p>(13 of 150 for year)</p> | <p>(6) The student explores the history of forensic science. The student is expected to (A) analyze the historical development and current advancements of different forensic science disciplines such as forensic biology, anthropology/odontology, forensic chemistry, trace evidence, ballistics, fingerprints, digital forensics, and questioned documents (B) explain significant historical and modern contributions to the development and advancement of forensic science made by contributors such as Edmond Locard, Mathieu Orfila, Francis Galton, Idwin Henry, and Alec Jeffreys.</p> <p>(7) The student analyzes legal aspects within forensic science. The student is expected to (A) summarize the ethical standards required of a forensic science professional (B) identify and explain knowledge of terminology and procedures employed in the criminal justice system as they pertain to the chain of custody procedures for evidence (C) identify and explain knowledge of terminology and procedures employed in the criminal justice system as they pertain to open witness testimony (D) research and discuss the effect of biases such as confirmation bias and framing cognitive bias on evidence collection, forensic analysis, and expert testimony (E) compare the admissibility of expert witness testimony in terms of the Frye Standard and the Daubert Standard under federal rules of evidence.</p> <p>(8) The student explores career options within forensic science. The student is expected to (A) explore and describe discipline-specific requirements for careers in forensic science, including college course requirements, licensure, certification, and physical and mental capabilities (B) differentiate the roles and responsibilities of professionals in the criminal justice system, including forensic scientists, crime scene investigators, criminologists, court systems personnel, and medicolegal death investigators (C) differentiate the functions of various forensic science disciplines such as forensic biology, forensic chemistry, trace evidence, ballistics, fingerprints, digital forensics, and questioned documents.</p> | <p>TEKS 6A + B - History of Forensic Science - C p128</p> <p>TEKS 7A - Ethical Standards - C p132</p> <p>TEKS 7B + C - The Chain of Custody and Expert Witnesses - Section 1 - C p137</p> <p>TEKS 7B + C - The Chain of Custody and Expert Witnesses - Section 2 - C p139</p> <p>TEKS 7D - Biases in Forensic Science - C p143</p> <p>TEKS 7E - Standards in Evidence Law - C p149</p> <p>TEKS 8A - Forensic Science Career Requirements - C p155</p> <p>TEKS 8B + C - Forensic Science Careers - C p163</p> <p>TEKS 6A, B, 7A, B, C, 8B, C - Career, History and Ethics - L p142</p> |
| Unit 9 | #Class Periods | Texas Essential Knowledge and Skills – Forensic Science | Textbook reference |
| <p>Procedure for Evidence Collection</p> <p>The student recognizes the procedures of crime scene investigation while maintaining scene integrity.</p> | <p>7 class periods of 50 mins each</p> <p>+ 2 for Lab activities</p> <p>(9 of 150 for year)</p> | <p>(9) The student recognizes the procedures of crime scene investigation while maintaining scene integrity. The student is expected to (A) explain the roles and tasks needed to complete a crime scene examination, which may require collaboration with outside experts and agencies, and demonstrate the ability to work as a member of a crime scene team (B) develop a detailed, technical written record based on observations and activities, documenting the crime scene examination (C) discuss the elements of criminal law that guide search and seizure of persons, property, and evidence (D) conduct a primary and secondary systematic search of a simulated crime scene for physical evidence utilizing search patterns such as spiral, line, grid, and zone (E) generate a physical or digital crime scene sketch, including coordinates or measurements from fixed points, compass directions, scale of proportion, legend key, heading, and title block (F) demonstrate proper techniques for collecting, packaging, and preserving physical evidence found at a crime scene while maintaining documentation, including chain of custody.</p> | <p>TEKS 9A - The Crime Scene Team - C p169</p> <p>TEKS 9B - Written Records - C p175</p> <p>TEKS 9C - Search and Seizure - C p181</p> <p>TEKS 9D - Search Patterns - C p188</p> <p>TEKS 9E - Photographic and Audiovisual Documentation - C p192</p> <p>TEKS 9F - Crime Scene Sketches - C p198</p> <p>TEKS 9G - Physical Evidence - C p205</p> <p>TEKS 8B, 9A, C, D, F, G - Procedure for Evidence Collection - L p197</p> |

| STEAM into Forensic Science - Pacing Plan/Year Planner | | | | | | | |
|---|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|----------|--------|------------------------|
| <div> <div>T P S</div> <div> <div>2025</div> <div>March</div> </div> </div> | | | | | | | |
| MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY | SUNDAY | |
| 24 | 25 | 26 | 27 | 28 | 01 | 02 | Texas Independence Day |
| 03 | 04 | 05 | 06 | 07 | 08 | 09 | |
| Unit 17 | Unit 17 | Unit 17 | Unit 17 | Unit 17 | | | |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
| Unit 17 | Unit 17 | Unit 17 | Unit 17 | The vision, assessment, and research | | | |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | |
| Revision, assessment, and research | Revision, assessment, and research | Revision, assessment, and research | Unit 18 | Unit 18 | | | |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| Unit 18 | Unit 18 | Revision, assessment, and research | Revision, assessment, and research | Unit 19 | | | |
| 31 | 01 | Notes | | | | | |
| Class Closure Day | | | | | | | |

Knowledge and Skills

Blood Stain Patterns

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18(A) Students will analyze a variety of blood stain patterns based on their appearance, looking in depth at size, shape, distribution, and location in order to determine the mechanism by which the patterns were created. Students shall also learn of the impacts of different surface types on the appearance of blood stains. By the end of this lesson, students will be familiar with a number of blood stain patterns and will be able to identify or reasonably estimate the source of such patterns based on their appearance and surface type.

Teacher Edition

Knowledge and Skills

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Section A — Blood Stain Patterns Notes

What are blood stain patterns?

Blood stain patterns, or blood spatter, are the terms used to describe the blood at the scene of a crime. Blood spatter can range from minute specks or drops of blood from a shallow wound to whole scenes where lots of individual blood stain patterns must be analyzed to help reconstruct events.



Blood stains are created when an injury draws blood and falls to a surface. The blood stains can help blood spatter analysts work out where and how the injury was made, with how much force and the consequent events. Blood stains can be found on the floors, walls, ceilings, and surfaces of anything in a room where the injury took place and it's a blood stain analyst's job to find each blood stain to help reconstruct events.

How does surface type affect blood stains?

Blood stains can fall anywhere and the type of surface on which it lands can affect not only the size of the blood spatter, but also the shape and distribution. A hard smooth surface will receive a drop of blood better (and in its spherical form) than a soft or rougher surface which could cause the drop to separate and appear irregular in shape.

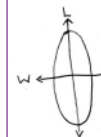
Blood stains may not always be visible to the naked eye for a number of reasons and can sometimes need chemical enhancing to become visible. UV lighting can also help enhance latent blood stains by making them significantly darker.



What affects the appearance of blood stain patterns?

Blood stains can be categorized into 3 basic groups: passive stains which are typically made from low velocity events (drops, trails, and pools); transfer stains which are made through contact between a bloody surface and a clean one (handprints, smears, and swipes); and impact stains which are the result of medium to high velocity events (splashes, spatters, and arterial spurts).

