

FORENSICS CURRICULUM

[NGSS link](#)



Grade Level(s): 11-12

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Course Description: Forensics L-2 is designed to meet the needs of students wishing to take a one semester elective science course above and beyond the required science courses. This class is designed around authentic performance assessments where students, both as individuals and groups, will use scientific knowledge and reasoning to solve mock crime scenes. This course will include the following units:

- Power of Observation/Introduction to Forensics
- Crime Scene Investigation and Evidence Collection
- Time of Death
- Hair & Fiber Analysis
- Fingerprint Analysis/ DNA Fingerprint Analysis
- Blood & Blood Spatter Analysis
- Handwriting / Shoeprint Analysis

Year At A Glance

Unit Title	Overarching Essential Question	Overarching Enduring Understanding	Vision of A Learner “I Can” Statements
Power of Observation /Introduction to Forensics (2-3 weeks)	How are observational skills and deductive reasoning used to solve crimes in forensic science?	Forensic science uses an investigator's ability to observe and document physical evidence, behavioral cues, and environmental factors at scenes to solve crimes.	TCC1(9-12); TCC2(9-12); TCC4(9-12)
Crime Scene Investigation and Evidence Collection (3-4 weeks)	How can meticulous observation and systematic evidence collection contribute to solving crimes and ensuring justice?	Thorough and methodical crime scene investigation and evidence collection are essential to establishing facts, reconstructing events, and facilitating justice in criminal investigations.	TCC1(9-12); TCC2(9-12); TCC3(9-12); TI3(9-12)
Time of Death (2-3 weeks)	How do forensic scientists use evidence and scientific methods to estimate the time of death accurately?	Determining the time of death is a complex and multifaceted process that integrates pathology, entomology, and environmental science to analyze postmortem changes and establish a timeline of events surrounding a death.	TCC4(9-12)
Hair & Fiber Analysis (2-3 weeks)	How can microscopic examination and chemical analysis of hair and fibers contribute to identifying individuals and reconstructing crime scenes?	Hair and fiber analysis plays a crucial role in forensic investigations by providing valuable evidence that can link individuals to crime scenes, establish timelines, and contribute to the reconstruction of events.	TCC2(9-12)
Fingerprint Analysis/ DNA fingerprinting (3-4 weeks)	How do fingerprints and DNA profiles provide unique identifiers and critical evidence in criminal investigations?	Fingerprinting and DNA fingerprinting are powerful tools in forensic science that provide unique identifiers, enabling accurate identification of individuals and aiding in criminal investigations.	TCC2(9-12); TCC4(9-12); CCE3(9-12)



Blood & Blood Spatter Analysis (3-4 weeks)	How can the analysis of blood and blood spatter patterns help reconstruct crime scenes and determine key details of violent events?	Blood and blood spatter analysis provides critical insights into crime scene dynamics, helping forensic investigators reconstruct events, determine mechanisms of injury, and contribute to the resolution of criminal cases.	TCC2(9-12); TCC3(9-12); TI3(9-12)
Handwriting/ Shoeprint Analysis (1 week)	How do the unique characteristics of handwriting and shoeprints contribute to identifying individuals and reconstructing events in forensic investigations?	Handwriting and shoeprint analysis are essential forensic tools that leverage unique characteristics to establish individual identities, reconstruct timelines, and provide critical evidence in criminal investigations.	TCC4(9-12)



Unit 1 - Power of Observation /Introduction to Forensics

Desired Results - Students will use Observations and Deductive Reasoning to Solve Crimes

Established Goals:

Common Core State Standards:

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RI.9-10.7: Analyze various accounts of a subject told in different mediums (e.g., a person's life story in print and multimedia), determining which details are emphasized in each account.

W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

NGSS Standards:

Systems and System Models (CCC 4): Investigate how different components of a forensic investigation system (e.g., evidence collection, analysis, interpretation) work together.

Vision of A Learner Attributes: Students will be able to independently use their learning to:

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

Understandings:

- Witness testimony relies on how accurately individuals perceive events and how well they can recall them later. Factors like stress, distractions, and the passage of time can all affect these abilities
- Forensic science intrigues people because it combines the rigor of scientific investigation with the drama of solving mysteries, offering insights into the human condition and justice system.
- Forensic science has undergone significant changes and advancements over time; such as utilization of sophisticated instruments and techniques for analyzing various types of evidence, including fingerprints, ballistics, trace evidence (e.g.,

Essential Questions:

- Are people reliable witnesses?
- Why does Forensic science intrigue people?
- How has forensic science changed over time?
- What career pathways can be used in Forensics?



