

# **NEW MILFORD PUBLIC SCHOOLS**

**New Milford, Connecticut**



## **College Prep Forensic Science**

**June 2016**

BOE Approved 04/18/2017

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## **New Milford Public Schools Mission Statement**

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

## **Course Overview**

### **College Prep Forensic Science**

Forensic Science is an integrated course in which students weave the various core sciences together to problem solve using crime scene scenarios. Students use open-ended inquiry, logic, and analytical thought to make sense of various types of evidence. Technology and laboratory techniques such as gel electrophoresis, fingerprinting analysis, blood typing, hair and fiber analysis, and microscopy are used. This is a rigorous semester course for academic level credit. Students may contract for honors level credit with teacher recommendation.

Committee Member(s): John Boothby Unit Title: <b>Introduction to Forensic Science</b>	Course/Subject: Forensic Science Grade Level: 11-12 # of Weeks: 3
<b>Identify Desired Results</b>	
<b>Common Core Standards</b>	
<ul style="list-style-type: none"> <li>● CCSS.ELA-Literacy.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</li> <li>● CCSS.ELA-Literacy.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</li> <li>● CCSS.ELA-Literacy.WHST.11-12.2.d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.</li> <li>● CCSS.ELA-Literacy.WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</li> </ul>	
<b>Enduring Understandings</b> Generalizations of desired understanding via essential questions (Students will understand that ...)	<b>Essential Questions</b> Inquiry used to explore generalizations
<ul style="list-style-type: none"> <li>● Forensic science is the application of scientific knowledge and techniques to solving crime.</li> <li>● Physical evidence is impartial and unbiased, unlike direct evidence (eyewitness testimony).</li> <li>● Evidence is only as good as the technology that exists and the expertise of the investigators.</li> <li>● A reconstruction must account for all the evidence and is the best explanation for the events which created the evidence.</li> <li>● Evidence that can be <i>individualized</i> can be narrowed down to one source, whereas evidence that can be merely <i>classified</i> can be narrowed down to a group.</li> </ul>	<ul style="list-style-type: none"> <li>● What is forensic science, and what is its role in the American legal system?</li> <li>● How is the scientific method utilized in forensic science?</li> <li>● How is physical evidence created at a crime scene, and how does the forensic scientist use it to answer questions?</li> <li>● What role do reconstruction patterns and individualization patterns play in forensic science?</li> <li>● What limitations exist in forensic science today?</li> </ul>

<b>Expected Performances</b> What students should know and be able to do	
<p>Students will know the following:</p> <ul style="list-style-type: none"> <li>● Any object or observed condition at a crime scene may be considered physical evidence.</li> <li>● To obtain the full value of the evidence, it must be evaluated by trained experts possessing adequate technology.</li> <li>● The scientific method must be applied during any forensic investigation.</li> <li>● There are many forensic science disciplines that fall under “forensic science” (from forensic anthropologist through forensic toxicologist). There are many career opportunities.</li> <li>● A reconstruction is more scientific than a reenactment, as it is limited to the evidence and must explain all evidence.</li> <li>● Eyewitness testimony is responsible for the majority of wrongful convictions.</li> <li>● Forensic science provides a major societal benefit, yet costs only a small fraction of what is spent for the entire legal system.</li> <li>● Individualization means to narrow down to one source, whereas classification means to narrow down to a group.</li> </ul> <p>Students will be able to do the following:</p> <ul style="list-style-type: none"> <li>● Identify whether something is considered physical evidence</li> <li>● Correctly apply the scientific method to a situation encountered by a forensic scientist</li> <li>● Detail a day in the life of a forensic scientist of his/her choosing</li> <li>● Construct a reconstruction based on evidence</li> <li>● Show the specific source of a piece of evidence (individualization)</li> </ul>	
<b>Character Attributes</b>	
<ul style="list-style-type: none"> <li>● Integrity -            Webster’s dictionary provides two definitions of integrity, both of which will be stressed in forensic science. First, integrity is the quality of soundness or perfect condition. The integrity of the collection and documentation process of crime scene evidence is essential in the presentation of a criminal case. Prosecutors must be able to show that each piece of evidence “is the exact same object that was collected from the victim, suspect or crime scene.” Documentation is crucial in that the “exact location where an item was found [is] important in reconstructing the incident.” (Gaensslen, 44). Integrity of the evidence will be emphasized at all times during the course, especially during lab experiences. Second, integrity is the quality of sound moral principle. Personal integrity will be emphasized with each student as it relates to a career in forensic science. Each student will be encouraged to treat his or her assignments with the seriousness and responsibility of someone who is contributing to the determination of another’s fate.</li> </ul>	