The appearance of blood stain patterns depends on the surface type, velocity, and quantity of the blood when it fell and impacts the appearance in size, shape, distribution, and location of the blood stain.



The shape of a blood drop changes as it hits a surface depending on the angle it fell from, the velocity behind the impact, and the distance it traveled. The angle of impact can cause the blood stain to elongate upon reaching the surface, and a drop of blood which fell at a 90 degree angle will be an almost perfect circle. The angle of impact can be calculated by measuring the length and width of the circular section of the blood stain. By calculating the inverse sine of width/length, you can find the angle of impact of the blood stain.

Knowledge and Skills

Teacher Edition



Section A — Blood Stain Patterns Notes

$$\sin^{-1} = W/L$$

There are three levels of velocity (or force) which a blood stain can travel: low, medium, and high. A low velocity impact spatter is a blood drop falling at the speed of gravity; these blood drops are typically the result of an open wound. A medium velocity impact spatter is the result of a more energetic force, for example a blunt force injury or assault. A high velocity impact spatter is typically associated with gunshot wounds or other very energetic events.

The distance which a blood drop travels can alter the shape of the stain and cause secondary splashes if fallen from a large height. The closer the impact from the injury, the more circular the blood stain will be.



As the force behind the blood droplets increases, the blood will separate into smaller individual drops as it impacts the surface. This is shown in the common result of a gunshot wound being a fine red mist.

The distribution of blood spatter can reveal a lot about the event that took place, for example, a blood stain pattern with both a back spatter and a forward spatter is indicative of a gunshot or other high velocity impact when the blood spatter has been directed back towards the source of the force. A more linear distribution of blood stains may be suggestive of an event where blood was shook from a weapon, and a wide spatter distribution could indicate a medium to high velocity event.

The location of the blood stain patterns can also help to produce a replica of the crime and aid in finding a convergence point or area where the force originated as well as the location of the blood source (the victim). Blood spatter trails may also lead from one location to another and further aid in the crime scene reconstruction.



How do these things help us determine the source of blood spatter?

A blood spatter analyst examines all of the features of a blood stain pattern to determine how the events of the crime played out. Other than the blood stain patterns, experts will also examine void areas which are clear from blood; these areas may be where an individual was stood during an event. They use special techniques to discover the origin of the blood spatter, including creating 3-D replicas to trace the angle of bloodstains to a converging point. A blood stain expert will take many photographs of the types of blood stains present at the crime scene and try to determine the sequence of events which took place.

Section 1 — Investigation: Blood Stain Patterns

Name _____ Date _____ Class _____

Objective:

To analyze blood stain patterns based on appearance to determine their source and understand the effect of different surface types on blood stains.

Background:

A blood spatter analyst has to become familiar with all different kinds of blood stain patterns so that they can form an opinion regarding a crime scene.

In the following activity, students will begin to recognize the different blood stain patterns by their appearance and form an opinion themselves as to the cause.

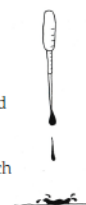
Materials:

- Metric rulers
- Scientific calculators
- Magnifying tools
- Blood stain cards (several per table/group)

Procedure:

Prior to the lesson:

1. Use red food coloring and a variety of tools to produce a variety of bloodlike stains on the card squares, including droplets (using a pipette), trails, mist (using a soft brush), spurts, smears, and splashes.
2. Ensure that your blood stains come from a variety of angles by holding up the card and also allowing droplets to run.
3. Mark a number in one corner for later use and make brief notes on how you made each stain and the type of stain for each card.



Procedure:

1. To begin the activity, distribute the blood stain cards to the tables or groups of students as well as the other equipment needed to examine and measure the stains.

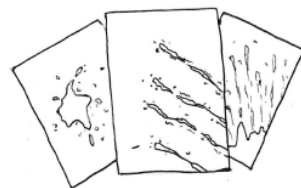
Section 1 — Investigation: Blood Stain Patterns

- Instruct the students to note down the appearance of each blood stain in their group, considering the following questions:
Is the blood stain a passive, transfer, or impact stain? How can you tell?

Is there a large amount of blood or small amount?

What shape are the blood stains? Are they circular, oval, or teardrop shaped?

Is the distribution of the blood stains significant?
- Students should then estimate the level of force/velocity which resulted in the stains (A low, medium, or high energy event?).
- Students should then calculate the angle of impact for any droplet stains using the equation:
$$\sin^{-1} = W/L$$
- When all of the above has been completed, students will rotate the blood stain cards from one table to the next and repeat the instructions until every student has had chance to examine every card.
- Students should document their observations thoroughly in their workbooks throughout the experiment, making sure to accurately label their notes with the number on the blood stain card.
- At the end of the activity, collect the blood stain cards and go through each one with the class, asking for volunteers to share their opinions of the blood stain patterns and provide estimates as to their causes. Encourage discussion within groups and support students who may have different ideas.



Section 1 — Investigation: Blood Stain Patterns

Follow-Up Questions:

- Calculate the angle of impact to the nearest whole number for the following bloodstains:
 - Blood drop with a width of 9mm and a length of 15mm
 - Blood drop with a width of 11mm and a length of 14mm
 - Blood drop with a width of 6mm and a length of 13mm
 - Blood drop with a width of 10mm and a length of 17mm
- Give examples of events which would result in low velocity blood spatter, medium velocity blood spatter, and high velocity blood spatter.
- How would a hard, non-porous surface type affect the blood stains?
- How would a soft, porous surface type affect the blood stains?
- The surface type in your activity was a piece of card, how would this affect the blood stains as they fell?
- An officer has opened the door to a crime scene and can immediately see that there has been a brutal assault. He suspects that a victim was injured and dragged across the room where they were then shot at close range. Explain the types of blood stain patterns you would expect to see to corroborate the officer's story.
- An officer is investigating a domestic abuse call from a neighbor, they enter the apartment and see a man cleaning up what seems to be a large amount of blood from the kitchen floor. On questioning the man, the officers are told that he cut himself whilst preparing dinner for his partner.
 - Do you think this is true?
 - What blood stains would you expect to see from a low velocity injury?
 - How would you go about determining the size of the blood stain even after the man has tried to clean it up? Explain your answer.

Investigation Prep:

Ensure that the blood stain cards are completely dry before distributing to students.

Teachers may also use their own preferred alternative to red food dye to create the blood stains.

Section 1 — Investigation: Blood Stain Patterns

8. What shape would a blood stain be if it fell at a 90 degree angle?
9. How do blood stains help crime scene investigators to reconstruct the events of the crime?
10. How would you determine if a blood stain was really blood?