<p>fibers, hair), and digital evidence (e.g., computer forensics) leading to more accurate and reliable methods for investigating crimes.</p> <ul style="list-style-type: none"> Forensics offers diverse career pathways across various disciplines; such as Crime Scene Investigator, Forensic Anthropologist, Forensic Psychologist, Digital Forensics Expert, Forensic Pathologist, Forensic Entomologist and toxicologist. 	
<p>Students will know...</p> <ul style="list-style-type: none"> the difference between observation and perception. examples of factors that influence eyewitness accounts. how forensic science has changed over time. the divisions of a crime lab and what happens in each department of a crime lab what the “CSI Effect” is and how it relates to juries. examples of different education disciplines that can lead to a career in forensic science. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> compare, critically, an eyewitness account to what actually happened. relate observational skills to forensic science. practice improving their observational skills. explain what happens when a person gets arrested. investigate Locard’s Exchange Principle. research a forensic career and present it to the class.
<p>Key Vocabulary: forensic science, deductive reasoning, eyewitness, perception, Bill of Rights, Miranda Rights, Locard’s Principle, Frye Standard</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks: Jane’s Crime scene activity used to improve observation skills Perception Activity: evaluate the differences between observation and perception. The Deadly Picnic: Using deductive reasoning to solve a crime Unit #1 Mini Crime Scene Forensics Career Project</p>	<p>Other Evidence: Kenneth Ireland article Answer Questions on Kenneth Ireland article Unit #1 Reading Guide Worksheet Review for Quiz on Unit #1 Topics for Unit #1 Quiz Unit #1 Quiz</p>
<p>Learning Plan</p>	
<p>RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <ul style="list-style-type: none"> <i>Reading guide fill-in notes o text</i> <i>Picture activities including Jane’s Crime Scene</i> <i>Questions on Case Study of Kenneth Ireland</i> 	



- *Solving the Deadly Picnic using deductive reasoning*

RI.9-10.7: Analyze various accounts of a subject told in different mediums (e.g., a person's life story in print and multimedia), determining which details are emphasized in each account.

- *Questions on Case Study of Kenneth Ireland*
- *Solving the Deadly Picnic using deductive reasoning*

W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

- *Forensic Science Career Project research and presentation*

Systems and System Models (CCC 4): Investigate how different components of a forensic investigation system (e.g., evidence collection, analysis, interpretation) work together.

- *Picture activities including Jane's Crime Scene*
- *Questions on Case Study of Kenneth Ireland*
- *Solving the Deadly Picnic using deductive reasoning*

Vision of A Learner Attributes:

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

- *Picture activities including Jane's Crime Scene*
- *Questions on Case Study of Kenneth Ireland*
- *Solving the Deadly Picnic using deductive reasoning*

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- *Picture activities including Jane's Crime Scene*
- *Questions on Case Study of Kenneth Ireland*
- *Solving the Deadly Picnic using deductive reasoning*

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

- *Forensic Science Career Project research and presentation*

CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

- *Forensic Science Career Project research and presentation*

Teacher Resources: Bertino Forensics textbook 3rd Edition Chapter 1

Unit 2 - Crime Scene Investigation and Evidence Collection

Desired Results - Students will use thorough and methodical crime scene investigation and evidence collection to establish facts, reconstruct events, and facilitate justice in criminal investigations.

Established Goals:

Common Core State Standards:

RI.9-10.7: Analyze various accounts of a subject told in different mediums (e.g., a person's life story in print and multimedia), determining which details are emphasized in each account.

W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

S-ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

NGSS Standards:

Constructing Explanations and Designing Solutions (SEP 6): Develop explanations based on evidence collected from crime scenes or design solutions for analyzing and preserving evidence.

Systems and System Models (CCC 4): Investigate how different components of a forensic investigation system (e.g., evidence collection, analysis, interpretation) work together.

HS-PS1-3 (PS1.A): Plan and conduct investigations to gather evidence and use the evidence to construct an explanation of the crime scene using atomic and molecular interactions.

HS-ESS2-7 (ESS2.D): Investigate crime scene evidence and use models to predict how Earth's systems impact the evidence found.

HS-PS2-1 (PS2.A): Use mathematical representations to support claims for the motions and interactions of objects in crime scene reconstructions.

Vision of A Learner Attributes: Students will be able to independently use their learning to:

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

TI3(9-12): I can formulate and investigate probing questions to further my learning.

Enduring Understandings:

- Crime scenes are sketched to provide a visual representation of the scene's layout, the placement of evidence, and the spatial relationships between various elements.

Essential Questions:

- How are crime scenes sketched?
- What happens once a crime scene is found?
- How does the police process crime scenes?
- How is evidence classified?