<ul style="list-style-type: none"> <li>● Honesty</li> </ul>	
<b>Technology Competencies</b>	
<ul style="list-style-type: none"> <li>● Use of stereomicroscope</li> </ul>	
<b>Develop Teaching and Learning Plan</b>	
<p>Teaching Strategies:</p> <ul style="list-style-type: none"> <li>● Ask students to provide examples of physical evidence</li> <li>● Individual research of forensic disciplines</li> <li>● Use microscope to explain individualization vs. classification (use of torn vs cut paper samples)</li> <li>● Use the movie <i>The Bone Collector</i> to demonstrate forensic science techniques. Call students' attention to any action in the movie that has potential to help solve the crime.</li> </ul>	<p>Learning Activities:</p> <ul style="list-style-type: none"> <li>● NOVA special: Forensic Science on Trial - discusses problems that exist in forensic science</li> <li>● Forensic specialty writing assignment - "A day in the life of a forensic _____" (anthropologist, odontologist, sculptor, etc.)</li> <li>● Analyze paper samples under microscope to explore individualization vs. classification</li> <li>● Explain forensic science techniques observed in the movie <i>The Bone Collector</i></li> </ul>

<b>Assessments</b>	
<b>Performance Task(s)</b>	<b>Other Evidence</b>
Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	Application that is functional in a classroom context to evaluate student achievement of desired results

<p>Goal: Demonstrate individualization of paper samples</p> <p>Role: Lab technician</p> <p>Audience: Classmates, teacher</p> <p>Situation: Evidence has been retrieved from crime scene</p> <p>Product or Performance: Properly focus microscope and show how samples line up and whether a direct match can be declared</p> <p>Standards for Success: Student can correctly state whether a piece of evidence is a class characteristic whether it has potential to be individualized</p>	<p>Formative</p> <ul style="list-style-type: none"> <li>● Jumpstarts</li> <li>● Exit tickets</li> <li>● Reading guides</li> <li>● Lab questions</li> </ul> <p>Summative</p> <ul style="list-style-type: none"> <li>● Quiz/test</li> <li>● Video questions</li> <li>● Creative writing exercise</li> <li>● List/explanation of forensic science techniques observed in <i>The Bone Collector</i></li> </ul>
<b>Suggested Resources</b>	
<ul style="list-style-type: none"> <li>● Textbook: <i>Introduction to Forensic Science and Criminalistics</i>, Gaensslen, Harris &amp; Lee</li> </ul>	



Committee Member(s): John Boothby Unit Title: <b>Physical Evidence and the Crime Scene</b>	Course/Subject: Forensic Science Grade Level: 11-12 # of Weeks: 3
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**Identify Desired Results**

**Common Core Standards**

- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- HS-ETS1-3. 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, as well as possible social, cultural, and environmental impacts.