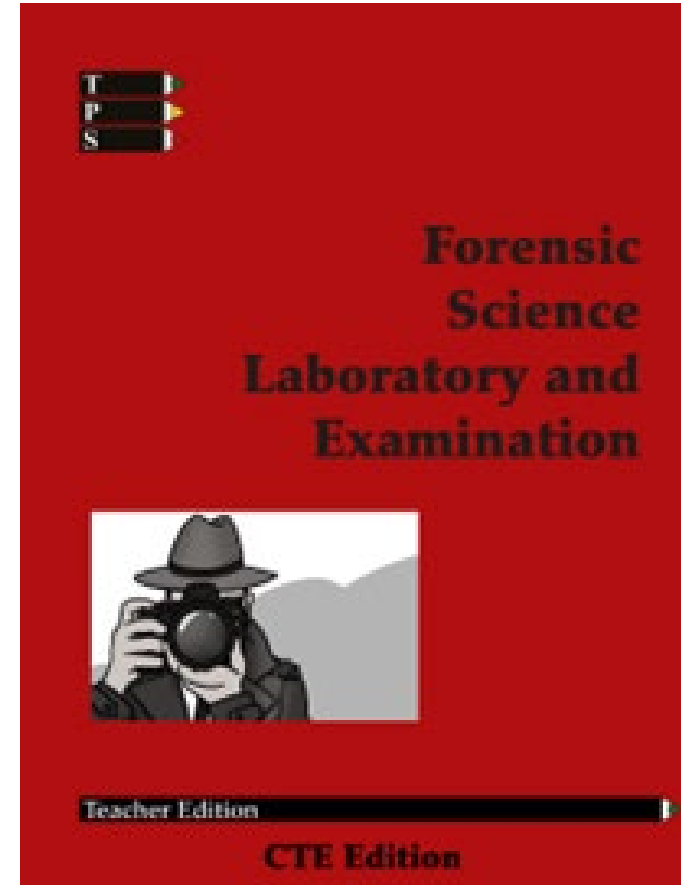
Exercise Answers:

1. a) 37 degrees
b) 52 degrees
c) 28 degrees
d) 36 degrees
2. Answers will vary.
3. The blood stains would likely retain their spherical shape if dropped directly onto surface, and could cause secondary splashes.
4. The blood stains would appear irregular in shape.
5. The card is a hard but porous surface, blood drops would appear irregular in shape.
6. There would be droplets or a pool of blood where the victim was injured, blood smear marks where the victim was dragged, and both back and forward spatter where the victim was shot.
7. a) No
b) The supposed low velocity injury would produce droplets and would very unlikely be able to produce a pool of blood.
c) Chemical enhancing would reveal traces of blood on the floor where the man has cleaned.
8. An almost perfect circle.
9. They can determine what sort of events took place and where victims or suspects were placed during the events through void spaces and convergence.
10. By using a presumptive test.



Laboratory and Examination Guide

Students, just as the professionals in the field, are expected to develop testable hypotheses and create logical connections between the design of the experiment and the scientific concepts



**Bloodstain Pattern****TEKS 18**

(18) The student analyzes blood spatter at a simulated crime scene. The student is expected to

(A) analyze blood stain patterns based on surface type and appearance such as size, shape, distribution and location in order to determine the mechanism by which the patterns are created

(B) explain the methods of chemically enhancing latent blood patterns using reagents such as Blue Star or Amido Black

Bloodstain Pattern**Blood Spatter**

Forensic Science is used to predict not the future but the past.

-Henry C. Lee (Reproduced in "Forensic Radiology" by B.G. Brogdon, at page 279)

On January 27, 2001, two young men knocked on the door of two Dartmouth College professors. Haf Zantop answered the door and the young men said they were students doing an environmental project and would like to ask him questions. Being a teacher and interested in helping students he invited them into the living area. Suzanne Zantop was in the kitchen preparing dinner for them and friends. One of the two students moved behind him and violently stabbed the unsuspecting Haf where he was found by the police. The lack of movement by the bloodstain pattern indicated he was unaware of the attack. Suzanne must have heard something as she moved down the hall where she met the attackers. The bloodstain pattern indicated she was aware of the attack. Blood was found all through the hallway indicating she fought back. When the students were arrested and interviewed the bloodstain pattern matched to their account of the murders.

(18) The student analyzes blood spatter at a simulated crime scene.

Essential Question

What are the important investigations in a simulated crime scene?

Objectives

1. Determine the source of the bloodstain pattern.
2. Determine the direction of the bloodstain pattern.
3. Demonstrate the angle of trajectory of the bloodstain pattern.
4. Define refractive index and explain how it is used in forensic glass analysis.
5. Explain the method of chemically isolating an invisible bloodstain using reagents such as luminol.



Bloodstain Pattern

Close up on Scientist

Christian Friedrich Schönbein

October 18, 1799 - August 29, 1868

Schonbein was a German-Swiss chemist who is best known for inventing the fuel cell (1838) and his discoveries of gun cotton and ozone. The first presumption tests for blood came from his studies with oxygen and how hemoglobin has the ability to oxidize. Schonbein moved around a lot to expand his learning and asked to be tested by a professor. He passed the exam and went on to become a professor of chemistry at the University of Basel in 1835. Five years before his death he gave presumptive blood tests a huge start when he developed one of the first presumptive tests in 1863. This test was based on the observation that peroxidase-like activity in hemoglobin causes the oxidation of hydrogen peroxide. The result of the reaction between hydrogen peroxide and hemoglobin is the appearance of "foaming" as the oxygen bubbles rise. Schonbein reasoned that if an unknown stain formed when hydrogen peroxide was applied to it, then that stain probably contained hemoglobin, and therefore was likely to be blood.



Bloodstain Pattern

Teacher Edition

Bloodstain Pattern

Career Focus

What is Blood Spatter Analysis?

Blood spatter analysis can be present in all types of crimes and requires a specialized technician who can read its story at a crime scene.



Roles:

Patterns can explain how a death occurred and what type of weapon was used. The blood spatter technician collects a sample if it is human blood. Once it is established that it is human they photograph and diagram the spatter. If angled he will measure and calculate the angle of trajectory as well as the direction from the tail.

Education and Training:

It is essential to have a degree in any natural science: biology, chemistry or physics. Without this degree an associate degree is accepted if the candidate has at least two years on the job training. Once hired a blood spatter analyst will be trained by a mentor.

Professional Certification:

There are certifications available for forensic scientists in a number of forensic disciplines including blood spatter. There is also an exam you can sit, the Comprehensive Criminalistics Examination. For this you would need to complete an approved proficiency testing program in a designated specialty area.

Salary Expectations:

The average earning for this profession is \$55,000 per year.

Teacher Edition

Bloodstain Pattern



Bloodstain Pattern

Vocabulary

In pairs, say each of these key words aloud. Ensure you are able to pronounce the words correctly. Ensure you are able to correctly use the words in a sentence. Monitor your own and your partner's spoken language.

| | |
|--|--|
| Angle of Impact | Angle at which a blood drop strikes a surface. |
| Area of Convergence | Intersections generated by lines drawn through the long axes of individual stains that indicates in two dimensions the location of the blood source. |
| Area of Origin | Three-dimensional location from which blood spatter originated. |
| Altered bloodstains | Bloodshed that has been changed physically or physiologically. |
| Bloodstain | Drops of blood on a surface. |
| Bloodstain pattern analysis(BSPA) | Distribution of bloodstains that indicates, through regular or repetitive pattern, the manner in which the pattern was deposited. |
| Cast-off Pattern | A bloodstain pattern resulting from blood drops released from an object due to its motion. |
| Confirmatory test | Final test for blood to say it is human blood |
| Expiration Pattern | To breathe out blood through nose, mouth or a wound |
| Forward Spatter Pattern | Blood drops that traveled in the same direction as the impact force. |
| Impact Pattern | A bloodstain pattern resulting from an object striking liquid blood. |
| Luminol | Chemical that glows when blood is covered |