<ul style="list-style-type: none"> • Once a crime scene is found, a series of critical steps such as securing the scene, documenting the scene, searching for evidence, collecting and packaging evidence, interviewing witnesses, processing forensic evidence to ensure the preservation of evidence and the thorough investigation of the incident. • Processing a crime scene is a meticulous and systematic process conducted by law enforcement personnel to gather evidence, document findings, and preserve the integrity of the scene. • Evidence in the context of criminal investigations is classified into different types based on its nature, relevance, and potential to support or refute a hypothesis or allegation. • Police investigators look for anything that appears out of place, unusual, or potentially connected to the crime. This could include weapons, bloodstains, damaged property, or items that may have been moved or tampered with. • Effective crime scene preservation and evidence collection require collaboration between forensic scientists, law enforcement officers, and other experts to ensure thorough examination and analysis. Also, accurate documentation and maintaining a clear chain of custody are critical to ensure the admissibility of evidence in legal proceedings. 	<ul style="list-style-type: none"> • How do the police know what is evidence and what is not? • How are different types of evidence collected properly?
<p>Students will know...</p> <ul style="list-style-type: none"> • what constitutes a crime scene. • the importance of first responding officer/crime scene investigator's actions in maintaining the integrity of the crime scene during the investigation. • crime scenes are sketched and the types of information that must be included in the final sketch. • what types of information need to be recorded at the crime scene. • evidence is classified as individual or class. • how different pieces of evidence are collected and packaged properly (ex. hair, DNA, blood, fibers, firearms, etc.) • how to fill out the chain of custody of the evidence. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • explain the jobs of the first responder and the first responding officer in securing and maintaining the integrity of the crime scene. • create a rough sketch of a crime scene. • use triangulation to locate evidence within a crime scene so that it can be put into the crime scene sketch. • create a final crime scene sketch to scale and include all of the necessary information on that sketch. • package different types of evidence and complete a chain of custody properly. • determine the probability of an occurrence using the product rule.

<ul style="list-style-type: none"> the different types of evidence databases that are available to police. 	
Key Vocabulary: crime scene, chain of custody, first responder, crime-scene reconstruction, paper bindle (druggist fold), primary and secondary crime scenes, circumstantial evidence, direct evidence, class evidence, individual evidence, trace evidence, product rule	
Assessment Evidence	
Performance Tasks: Search Warrants Activity to determine what is a legal vs. illegal search Product Rule Probability Calculations Sketching a crime scene lab activity Mini Crime scene activity: Collecting Evidence Physical Evidence Collecting Lab Activity	Other Evidence: Quiz on performing proper evidence collection Units #1 & 2 Test
Learning Plan	
<p>RI.9-10.7: Analyze various accounts of a subject told in different mediums (e.g., a person's life story in print and multimedia), determining which details are emphasized in each account.</p> <ul style="list-style-type: none"> <i>Mini Crime scene activity: Collecting Evidence</i> <i>Search Warrant Activity</i> <p>W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.</p> <ul style="list-style-type: none"> <i>Mini Crime scene activity: Collecting Evidence</i> <i>Physical Evidence Collecting Activity</i> <p>S-ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <ul style="list-style-type: none"> <i>Sketching a crime scene</i> <i>Product Rule and Probability Activity</i> <p>Constructing Explanations and Designing Solutions (SEP 6): Develop explanations based on evidence collected from crime scenes or design solutions for analyzing and preserving evidence.</p> <ul style="list-style-type: none"> <i>Mini Crime scene activity: Collecting Evidence</i> <i>Physical Evidence Collecting Activity</i> <i>Sketching a Crime Scene</i> <i>Search Warrant Activity</i> <p>Systems and System Models (CCC 4): Investigate how different components of a forensic investigation system (e.g., evidence collection, analysis, interpretation) work together.</p>	



- *Mini Crime scene activity: Collecting Evidence*
- *Physical Evidence Collecting Activity*

HS-PS1-3 (PS1.A): Plan and conduct investigations to gather evidence and use the evidence to construct an explanation of the crime scene using atomic and molecular interactions.

- *Mini Crime scene activity: Collecting Evidence*
- *Physical Evidence Collecting Activity*

HS-PS2-1 (PS2.A): Use mathematical representations to support claims for the motions and interactions of objects in crime scene reconstructions.

- *Sketching a crime scene with evidence measured from two stationary points.*

HS-ESS2-7 (ESS2.D): Investigate crime scene evidence and use models to predict how Earth's systems impact the evidence found.

- *Sketching a crime scene with evidence measured from two stationary points.*
- *Product rule and probability Calculations*

Vision of A Learner Attributes:

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

- *Mini Crime scene activity: Collecting Evidence*
- *Sketching a Crime Scene*

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- *Mini Crime scene activity: Collecting Evidence*
- *Physical Evidence Collecting Activity*
- *Search Warrant Activity*

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

- *Mini Crime scene activity: Collecting Evidence*
- *Physical Evidence Collecting Activity*
- *Search Warrant Activity*
- *Sketching a Crime Scene*

TI3(9-12): I can formulate and investigate probing questions to further my learning.

- *Mini Crime scene activity: Collecting Evidence*
- *Search Warrant Activity*

Teacher Resources: Bertino Forensics textbook 3rd Edition

Unit 3 - Time of Death

Desired Results - Students will be able to determine the time of death using pathology, entomology, and environmental science.

Established Goals:

Common Core State Standards:

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

NGSS Standards:

HS-LS1-2 (LS1.B): Develop and use a model to illustrate the key steps of decomposition and how they relate to the time of death.

HS-PS1-7 (PS1.A): Use mathematical representations to support explanations of factors that affect the rate of chemical reactions in decomposition processes.