<b>Enduring Understandings</b> Generalizations of desired understanding via essential questions (Students will understand that ...)	<b>Essential Questions</b> Inquiry used to explore generalizations
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| <ul style="list-style-type: none"> <li>● Physical evidence must be processed in a specific order to maintain its integrity .</li> <li>● Physical evidence can tell investigators many important things that may help solve a crime .</li> <li>● The crime scene must be processed in specific order to maintain its integrity.</li> <li>● Locard's Exchange Principle states that when objects come into contact, there is a mutual exchange of material between the objects across the contact boundary.</li> <li>● A reconstruction must account for all the evidence and is the best explanation for the events which created the evidence.<br/>Reenactments are speculative and are only partially supported by the evidence.</li> </ul> | <ul style="list-style-type: none"> <li>● How are careful collection and documentation essential to the integrity of forensics evidence?</li> <li>● What information can evidence tell investigators about the crime that took place?</li> <li>● What role do reconstruction patterns and individualization patterns play in forensic science?</li> <li>● How is physical evidence created at a crime scene, and how does the forensic scientist use it to answer questions?</li> </ul> |
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**Expected Performances**  
What students should know and be able to do

Students will know the following:

- Physical evidence is processed in this order: recognition, documentation, collection, lab analysis, reporting/testimony
- Controls (known, alibi, blank) and substratum comparison are used to maintain the validity and reliability of evidence.
- The crime scene is processed in this order: scene survey and recognition, scene search, documentation, evidence collection/preservation, release of the scene.
- Physical evidence can tell investigators the following important information: develop the assailant's *modus operandi*, provide leads, establish linkages or exclusions, provide corroboration, identify substances, identify people, and establish *corpus delicti*
- Reconstructions improve with increasing evidence but, as with a hypothesis or theory in any science, they can never be proven to be 100% correct

Students will be able to do the following:

- Explain how forensic scientists can use physical evidence to answer questions
- Write a detailed reconstruction based on evidence
- Provide essential documentation for a piece of evidence
- Create druggist fold to contain trace evidence
- Draw a crime scene to scale with adequate evidence
- Provide a reasonable reconstruction for a fictional crime scene based on evidence of students' choosing
- Apply Locard's Exchange Principle to the examination of an article of the student's clothing

#### Character Attributes

- Integrity
- Honesty

#### Technology Competencies

- Use of stereomicroscope, UV light, forceps, druggist folds to look for and collect evidence

### Develop Teaching and Learning Plan

Teaching Strategies:

- Present students with **phenomena** of various crime scenes, and ask what actions may have created such evidence.
- Class discussion on types of physical evidence
- Small group activity analyzing evidence and drawing conclusions, eventually leading to final reconstruction. Students will then join larger group and assess their strategies
- Class discussion on importance of

Learning Activities:

- Fossil evidence lab
- *The Case of the Missing Computer Chip* activity
- Crime scene sketch
- Article: reconstruction vs. reenactment

<ul style="list-style-type: none"> <li>documentation</li> <li>● Critique of sample crime scene sketches</li> <li>● Small group brainstorming, drawing of fictional crime scene with corresponding reconstruction</li> <li>● Class discussion: reconstruction vs. reenactment</li> </ul>	

<b>Assessments</b>	
<b>Performance Task(s)</b>	<b>Other Evidence</b>
Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	Application that is functional in a classroom context to evaluate student achievement of desired results
<p>Goal: Draw accurate crime scene sketch with accompanying reconstruction that explains all evidence</p> <p>Role: Crime scene investigator (CSI)</p> <p>Audience: Judge/jury</p> <p>Situation: Crime scene being documented</p> <p>Product or Performance: Sketch &amp; reconstruction</p> <p>Standards for Success: Drawing is to scale, contains a variety of evidence, and reconstruction explains all the evidence</p>	<p>Formative</p> <ul style="list-style-type: none"> <li>● Jumpstarts</li> <li>● Exit tickets</li> <li>● Reading guides</li> <li>● Lab questions</li> <li>● Computer Chip activity</li> <li>● Locard Exchange Principle Lab</li> </ul> <p>Summative</p> <ul style="list-style-type: none"> <li>● Quiz/test</li> <li>● Video questions</li> <li>● Crime scene sketch</li> </ul>
<b>Suggested Resources</b>	
<ul style="list-style-type: none"> <li>● Textbook: <i>Introduction to Forensic Science and Criminalistics</i>, Gaensslen, Harris &amp; Lee</li> <li>● Article on reconstruction vs. reenactment: <a href="http://www.tissuegroup.chem.vt.edu/chem-ed/ethics/garrison/shooting.html">http://www.tissuegroup.chem.vt.edu/chem-ed/ethics/garrison/shooting.html</a></li> </ul>	