Bloodstain Pattern

Vocabulary

| | |
|----------------------------|--|
| Mist Pattern | Blood reduced to a spray of micro-drops as a result of the force applied. |
| Parent Stain | Bloodstain from which a satellite stain originated |
| Passive bloodstains | Caused by gravity and forms the blood drops |
| Perimeter Stain | An altered stain that consists of the peripheral characteristics of the original stain. |
| Presumption test | Test for testing blood in the field |
| Projected Pattern | Ejection of a volume of blood under pressure, such as a spurt or spray. |
| Satellite Stain | A smaller bloodstain that originated during the formation of the parent stain as a result of blood impacting a surface. |
| Saturation Stain | Accumulation of liquid blood in an absorbent material. |
| Spatter Stain | Blood drop dispersed through the air due to an external force applied to a source of liquid blood. |
| Spines | Spokes or rays emanating out from the edge of a blood drop; they result from the drop contacting a nonsmooth surface. |
| Splash Pattern | Volume of liquid blood that falls or spills onto a surface. |
| Swipe Pattern | Smear of blood from a bloodbearing surface onto another surface, with characteristics that indicate motion between the two surfaces. |
| Transfer Stain | A bloodstain resulting from contact between a blood-bearing surface and another surface. |
| Void | An absence of blood |
| Wipe Pattern | An altered bloodstain pattern resulting from an object moving through a pre-existing wet bloodstain. |



Bloodstain Pattern

History of Blood Stain Patterns

The first modern study of bloodstain pattern analysis was in 1895. As time progressed the interest in bloodstain pattern analysis came to the forefront and cases were viewed many different ways. Drops of blood that are at an angle or converged in a pattern were used to explain where an assault took place. A bloodstain can also tell us what amount force was used and the weapon used. The Sam Sheppard case became an important teaching tool for forensics. Sheppard came home to find his wife dead. He was charged and brought to trial, convicted and sent to prison. Years later Paul Kirk revisited the evidence.

Students should create a pictorial representation of the history of blood stain patterns. Once complete, students should present their work to the rest of the class and retell the information they have learned.

Bloodstain Pattern

18 (A) analyze blood stain patterns based on surface type and appearance such as size, shape, distribution and location in order to determine the mechanism by which the patterns are created

Key Question

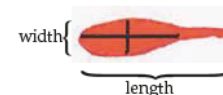
What are the procedures for analyzing the source, direction, and trajectory of a blood stain pattern?

Bloodstain Pattern Analysis Notes

The angle of impact of a blood drop can be determined by applying the following formula to the length and width of the drop. (Note: The length is the measurement of the long axis of the drop, while the value for the angle of impact is found by referring to the sine table on the following page.)

$$\text{Sine of the impact angle} = \frac{\text{Width of Drop}}{\text{Length of Drop}}$$

Angle of Impact Calculation for Drop "A":



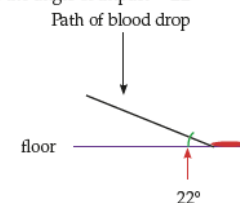
$$\text{Sine of the impact angle} = \frac{\text{Width of Drop}}{\text{Length of Drop}}$$

*Note: When determining the length of the blood drop, do not include the tapered end during measurement.

$$\text{Sine of the impact angle} = \frac{0.7 \text{ cm}}{1.9 \text{ cm}} = 0.37$$

Referring to the sine table, .37 corresponds to 22°

Therefore, the angle of impact = 22°



(side view representation of the 22° angle of impact for blood drop "A")









Bloodstain Pattern

Bloodstain Pattern Analysis Notes

Bloodstain Patterns

Bloodstain patterns are caused by different actions. The analysis of bloodstain patterns can aid in the reconstruction of a crime scene.

Below is a chart outlining the name, cause and appearance for the following bloodstain patterns: Radial, Artery spurts, Cast-off (Arc), Pool, Contact (Transfer) and Trail.

| Name of pattern | Cause of Pattern | Appearance | Pattern |
|--------------------|---|--|---|
| Radial | Results from a blow to blood that has pooled in an open wound. | Blood flares outward in a fan like pattern. |  |
| Artery Spurts | Results from a wound to a major artery. Blood spurts correspond with the contractions of the heart. | Spaced out splotches of blood reflecting the movement of the victim and a decrease in the amount of blood. |  |
| Cast – off (Arc) | Blood that is on the weapon from previous blows flies off onto the ceiling, walls and floor while being raised in preparation for another blow. | Multiple, thin streaks in a relatively straight formation. |  |
| Pool | Blood flowing from a wound collects in a puddle formation. | Puddle formation. |  |
| Contact (Transfer) | Bloodied object (Hand, weapon, clothing) touches a surface. | Pattern of object (ex. Hand print) present on a surface. |  |
| Trail | Blood drops from an object (weapon, hand, open wound) onto a horizontal surface. | Circular drops. |  |

Bloodstain Pattern

Teacher Edition

Bloodstain Pattern

Bloodstain Pattern Analysis Notes

High, Medium and Low Velocity Impact Spatter

Bloodstain patterns are also categorized based on the velocity of the object that caused the spatter.

High velocity impact spatters appear as a collection of very small blood drops and may be produced by actions such as a gunshot.



Medium velocity impact spatters appear as a collection of blood drops slightly larger than those comprising a high velocity impact spatter and may be caused by actions such as stabbing.



Low velocity impact spatters appear as blood drops slightly larger than those comprising a medium velocity impact spatter and may be caused by actions such as the effect of gravity. (Ex. Blood dripping from a weapon or wound.)



Teacher Edition

Bloodstain Pattern

Bloodstain Pattern

Investigation: Bloodstain Patterns

Objective

To develop your own understanding for the direction of travel, area of convergence and the angle of impact for blood drops that comprise a bloodstain pattern

Bloodstain patterns are caused by different actions. The analysis of spatter patterns can aid in the reconstruction of a crime scene.

Below is a chart outlining the name and cause of pattern for the following bloodstain patterns: Radial, Artery spurts, Cast-off (Arc), Pool, Contact (Transfer) and Trail.

Procedure:

1. Read the information for the "Cause" and "Appearance" for the Radial bloodstain pattern.
2. View illustrations "A" - "F."
3. Determine which illustration represents the Radial bloodstain pattern.
4. Record the name of the pattern on the line beneath the illustration.
5. Repeat for the remaining bloodstain patterns.

| Name of pattern | Cause of Pattern | Appearance |
|--------------------|---|--|
| Radial | Results from a blow to blood that has pooled in an open wound. | Blood flares outward in a fan like pattern. |
| Artery Spurts | Results from a wound to a major artery. Blood spurts correspond with the contractions of the heart. | Spaced out splotches of blood reflecting the movement of the victim and a decrease in the amount of blood. |
| Cast - off (Arc) | Blood that is on the weapon from previous blows flies off onto the ceiling, walls and floor while being raised in preparation for another blow. | Multiple, thin streaks in a relatively straight formation. |
| Pool | Blood flowing from a wound collects in a puddle formation. | Puddle formation. |
| Contact (Transfer) | Bloodied object (Hand, weapon, clothing) touches a surface. | Pattern of object (ex. Hand print) present on a surface. |
| Trail | Blood drops from an object (weapon, hand, open wound) onto a horizontal surface. | Circular drops. |

Key: A. Contact (transfer) B. Arterial spurt C. Trail D. Cast off (arc) E. Radial F. Pool

Bloodstain Pattern

Investigation

Bloodstain Patterns

A.