HS-ESS2-5 (ESS2.C): Develop and use a model to describe how changes in temperature and other environmental factors affect the rate of decomposition and time of death estimation.

Vision of A Learner Attributes: Students will be able to independently use their learning to:

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

Understandings:

- Different countries and jurisdictions may have specific legal definitions and criteria for declaring death, which may include the involvement of specialized medical experts and protocols to ensure accuracy and consistency in determining the end of life.
- Medical examiners estimate time of death based on characteristics of the body and stages of insect development.
- Insects have predictable life cycles, including egg, larval (maggot), pupal, and adult stages. Forensic entomologists can examine the developmental stage of insect larvae found on or near the body to estimate the time since colonization (minimum PMI).
- Environmental factors such as ambient temperature, humidity, exposure to sunlight, moisture and air circulation

Essential Questions:

- How is death defined?
- How does the medical examiner estimate the time of death?
- How can insects help estimate the time of death?
- How do environmental factors influence the estimated time of death?
- How is an autopsy done?

<p>play a significant role in influencing the estimated time of death (postmortem interval, PMI) in forensic investigations.</p> <ul style="list-style-type: none"> • An autopsy, also known as a postmortem examination, is a medical procedure performed by a forensic pathologist to examine a deceased person's body in order to determine the cause of death, understand the circumstances surrounding death, and gather forensic evidence. 	
<p>Students will know...</p> <ul style="list-style-type: none"> • the manner, cause and mechanism of death and how “death” itself is defined by experts. • time of death can be estimated based on biological processes, such as rigor mortis, livor mortis, and decomposition. • what environmental factors will affect body decomposition. • the succession of different types of insects that are found on a body as it decomposes and what each stage of development indicates about time of death. • how to explain what is involved in the forensic analysis of a deceased body, including conducting an autopsy, establishing post mortem interval, and determining a probable cause of death. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • distinguish between the four manners of death: natural, accidental, suicidal and homicidal. • describe the stages of decomposition of a corpse. • calculate the approximate time of death using algor mortis, rigor mortis and livor mortis, stomach contents • calculate time of death using the insect stage of development of blow flies. • predict the influence of environmental factors on body decomposition
<p>Key Vocabulary: cause of death, manner of death, mechanism of death, algor mortis, rigor mortis, livor mortis, autolysis, entomology, larva, instar, spiracle, pupa, autopsy</p>	
<p style="text-align: center;">Assessment Evidence</p>	
<p>Performance Tasks: Estimating time of death using a graph Algor mortis: time of death calculations Time of death discovery based on stomach contents, environmental conditions and algor, liver & rigor mortis When did Zelda die? Mystery</p>	<p>Other Evidence: Case Studies on “A Maggot for the Prosecution” and Stella Nickell cases. Unit #3: Time of Death Test</p>

Learning Plan

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

- *Evaluation of Stella Nickell Case Study & “A Maggot for the Prosecution” Article*
- *Fill-in Notes*
- *“When did Zelda Die?” Activity*

HS-LS1-2 (LS1.B): Develop and use a model to illustrate the key steps of decomposition and how they relate to the time of death.

- *Estimating Time of Death Graphing Exercise*

HS-PS1-7 (PS1.A): Use mathematical representations to support explanations of factors that affect the rate of chemical reactions in decomposition processes.

- *Estimating Time of Death Graphing Exercise*
- *Algor mortis Calculation problems*
- *“When did Zelda Die?” Activity*
- *Determining Time of Death using algor, livor & rigor mortis, stomach contents and environmental factors Activity*

HS-ESS2-5 (ESS2.C): Develop and use a model to describe how changes in temperature and other environmental factors affect the rate of decomposition and time of death estimation.

- *Estimating Time of Death Graphing Exercise*
- *Algor mortis Calculation problems*
- *“When did Zelda Die?” Activity*
- *Determining Time of Death using algor, livor & rigor mortis, stomach contents and environmental factors Activity*

Vision of A Learner Attributes:

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

- *“When did Zelda Die?” Activity*
- *Determining Time of Death using algor, livor & rigor mortis, stomach contents and environmental factors Activity*

Teacher Resources: Bertino Forensics textbook 3rd Edition

Unit 4 - Hair & Fiber Analysis

Desired Results - Students will use hair and fiber analysis to link individuals to crime scenes.

Established Goals:

Common Core State Standards:

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

NGSS Standards:

HS-LS1-1 (LS1.A): Use models and evidence to explain the role of cellular structures in the functioning of living organisms, which can be applied to understanding hair structure and growth.

HS-PS1-3 (PS1.A): Plan and conduct investigations to gather evidence to compare the substances found in different types of fibers and their interactions with other substances.

HS-ETS1-3 (ETS1.B): Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, which could relate to improving forensic methods for hair and fiber analysis.