Committee Member(s): John Boothby Unit Title: <b>Examination of Physical Evidence</b>	Course/Subject: Forensic Science Grade Level: 11-12 # of Weeks: 4
<b>Identify Desired Results</b>	
<b>Common Core Standards</b>	
<ul style="list-style-type: none"> <li>● HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).</li> <li>● CCSS.ELA-Literacy. RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.</li> <li>● CCSS.ELA-Literacy.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</li> <li>● CCSS.ELA-Literacy. RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</li> <li>● CCSS.ELA-Literacy. WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</li> <li>● CCSS.ELA-Literacy. WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</li> <li>● CCSS.ELA-Literacy. SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</li> </ul>	
<b>Enduring Understandings</b> Generalizations of desired understanding via essential questions (Students will understand that ...)	<b>Essential Questions</b> Inquiry used to explore generalizations
<ul style="list-style-type: none"> <li>● Reconstruction patterns can only be “collected” through thorough documentation.</li> </ul>	<ul style="list-style-type: none"> <li>● What role do reconstruction patterns and individualization patterns play in forensic science?</li> </ul>

<ul style="list-style-type: none"> <li>• Blood spatter is created according to well-known physical laws.</li> <li>• Individualization requires physical matching between an evidentiary specimen and a known specimen.</li> <li>• Direct physical matches are more convincing that two objects were once part of the same object than indirect physical matches.</li> </ul>	<ul style="list-style-type: none"> <li>• What role does physical evidence play in the development of a reconstruction?</li> </ul>
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**Expected Performances**  
What students should know and be able to do

Students will know the following:

- Reconstruction patterns include: blood spatter, glass fracture, track and trail, tire and skid mark, clothing and article, gunshot residue, projectile trajectory, fire burn, modus operandi, and wound/injury/damage
- Blood spatter is affected greatly by speed and angle; patterns include falling droplets, contact deposits, wipe and swipe, arterial spurt, cast-off, running patterns, and secondary spatter. Students will know the actions that create each of these.
- Glass fracture patterns can indicate direction and order of multiple impacts.
- Direct physical matches allow the matching of a known sample to the unknown sample (evidentiary specimen) with certainty.
- Indirect physical matches between a known and unknown sample are intrinsically less convincing because they are either soft/pliable or pieces are missing.
- Radial fractures emanate from the projectile impact and move toward the edge, whereas tangential fractures encircle the point of impact.

Students will be able to do the following:

- Brainstorm factors that affect the appearance of blood spatter and manipulate those factors to generate data.
- Explain data generated by blood spatter experiment.
- Draw glass fracture pattern showing the result of multiple impacts.
- Reconstruct solid glass object using knowledge of impact patterns and direct/indirect physical matches.