Bloodstain pattern name _____

B.



Bloodstain pattern name _____

C.



Bloodstain pattern name _____

D.



Bloodstain pattern name _____

E.



Bloodstain pattern name _____

F.



Bloodstain pattern name _____

Teacher Tip

This investigation should precede notes on Direction of Travel, Area of Convergence and Angle of Impact.

Bloodstain Pattern

Investigation: Direction of Travel, Area of Convergence and Angle of Impact

Background:

Bloodstain pattern reconstruction involves determining the direction of travel, area of convergence and angles of impact of blood drops that comprise a bloodstain pattern.

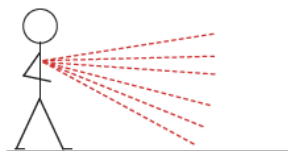
The analysis and reconstruction of bloodstain patterns can yield the following information: position of the victim, position of the perpetrator relative to the victim and origin of the blood during the incident that created the bloodstain pattern.

Direction of Travel

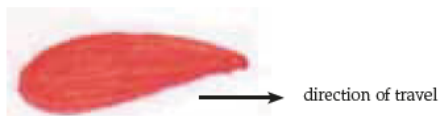
Imagine an individual, standing upright, has been shot in the chest. Blood will travel outward from the wound. Examining a single traveling blood drop we see the following: as the blood drop strikes the floor, the bottom portion will stop and the upper portion will continue to move. The upper portion moves forward, forming a tapered band upon rest. The final blood drop spatter appears as an ellipse with a tapered end pointing in the direction of travel of the blood drop.

Using the information above:

1. Make a "bird's eye view" sketch of a single blood drop that has traveled from left to right and has landed on a flat, horizontal surface. (See diagram below.)
2. Label the end of the drop that indicates the "direction of travel" of the drop.



Sketch



Bloodstain Pattern

Investigation

3. Describe the appearance of a blood drop that has hit a flat, horizontal surface when traveling from left to right.
Rounded end towards the left side of the drop. Tapered band towards the right of the drop.
4. Explain why the blood drop takes on the appearance described above, rather than a spheroid or oval shape.
Because the upper portion of a blood drop that has landed moves forward since it is not confined.

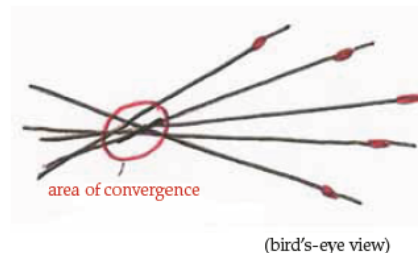
Area of Convergence

The area of convergence of the blood drops that comprise a bloodstain pattern represents the general area from which the blood originated.

Imagine a radial bloodstain pattern found on the floor of a vacant crime scene. Investigators can determine the location from which the blood originated by determining the area of convergence of lines that are drawn through several of the blood drops that make up the pattern. Straight lines are drawn through the blood drops starting at the tapered end and running straight through the rounded end until they intersect each other. The area where all of the lines intersect is called the "Area of Convergence."

Using the above information:

1. Draw lines through the blood drops of the pattern below.
2. Circle and label the area of convergence.



Bloodstain Pattern

Investigation

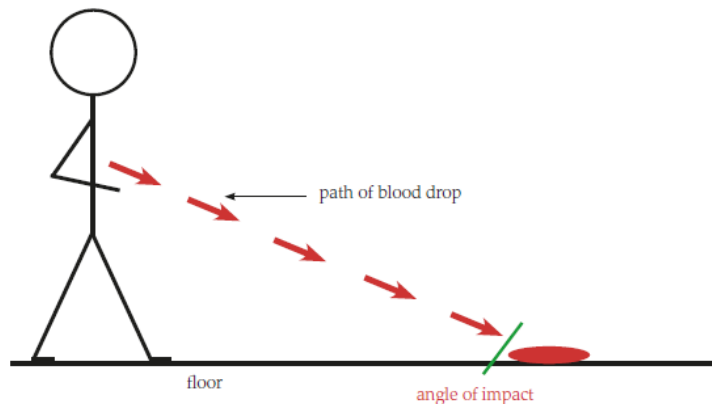
- Explain why the term "Area of Convergence" is used instead of the term "Point of Convergence" when determining the origin of a bloodstain pattern.

Answers will vary - because a body can move as it is releasing blood.

Angle of Impact

The angle of impact of a blood drop is described as the angle between the path of the drop and the surface it strikes. Calculating the angle of impact of a blood drop helps to determine more specifically where the blood originated in a three-dimensional aspect.

Based on the definition of "angle of impact" for a blood drop, label the angle of impact in the diagram below which focuses on the path of a single blood drop.



Bloodstain Pattern

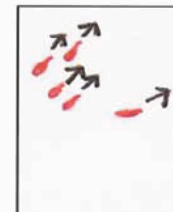
Follow Up Investigation: Direction of Travel, Area of Convergence and Angle of Impact

- Direction of Travel

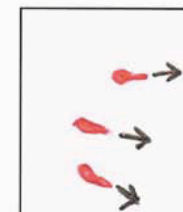
Using arrows, indicate the direction of travel of the blood drops in the spatters below.



A



B



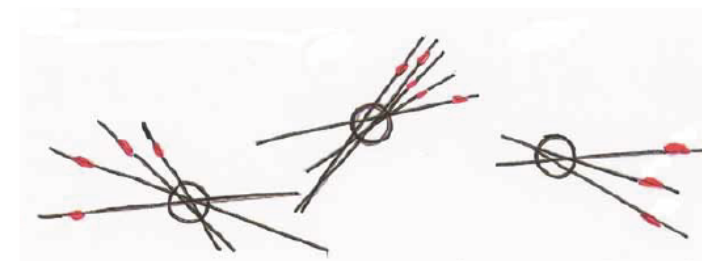
C

- Using lines, determine the area of convergence for the blood drops in the spatters below (draw a circle around the area of convergence).

A

B

C



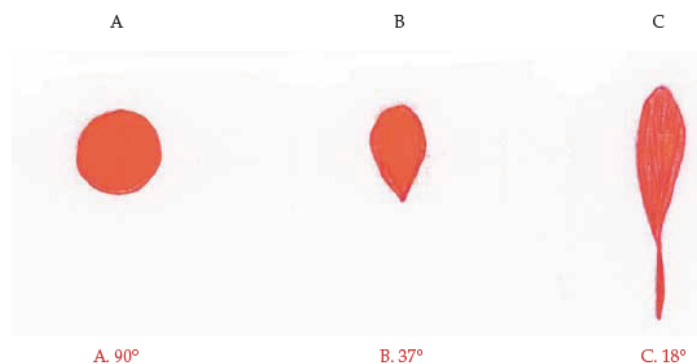
Bloodstain Pattern

Follow Up Investigation: Direction of Travel, Area of Convergence and Angle of Impact

3. Use the following formula

$$\text{Sine of the impact angle} = \frac{\text{Width of Drop}}{\text{Length of Drop}}$$

and the Sine table, to determine the angle of impact for the blood drops below.