Vision of A Learner Attributes: Students will be able to independently use their learning to:

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

Understandings:

- Hair and fibers possess unique microscopic characteristics that can be used to associate them with a particular individual, location, or source.
- Human and animal hairs differ in several key aspects, including their structure, composition, growth patterns, and microscopic characteristics.
- Forensic scientists use a combination of macroscopic and microscopic characteristics such as color, length, diameter, cuticle pattern, and medullary index to differentiate between different hairs, whether they are from different individuals or different species.
- Forensic scientists use various methods to differentiate between different types of fibers found at a crime scene or associated with evidence such as structure, color, dye analysis, flame tests, texture and diameter measurements.

Essential Questions:

- How are hair & fibers used in forensics?
- How do human and animal hairs differ?
- How do forensic scientists tell different hairs apart?
- How do forensic scientists tell different fibers apart?
- How are natural and synthetic fibers different?



<p>Students will know...</p> <ul style="list-style-type: none"> • the structural makeup of a hair. • the different places hair is found on the human body and how it is collected. • how to determine if hair is human or animal origin. • how to measure and calculate the medullary index of a hair. • the different techniques that can be used in hair analysis. • where DNA can be found in hair. • the different techniques that can be used in fiber analysis. • how to determine if a fiber is natural or synthetic. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • use a microscope to draw different types of human and animal hair. • label and describe the structure of hair. • analyze an unknown hair to determine if it is of human or animal origin. • calculate the medullary index of hair (if a medulla is present) • create a cuticle imprint from a hair. • use a microscope to draw different types of fibers: cotton, wool, polyester, rayon, nylon and acrylic. • perform a burn test on a fiber to determine the type of fiber material. • analyze an unknown fiber to determine the type of fiber.
<p>Key Vocabulary: medulla, cortex, cuticle, hair follicle, follicular tag, keratin, melanin, neutron activation analysis, comparison microscope, natural fiber, synthetic fiber, textile, warp, weft, monomer, polymer, yarn, amorphous, flame test</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks: Hair Lab: evaluating human & animal hairs under the microscope to determine identifiable characteristics. Fiber lab: evaluating natural & synthetic hairs under the microscope to determine identifiable characteristics.</p>	<p>Other Evidence: Dead Reckoning and Enrique Camerena Case Studies Test on Hair & Fibers</p>
<p>Learning Plan</p>	
<p>RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <ul style="list-style-type: none"> • <i>Dead Reckoning and Enrique Camerena Case Studies</i> <p>HS-LS1-1 (LS1.A): Use models and evidence to explain the role of cellular structures in the functioning of living organisms, which can be applied to understanding hair structure and growth.</p> <ul style="list-style-type: none"> • <i>Hair Lab</i> • <i>Fiber lab</i> <p>HS-PS1-3 (PS1.A): Plan and conduct investigations to gather evidence to compare the substances found in different types of fibers and their interactions with other substances.</p> <ul style="list-style-type: none"> • <i>Hair Lab</i> • <i>Fiber lab</i> 	

HS-ETS1-3 (ETS1.B): Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, which could relate to improving forensic methods for hair and fiber analysis.

- *Hair Lab*
- *Fiber lab*

Vision of A Learner Attributes: Students will be able to independently use their learning to:

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- *Hair Lab*
- *Fiber lab*

Teacher Resources: Bertino Forensics textbook 3rd Edition



Unit 5 - Fingerprint Analysis/ DNA Fingerprinting

Desired Results - Students will use fingerprinting and DNA fingerprinting to identify individuals in criminal investigations.

Established Goals:

Common Core State Standards:

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

S-ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

NGSS Standards:

Analyzing and Interpreting Data (SEP 4): Students can analyze patterns in data related to crime scenes, DNA analysis, or other forensic evidence.

Using Mathematics and Computational Thinking (SEP 5): Apply mathematical reasoning and computational tools to analyze forensic data, such as DNA sequences or statistical analyses of evidence.

Patterns (CCC 1): Identify patterns in evidence, such as blood spatter patterns or fingerprint ridge characteristics.

Systems and System Models (CCC 4): Investigate how different components of a forensic investigation system (e.g., evidence collection, analysis, interpretation) work together.

LS1: From Molecules to Organisms: Structures and Processes: Relate concepts of DNA structure and function to forensic DNA analysis.

LS4: Biological Evolution: Unity and Diversity: Explore concepts of genetic variation and inheritance in forensic genetics.

HS-LS3-1 (LS3.A): Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms, including DNA structure and function.

Vision of A Learner Attributes: Students will be able to independently use their learning to:

CCE3(9-12): I can show initiative in prompting group discourse and fostering collaboration among others, providing actionable feedback, and working with others to solve problems and/or design products.

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

Understandings:

- Fingerprints are unique to each individual and can be used as reliable identifiers in forensic investigations because they have patterns that can be classified into distinct categories (arches, loops, whorls) to aid in identification and comparison.
- Forensic technicians use fingerprint powder, which is often a fine, colored powder (e.g., black, white, or fluorescent) that

Essential Questions:

- How are fingerprints unique to each person?
- How are fingerprints lifted at a crime scene?
- How do forensic scientists match a fingerprint to a person?
- How is DNA unique to each individual (except identical twins)?
- How does the structure of DNA lend itself to be used in forensic analysis?