Bloodstain Pattern

Investigation: Effect of Distance, Surface Type and Angle

Objective

To gain practice in the creation and interpretation of bloodstain patterns regarding distance, surface type, and angle.

Materials:

- Fake blood
- Yard stick
- Eye dropper
- Paper towel
- Tile
- Protractor
- 4 pieces of 8"x 10" stiff cardboard
- 4 pieces of white writing paper

Procedure:

Part I: Distance

1. Label one piece of paper 2 feet and place it on a flat surface.
2. Fill the eyedropper with blood.
3. Using the yardstick, hold the dropper 2 feet above the paper and drop one drop of blood on to the paper.
4. Sketch and record your observations in Data Table I.
5. Repeat steps 1-4 for distances 4 feet and 6 feet.

Part II: Surface

1. Place one piece of tile on a flat surface.
2. Fill the eyedropper with "blood."
3. Using the yardstick, hold the dropper 3 feet above the tile and release one drop of "blood" on to the tile.
4. Sketch and record your observations in Data Table II.
5. Repeat steps 1- 4 for the writing paper and the paper towel.

**Bloodstain Pattern****Investigation****Investigation Prep and Notes:**

Recipe for fake blood:

- 100 ml Corn Syrup • 300 ml Water • 3 drops of red food coloring
- Depending on the environmental temperature, the amount of corn syrup and water may have to be adjusted in order to achieve the proper consistency.
- Add a very small amount of blue or green food coloring to make the color more realistic.
- Writing paper, tile and cardboard should have smooth surfaces.
- Stiff file folders can be used in place of the cardboard.

Data Table I (Distance)

| Distance (feet) | Sketch | Observations |
|-----------------|--------|--------------|
| 2.0 | | |
| 4.0 | | |
| 6.0 | | |

Data Table II (Surface Type)

| Surface | Sketch | Observations |
|---------------|--------|--------------|
| Tile | | |
| Writing paper | | |
| Paper towel | | |

Bloodstain Pattern**Investigation****Part III: Angle**

1. Label one piece of cardboard 90° and place it on a flat surface.
2. Fill the eyedropper with "blood."
3. Using the yardstick, hold the dropper 4 feet above the folder and drop one drop of "blood" onto the cardboard.
4. Sketch and record your observations in Data Table III.
5. Repeat steps 1-4 for angles, 60°, 30° and 10°.
(Note: See the following page for instructions on how to hold the cardboard for each angle.)

Data Table III (Angle of Impact)

| Angle | Sketch | Observations |
|-------|--------|--------------|
| 90° | | |
| 60° | | |
| 30° | | |
| 10° | | |





Bloodstain Pattern

Investigation: Follow-Up Questions

1. State the relationship between the following:
 - a. The distance a drop of blood falls and the diameter of the blood drop.
 - b. The type of surface on which a drop of blood falls and the appearance of the blood.
 - c. The angle of impact of a drop of blood, and its appearance.

a. Answers will vary depending on students' techniques.
b. As the absorbency of a surface increases, the diameter of the blood drop increases.
c. As the angle of impact increases, the drop appears more round. As the angle of impact decreases, the drop appears more elongated.
2. Describe how a drop of blood would appear if it fell on a cotton T-shirt.

The drop would appear spread out due to absorption by the material.
3.
 - a. Using the formula for the angle of impact,
$$\text{Sine of the impact Angle} = \frac{\text{Width of Stain}}{\text{Length of Stain}}$$
calculate the angle of impact for each of the drops for Part III of the investigation.
 - b. What could account for any discrepancies that exist between the desired angle of impact and the calculated angle of impact for the drops. List three possible sources of error.

a. Answers will vary.
b. Answers may include but are not limited to the following:
The cardboard was not held at the proper angle. The blood drop was not measured properly.
The blood does not have the actual consistency of real blood.
The dropper was not held properly.
4. Describe how the following bloodstain patterns would appear:
 - a. "Low velocity impact spatter" (Spatter from a wound to the head made by a heavy item such as a crow bar.)
 - b. "Medium velocity impact spatter" (Spatter from a stab wound made by a knife.)
 - c. "High velocity impact spatter." (Spatter from a wound resulting from a gunshot.)

(Answers will vary)
a. Large splotches in a contained area. Puddle-like appearance.
b. Less contained. Smaller splotches than above.
c. Spray like pattern consisting of numerous, very small drops.



Bloodstain Pattern

Exam: Bloodstain Pattern Analysis

Instructions

Record your answers on the Answer sheet provided using the crime scene sketch.

1. State the name of the type of bloodstain pattern for each of the numbered bloodstains.
2. The following represent photographs of portions of bloodstains 10, 12 and 17.



Bloodstain #10



Bloodstain #12



Bloodstain #17

Use the following formula:

$$\text{Sine of the impact Angle} = \frac{\text{Width of Drop}}{\text{Length of Drop}}$$

and the Sine table to determine the angle of impact for each bloodstain.

3. Explain why bloodstain #17 would be described as a "High Velocity" bloodstain pattern.
4. Describe the appearance of a "Low Velocity" bloodstain pattern.

Bloodstain Pattern

Exam: Bloodstain Pattern Analysis

5. The bloodstain pattern to the right was found in an apartment next door to the crime scene that you are studying:

On your answer sheet:

- a. Indicate the direction of travel for each blood drop using arrows.
- b. Determine the area of convergence for the blood drops.
- c. Label the area of convergence with an "A."
- d. Indicate the general position of the victim with a "V."
- e. Indicate the general position of the perpetrator with a "P."





Chapter 8 — Bloodstain Pattern

Background:

Analyze blood spatter at a simulated crime scene. Determine the source, direction, and angle of trajectory of a bloodstain pattern. Explain the method of chemically isolating an invisible bloodstain using reagents.

A violent attack has occurred in the local area. Blood spatter analysts have investigated the scene and drawn their conclusions as to what happened during the fatal attack. They have hypothesized that the initial attack occurred in the open plan kitchen/lounge, to the left of the couch next to the wall. There the victim was stabbed multiple times in quick succession in a haphazard manner. One of these stabbings nicked an artery. The victim did not die immediately and attempted to reach the sliding doors onto the patio. They grabbed the arm of the couch as they passed and died shortly before reaching the doors. The attacker then walked over to the kitchen sink to rinse off their weapon, before leaving via the hallway to the front door.

Chapter 8 — Bloodstain Pattern

Follow-Up Questions:

Read through the scenario on prior page

Detail what blood patterns and evidence must have been present for the blood spatter analysts to have drawn this conclusion. Be detailed in your descriptions of the terms.

Medium velocity impact splatter (a collection of medium sized drops) as it is a stabbing.