<p>adheres to the oils and residues left behind by fingers and lifts the dusted prints with adhesive tape.</p> <ul style="list-style-type: none"> • Forensic scientists use points of similarity and minutiae in fingerprints to match questioned prints with known prints from suspects or databases such as AFIS. • DNA profiles are unique to each individual (except identical twins) and provide highly specific identification. • DNA sequences vary among individuals, allowing for differentiation and identification through separation of different lengths of fragments by gel electrophoresis. • DNA profiling is used to match biological evidence (such as blood, saliva, or hair) with individuals, establish paternity, and identify victims and suspects. • DNA sequencing technologies, such as PCR (which creates millions of copies of DNA), gel electrophoresis and next-generation sequencing, have revolutionized forensic DNA analysis, making it faster and more sensitive. 	<ul style="list-style-type: none"> • Where can DNA be found in a crime scene? • How can forensic scientists create copies of DNA and analyze to match suspects?
<p>Students will know...</p> <ul style="list-style-type: none"> • fingerprints are caused by dermal skin ridges that form in utero and serve a purpose. • no two people have the same fingerprints based on their ridge patterns called minutiae. • how fingerprints are classified. • how the Henry system is used to classify fingerprints. • fingerprints may be visible or invisible to the naked eye at a crime scene. • how fingerprints can be lifted at a crime scene and analyzed. • how some criminals attempted to alter their fingerprints. • IAFIS is the database for fingerprints. • that DNA, except for identical twins, is unique to each individual. • the basic structure and components of DNA • PCR (Polymerase Chain Reaction) is a technique used by forensic scientists to make copies of DNA. • that restriction enzymes are used to cut DNA into fragments. • Gel Electrophoresis is a technique used to separate strands of DNA by length and match to specific individuals. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • create a 10 print card of their fingerprints. • identify the characteristics of fingerprints (loop, whorl or arch and what type). • calculate their Henry system number using their ten-print card. • identify whether a fingerprint is a patent, latent or plastic print. • match prints if given samples. • identify minutiae patterns in fingerprints. • properly collect fingerprints using charcoal dusting powder, magnetic powder, cyanoacrylate fuming, iodine fuming. • explain the structure & significance of DNA in a human. • explain the base-pairing rules for the nitrogen bases and use it to create the complementary strand of DNA if given one side of the strand. • explain how PCR works and its benefits. • model how a restriction enzyme is used to cut DNA and how gel electrophoresis is used to separate the fragments of DNA. • conduct a gel electrophoresis experiment using DNA samples including: making the gel, loading the samples in the gel, staining the gel and analyzing the gel.

<ul style="list-style-type: none"> • DNA can be found in saliva, skin, semen, blood, sweat or hair found at crime scenes, • CODIS is the database for DNA samples. 	
<p>Key Vocabulary: loop, whorl, arch, delta, core, minutiae (bridge, bifurcation, island, eye, ridge, dot, spur, trifurcation), ten-print card, Henry System, plastic fingerprint, latent fingerprint, patent fingerprint, ridge pattern, ninhydrin, cyanoacrylate fuming, silver nitrate, iodine fuming, magnetic powder, double helix, nucleotide, nitrogen bases (adenine, thymine, guanine, and cytosine), deoxyribose, allele, chromosome, DNA fingerprint, restriction enzymes, gene, gel electrophoresis, PCR(polymerase chain reaction), STR (short tandem repeat), polymorphisms</p>	
<p style="text-align: center;">Assessment Evidence</p>	
<p>Performance Tasks: 10 Fingerprints Card Lab and analysis: students take their own fingerprints, identity characteristics, minutiae and calculate Henry system value. Lifting Fingerprints Lab: students dust or fingerprints, lift them and analyze characteristics. Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates. Matching DNA fingerprinting to correct suspect</p>	<p>Other Evidence: Should the Government be able to collect DNA?: Class debate/discussion Fingerprinting & DNA fingerprinting Test</p>
<p style="text-align: center;">Learning Plan</p>	
<p>RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <ul style="list-style-type: none"> • <i>Should the Government be able to collect DNA?</i> • <i>Matching DNA fingerprinting to correct suspect</i> <p>S-ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <ul style="list-style-type: none"> • <i>10 Fingerprints Card Lab and analysis: students calculate Henry system value.</i> • <i>Lifting Fingerprints Lab: students dust or fingerprints, lift them and analyze characteristics.</i> • <i>Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.</i> • <i>Matching DNA fingerprinting to correct suspect</i> <p>Analyzing and Interpreting Data (SEP 4): Students can analyze patterns in data related to crime scenes, DNA analysis, or other forensic evidence.</p> <ul style="list-style-type: none"> • <i>10 Fingerprints Card Lab and analysis: students calculate Henry system value.</i> 	



- *Lifting Fingerprints Lab: students dust or fingerprints, lift them and analyze characteristics.*
- *Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.*
- *Matching DNA fingerprinting to correct suspect*

Using Mathematics and Computational Thinking (SEP 5): Apply mathematical reasoning and computational tools to analyze forensic data, such as DNA sequences or statistical analyses of evidence.