Cast off (arc) pattern on the walls (thin streaks in a fairly straight formation) and ceiling from the knife while stabbing in quick succession.

Arterial spurts (splashes) spaced out on the wall from the initial attack location towards the sliding doors, decreasing in the amount of blood as it went.

A contact (transfer) pattern of a handprint on the arm of the sofa near the doors.

A pool of blood next to the sliding doors where the victim died.

A trail pattern (circular drops) leading from the attack location towards the kitchen sink, resulting from the knife dripping as the perpetrator walked.

Contact (transfer) footprint patterns heading from the sink (where they had stepped in some of the trail blood), down the hallway toward the front door.





The Mathematics in Forensic Science

Bloodstain Pattern

Analysis of bloodstain patterns via value tables to determine origins of impact is walking into Geometry, though the use of sine value tables rather than the function does make it lean more heavily into Algebra than usual geometry questions.

Police are called out to a shooting that was reported to occur at 3am. When they arrive, there is no body, but there are several bloodstains. A witness to a crime scene says that there was a gunshot from an alleyway and that's where they saw the suspected culprit. Some high velocity impact spatter bloodstains were found on the roadside, on the opposite side of the road to the alleyway, several of which had a length of 2.02mm and a width of 1.98mm. What would the impact angle be?

$$\sin(\text{Impact Angle}) = \text{Width of Spatter} / \text{Length of Spatter} = 1.98 / 2.02 = 0.980; \text{Impact Angle} = 78.6^\circ$$

Using your answer, how likely is it that the witness' statement is true?

Unlikely, since the angle of impact calculated would require the gun to have shot the victim from an elevated angle rather than in an alleyway.

Nearby the impact spatter is a pool of blood with large contact (transfer) stains on the floor leading to the alleyway the witness mentioned. This contains a closed dumpster bin with damaged hinges. The blood contact (transfer) stain ends there, though there are some low velocity impact spatters with a width 2.7cm and a length of 6.3cm. There is the smell of smoke and burnt refuse and tire tracks that leave the alleyway onto the road. Explain what the pool of blood and the large contact (transfer) stain suggests.

The pool of blood suggests that was where the victim died, while the large contact (transfer) stain suggests the body was subsequently dragged into the alleyway.

Give an example of an action and/or object, as well as the angle of impact, that could have caused the low velocity impact spatters.

$$\text{A hit to the body/head with a blunt object such as a crowbar or hammer. } \sin(\text{Impact Angle}) = 2.7 / 6.3 = 0.429; \text{Impact Angle} = 25.4^\circ$$

Given your two previous answers, what do the low velocity impact spatters suggest about the events or nature of this crime?

Answers will vary. Examples might include that it was a crime of passion (since the corpse was attacked after death) or that it was committed by multiple people, but there was a falling out (that the low velocity blood spatters were evidence of one culprit attacking the other).

The Mathematics in Forensic Science

Give two leads the investigators could consider next with the information you have been given.

There are at least five, though it is possible that there could be more.

1. Investigate the tire tracks and vehicle they could belong to.
2. Investigate the contents of the dumpster bins, since something was burnt in them.
3. Investigate using luminol (for contact stains) and/or checking for fingerprints on the dumpster bin; the hinges are damaged, and the witness could have confused the slamming of its lid for a gunshot.
4. Investigate the dragging of the body for any fibers or hairs so that there is evidence of the identity of either the victim or the culprit.
5. Investigate the area of convergence and possible origin location of the shot that caused the high velocity impact spatter.



Forensic Do Nows

Convenience Store Murders

Do Now!

Introduction:

A Young man walks into a Convenience store. Behind the counter, he finds the store clerk (a young woman) dead and calls the Police. Investigators determine that the clerk appears to have died as a result of multiple stab wounds to the chest. Investigators also find that money has been removed from the cash register.

No suspects are found. No leads are developed.

Two weeks later, another clerk (a young male) is found stabbed to death in the storage room of a Convenience store just 5 miles away from the other store. The security camera as well as the money from the cash register is missing.

This time, Investigators receive information from a witness that leads them to a suspect. Investigators arrive at the suspect's residence to question him. A young woman answers the door. Looking down the hall, Investigators see the suspect jump out of a window and run.

Investigators catch the suspect and search the bedroom that he fled from. Under the mattress, Investigators find a black-handled steak knife.

The knife is examined by the Medical Examiner who performed the autopsies on the two victims. The M.E., also a tool marks expert, determines that the knife is the weapon responsible for killing the two store clerks.

- Describe how you think the M.E. determined that the knife was the weapon responsible for killing the two store clerks.

The blade of the suspected knife fit perfectly into knife wounds present in _____
both victims' sternums. _____



Bloodstain Pattern Analysis

Head Injury

Do Now!

- Before the knife was determined to be the murder weapon, blood found on a sweatshirt from the suspect's bedroom was determined by a Forensic Serologist to match blood from both of the victims. When questioned by Investigators about the presence of both of the victims' blood on his sweatshirt, the suspect calmly explained that... What do you think was the suspect's explanation for the presence of the victims' blood on his sweatshirt?

(This is a true story!) _____

The Suspect said that he was indeed present at both scenes. He stated that he came upon both victims and tried to help revive them which caused their blood to transfer to the sweatshirt that he happened to be wearing during both occasions! _____

He further claimed that when he was unable to revive them, he just ran because _____
he was afraid that he would be blamed for their deaths if he reported them. _____

- Name at least two types of bloodstain patterns that you think Investigators found at both crime scenes.
 - Provide an explanation for how you think each pattern formed.

Arc - created as a result of the upswing of the knife during the stabbing. _____

Pool - created as a result of the victims bleeding out onto the _____
floor from their chest wounds. _____



Bloodstain Pattern Analysis



Forensic Safety Handbook

4

Lab Safety Handbook – TPS Forensic Science

Tips for the teacher:

Lab Safety is an ongoing process and should be taught within every lab. However, certain procedures regarding the use and handling of safety equipment and materials must be thoroughly taught prior to students participating in any lab situation.

1. Always try out the investigation/experiment/lab prior to attempting it in class.
2. Modeling correct use of lab materials and safety equipment can be broken up into sections if time restraints present a problem.
3. The teacher must insure that all students know the correct use and need of the safety equipment prior to any use in any lab.
4. Enlist students as members of the Lab Safety Committee.
5. Conduct safety drills and mock-up safety issues as a frequent part of the curriculum.
6. Every time a lab occurs where the materials might be needed, a review of procedures orally and written must also occur.
7. A printed list of safety procedures needs to be placed in every lab setting, visible to all students.
8. When working with simulated materials, the teacher should use all precautions, as if the materials were real.
9. Accidents can happen with any setting, so treat all labs as if hazards could occur. Handle everything as if it were pathogenic.
10. No eating or drinking in labs.
11. Clean spills from the outside in.

Lab Safety Handbook

Teacher Edition

5

Lab Safety Handbook – TPS Forensic Science

Tips for the teacher:

12. Wash hands before and after labs.
13. A bucket of 90% sand and 10% vermiculite, or kitty litter should be available where chemicals are used.
14. Dispose of hazardous waste in proper labeled containers.
15. Never allow students to conduct experiments alone.
16. Reiterate to students to ask if they are in doubt about use of any equipment or materials.
17. Be supportive of the students.
18. Have students sign a contract regarding science lab safety.