- *10 Fingerprints Card Lab and analysis: students calculate Henry system value.*

Patterns (CCC 1): Identify patterns in evidence, such as blood spatter patterns or fingerprint ridge characteristics.

- *10 Fingerprints Card Lab and analysis: students calculate Henry system value.*
- *Lifting Fingerprints Lab: students dust or fingerprints, lift them and analyze characteristics.*
- *Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.*
- *Matching DNA fingerprinting to correct suspect*

Systems and System Models (CCC 4): Investigate how different components of a forensic investigation system (e.g., evidence collection, analysis, interpretation) work together.

- *Lifting Fingerprints Lab: students dust or fingerprints, lift them and analyze characteristics.*
- *Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.*

LS1: From Molecules to Organisms: Structures and Processes: Relate concepts of DNA structure and function to forensic DNA analysis.

- *Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.*

LS4: Biological Evolution: Unity and Diversity: Explore concepts of genetic variation and inheritance in forensic genetics.

- *Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.*
- *Matching DNA fingerprinting to correct suspect*

HS-LS3-1 (LS3.A): Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms, including DNA structure and function.

- *Online Gel electrophoresis lab: students separate DNA fragments using virtual gel plates.*
- *Matching DNA fingerprinting to correct suspect*

Vision of A Learner Attributes:

CCE3(9-12): I can show initiative in prompting group discourse and fostering collaboration among others, providing actionable feedback, and working with others to solve problems and/or design products.

- *Should the Government be able to collect DNA?*

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- *Should the Government be able to collect DNA?*

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

- *10 Fingerprints Card Lab and analysis: students calculate Henry system value.*
- *Lifting Fingerprints Lab: students dust or fingerprints, lift them and analyze characteristics.*
- *Should the Government be able to collect DNA?*

Teacher Resources: Bertino Forensics textbook 3rd Edition

Unit 6 - Blood & Blood Spatter Analysis

Desired Results - Students will use blood and blood spatter analysis to reconstruct events, determine mechanisms of injury, and solve criminal cases.

Established Goals:

Common Core State Standards:

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

NGSS Standards:

Patterns (CCC 1): Identify patterns in evidence, such as blood spatter patterns or fingerprint ridge characteristics.

LS4: Biological Evolution: Unity and Diversity: Explore concepts of genetic variation and inheritance in forensic genetics.

HS-PS2-1 (PS2.A): Investigate and explain the relationships between the motion of objects and the forces acting on them to analyze blood spatter patterns and trajectories.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

TI3(9-12): I can formulate and investigate probing questions to further my learning.

Understandings:

- Blood is a crucial form of physical evidence at crime scenes, providing information about the events that occurred. Blood typing is class evidence; DNA analysis of blood can identify individuals, link suspects to crime scenes, and exclude innocent parties.
- Blood spatter patterns can provide insights into the direction, angle, and velocity of impacts, helping to interpret patterns to reconstruct the sequence of events at a crime scene, considering factors such as weapon type, force, and victim position.
- Students will understand that various forensic techniques, such as luminol testing, pattern analysis, and DNA profiling of

Essential Questions:

- How is blood type at a crime scene used in forensics?
- What can blood or blood spatter at a crime scene tell forensic scientists about the crime?
- How can you tell if blood found at a crime scene is human blood, animal blood or something else?

<p>blood stains, contribute to the identification of blood as human or animal and aid in the prosecution of crimes</p>	
<p>Students will know...</p> <ul style="list-style-type: none"> • the composition of blood and the function of its components. • that blood types (ABO system) are based on antigens found on the surface of red blood cells. • that blood typing is based on antigen-antibody complexes that are part of the normal immune system function in humans. • how to calculate the probability of certain blood types or blood proteins in a population. • the different tests that can be used to determine the presence of blood: hemastix, Kastle-Meyer, blood typing, precipitin, etc. • that blood spatter can tell forensic scientists: the velocity of blood drop, direction the blood came from and at what angle, what type of weapon may have been used, the height the victim was at when they were attacked, where the person was when they were attacked, etc. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • explain the components in blood and their functions. • explain the antigen-antibody complex and how it relates to blood typing. • conduct a blood typing analysis with simulated blood to determine blood types. • calculate the probability of certain blood types/ blood proteins in a given population. • conduct an experiment to determine if blood is present or not. • conduct an experiment, gather data and analyze the effect of impact angle on blood drops. • conduct an experiment, gather data, and analyze the effect of height of a blood drop on blood spatter patterns. • conduct experiments, gather data and analyze the effect of arterial spurts, walking, running, velocity, etc. have on blood spatter patterns.
<p>Key Vocabulary: agglutination, antibodies, antigens, antigen-antibody response, plasma membrane proteins, red blood cells, white blood cells, plasma, , platelets, blood clotting, ABO blood groups, point of origin, line of convergence, satellite drop, spike, velocity</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks: Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests Punnett Squares Activity Blood Spatter Lab: students create various blood spatter patterns and take measurements of blood drops and angles of impact.</p>	<p>Other Evidence: Blood & Blood Spatter Test</p>
<p>Learning Plan</p>	
<p>RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <ul style="list-style-type: none"> • <i>Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests</i> <p>W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the</p>	



effective selection, organization, and analysis of content.