All students must be provided a free and appropriate education in the least restrictive environment possible through IDEA (Individuals with Disabilities Education Act).

Teacher Edition

Lab Safety Handbook





Forensic Science Club

A resource which describes a 20 week Forensic Science Club which culminates in holding a crime scene investigation with younger students

This can be run by caregivers





Digital Programs

All our components can be purchased under a digital licence, using many platforms, saving space and expenditure.

TPS Publishing Inc. Resources

Proclamation 2024

Choose a Menu:

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Assessment Generator

Texas High School Biology Assessment / Core Area 3 - Biology

Browse + Navigate

Biological evolution.

Set 7.TEKS 9

Set 7.TEKS 10

Review + Select

Core Area 3

☐ Below ☒ At ☐ Above

Biological evolution.

Set 7 -Covers: 10 – The Evidence for Evolution: 11 – Natural Selection and Evolution:

☐ **Set 7.TEKS 9** Science concepts--biological evolution. The student knows evolutionary theory is a scientific explanation for the unity and diversity of life that has multiple lines of evidence. The student is expected to:

☒ **Set 7.TEKS 10** Science concepts--biological evolution. The student knows evolutionary theory is a scientific explanation for the unity and diversity of life that has multiple mechanisms. The student is expected to:

Select Questions

Question Format

☐ Multiple Choice ☐ Open Ended ☒ Both

☒ **185** Which statement best described the differences between the terms variation and natural selection?

☒ **188** Most observable and measurable variations in characteristics are caused by a combination of both genetic and environmental factors. Inherited factors are carried in our genes and cause variations as they are expressed throughout a lifetime, whereas environmental variations are caused by external factors such as lifestyle and where we live. Which of the following statements correctly identifies variations which are caused wholly by genetic or environmental factors only?

☒ **191** Variation in a species can be categorized into two distinct groups. Which type of variation is when observations or measurements of a particular phenotype can be sorted into distinct and limited groups or categories.

☒ **194** What causes the difference between

TPS

Home Preview Questions Credits





TPS Test Prep Interactive Tool

Dashboard

NAVIGATION

Dashboard

Users

Tests / Assignments

Question studio

Assign student

User Submissions

Score Assignment

Subscriptions

Packages Store

Purchases

Users

Tests/Assignments

Question studio

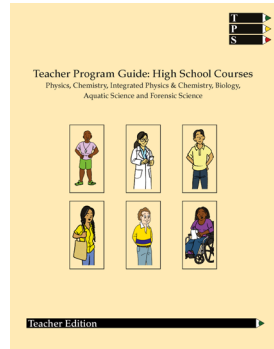
Packages Store



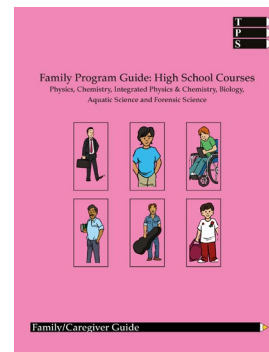
Guides

STEAM Arts Guide K-12 projects aligned to TEKS linked to global locations and people

Teacher Guide



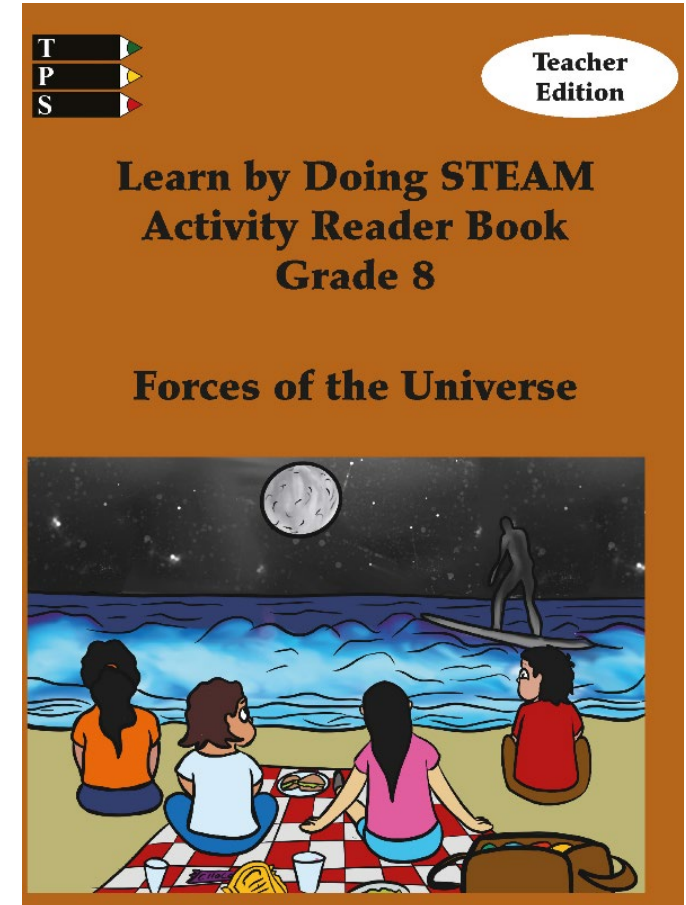
Family/Caregiver Guide





Digital Access –Learn By Doing K-8

- Learn By Doing K-8 is part of the TPS K-8 program and using storytelling, The Scientific Method and
- Design Engineering Process aligns to all TEKS K-8.
- Access is provided digitally so students operating below grade level, can use the materials and revisited prior grades, without stigma.
- The content is not labelled with grades.





Accessibility

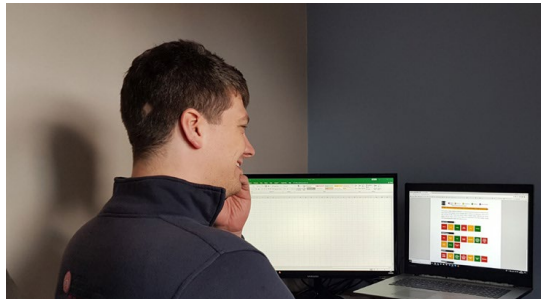
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- TPS Publishing's materials have been tested with a variety of screen readers to ensure students have the tools they need
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- Professional Development is provided by TPS teacher/writers and/or professors from Illinois State University Center for Mathematics, Science and Engineering.
- This University is one of the largest producers of teachers in the nation.
- CeMaST was one of the first STEM Centers in the U.S.A.





Caregivers

TPS provide caregivers with free of charge digital access to:

- Homework content
- Learn By Doing K-8 – allows caregivers to assist children operating with lower grade ELAR skills
- Archway – a tool to allow families to learn to read, write and speak English (you will need to assign a mentor)
- Blackline Master – Glossaries
- TPS will provide the district with a user- name and password for caregivers.





Your personalized log-on information and digital access to view all programs.

<https://tpspublishing.com/my-resources>

**Follow the link above and when prompted enter User ID & Password.
You will then be asked to agree the terms of the review before being presented with the menu.
Each course has its own sub-menu.**

Further information:

maz@tpspublishing.com or call the toll free number 866-417-9384