- *Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests*

Patterns (CCC 1): Identify patterns in evidence, such as blood spatter patterns or fingerprint ridge characteristics.

- *Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests*
- *Blood Spatter Lab: students create various blood spatter patterns and take measurements of blood drops and angles of impact.*

LS4: Biological Evolution: Unity and Diversity: Explore concepts of genetic variation and inheritance in forensic genetics.

- *Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests*
- *Punnett Squares Activity*

HS-PS2-1 (PS2.A): Investigate and explain the relationships between the motion of objects and the forces acting on them to analyze blood spatter patterns and trajectories.

- *Blood Spatter Lab: students create various blood spatter patterns and take measurements of blood drops and angles of impact.*

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- *Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests*
- *Blood Spatter Lab: students create various blood spatter patterns and take measurements of blood drops and angles of impact.*

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

- *Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests*
- *Blood Spatter Lab: students create various blood spatter patterns and take measurements of blood drops and angles of impact.*
- *Punnett Squares Activity*

TI3(9-12): I can formulate and investigate probing questions to further my learning.

- *Blood Typing Lab: students identify which child belongs to which couple by completing multiple blood typing tests*
- *Blood Spatter Lab: students create various blood spatter patterns and take measurements of blood drops and angles of impact.*

Teacher Resources: Bertino Forensics textbook 3rd Edition

Unit 7 - Handwriting/ Shoeprint Analysis

Desired Results - Students will use the unique characteristics of handwriting and shoeprints to solve criminal investigations.

Established Goals:

Common Core State Standards:

RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

NGSS Standards:

Patterns (CCC 1): Identify patterns in evidence, such as blood spatter patterns or fingerprint ridge characteristics.

Vision of A Learner Attributes: Students will be able to independently use their learning to:

TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

Understandings:

- Handwriting has unique features that can be used to identify individuals, including stroke formation, spacing, and letter forms.
- Forensic document examiners use comparative analysis to determine the likelihood of a match between questioned handwriting and known examples.
- Shoe Prints can be collected as impression evidence from crime scenes and compared to known shoe impressions or databases.
- Shoe Prints exhibit both class characteristics (related to shoe type and size) and individual characteristics (wear patterns, unique markings).

Essential Questions:

- How can handwriting analysis be used to identify individuals in forensic investigations?
- What are the key characteristics of handwriting that forensic experts look for in their analysis?
- How are shoeprints left at crime scenes and what information can they provide to investigators?
- What are the methods and technologies used to collect and analyze shoeprint evidence?

Students will know...

- handwriting analysis relies on the unique characteristics and habits of individuals, which can be systematically identified and compared.
- handwriting analysis requires a combination of observational skills, scientific methods, and forensic techniques to establish connections between individuals and written documents.
- that the analysis of shoeprints involves understanding how various factors, such as shoe design, wear patterns, and environmental conditions, influence the impressions left at crime

Students will be able to...

- list handwriting characteristics that are used to identify a suspect.
- compare and identify the suspect from various handwriting samples.
- create a shoe print cast .
- compare and identify the suspect from various shoe print samples.

scenes. <ul style="list-style-type: none"> the limitations in shoeprint analysis, such as variations in footwear manufacturing and degradation of impression quality over time, must be considered when drawing conclusions in forensic investigations. 	
Key Vocabulary: Exemplar, graphology, individual characteristics, class characteristics, forgery, footwear impression, tread pattern, wear patterns, casting, impression evidence, forensic document examiner, ridge characteristics	
Assessment Evidence	
Performance Tasks: Handwriting Lab Shoeprint cast creation lab & Analysis (if time permits) Final Crime Scene Performance Assessment	Other Evidence: Handwriting analysis
Learning Plan	
RI.9-10.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. <ul style="list-style-type: none"> <i>Handwriting Lab</i> <i>Shoeprint cast creation lab & Analysis (if time permits)</i> <i>Final Crime Scene Performance Assessment</i> NGSS Standards: Patterns (CCC 1): Identify patterns in evidence, such as blood spatter patterns or fingerprint ridge characteristics. <ul style="list-style-type: none"> <i>Handwriting Lab</i> <i>Shoeprint cast creation lab & Analysis (if time permits)</i> <i>Final Crime Scene Performance Assessment</i> Vision of A Learner Attributes: TCC4(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life. <ul style="list-style-type: none"> <i>Handwriting Lab</i> <i>Shoeprint cast creation lab & Analysis (if time permits)</i> <i>Final Crime Scene Performance Assessment</i> 	
Teacher Resources: Bertino Forensics textbook 3rd Edition	