**Character Attributes**

- Integrity
- Honesty

**Technology Competencies**

- Online research in LLC

**Develop Teaching and Learning Plan**

<p>Teaching Strategies:</p> <ul style="list-style-type: none"> <li>• Present students with <b>phenomenon</b> of bloody crime</li> </ul>	<p>Learning Activities:</p> <ul style="list-style-type: none"> <li>• A Killer's Trail (documentary Dr. Sam Sheppard)</li> </ul>
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<p>scene and ask for hypotheses of the actions that could have created it.</p> <ul style="list-style-type: none"> <li>● Ask students what actions can influence the appearance of blood spatter and encourage them to solve the problem of how such an action can create such a spatter pattern</li> <li>● Powerpoint lecture on various blood spatter patterns</li> <li>● Sample drawing of glass fracture pattern for students to interpret</li> <li>● Demonstration of footprint cast formation using dental stone</li> <li>● Demonstration of online searching hints using iCONN, Opposing Viewpoints databases in LLC</li> </ul>	<ul style="list-style-type: none"> <li>● Blood spatter lab</li> <li>● <i>Who Shot Ard Dia</i> bullet reconstruction</li> <li>● Create footprint casts</li> <li>● Glass bottle reconstruction</li> <li>● Landmark Case Research</li> </ul>
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<b>Assessments</b>	
<b>Performance Task(s)</b> Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	<b>Other Evidence</b> Application that is functional in a classroom context to evaluate student achievement of desired results
<p>Goal: Lab report</p> <p>Role: Forensic scientist conducting experiment in laboratory</p> <p>Audience: Other forensic scientists</p> <p>Situation: Evidence being analyzed in laboratory for validity &amp; reliability</p> <p>Product or Performance: Lab Report</p> <p>Standards for Success: Experimental design generates reliable quantitative data. Conclusions explain data and reflect on validity and reliability of data/experiment.</p>	<p>Formative</p> <ul style="list-style-type: none"> <li>● Jumpstarts</li> <li>● Exit tickets</li> <li>● Reading guides</li> <li>● Blood spatter lab (development of procedure and data collection)</li> <li>● Research progress in class/LLC</li> </ul> <p>Summative</p> <ul style="list-style-type: none"> <li>● Quiz/test</li> <li>● Video questions</li> <li>● Blood spatter lab report</li> <li>● Landmark Case Project</li> </ul>
<b>Suggested Resources</b>	

- Library resources for landmark case
- Textbook: *Introduction to Forensic Science and Criminalistics*, Gaensslen, Harris & Lee

Committee Member(s): John Boothby Unit Title: <b>Physical Pattern Evidence for Individualization</b>	Course/Subject: Forensic Science Grade Level: 11-12 # of Weeks: 3
<b>Identify Desired Results</b>	
<b>Common Core Standards</b>	
<ul style="list-style-type: none"> <li>● CCSS.ELA-Literacy.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</li> <li>● CCSS.ELA-Literacy.WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</li> </ul>	
<b>Enduring Understandings</b> Generalizations of desired understanding via essential questions (Students will understand that ...)	<b>Essential Questions</b> Inquiry used to explore generalizations
<ul style="list-style-type: none"> <li>● Biometric measures have the power to individualize when used properly.</li> <li>● Fingerprints may be developed using physical or chemical methods.</li> <li>● AFIS (Automated Fingerprint Identification System) has revolutionized the examination of fingerprint evidence.</li> <li>● A questioned document is any means of communication that is suspect as to its authenticity or origin.</li> </ul>	<ul style="list-style-type: none"> <li>● What role do biometric measures play in individualization?</li> <li>● What is the value of questioned documents in a forensic investigation?</li> </ul>
<b>Expected Performances</b> What students should know and be able to do	
Students will know the following: <ul style="list-style-type: none"> <li>● Biometric measures include fingerprints, retina/iris scans, dental records, DNA analysis, face thermography, and others.</li> <li>● Fingerprints can be developed using physical methods which adhere to fingerprint residue, or chemical methods, which cause a noticeable chemical reaction. They may be further enhanced with alternate light sources. Fingerprints are then scanned into AFIS to determine if they match any that are on file.</li> <li>● Questioned documents must be handled carefully, placed in sheet protectors, and dusted for fingerprints.</li> </ul>	



- Questioned documents include forgeries, threatening letters, and extortion notes. Students will be able to do the following:
  - Develop and collect fingerprints using magnetic powder and tape
  - Develop and collect fingerprints using a chemical method such as superglue, ninhydrin, or iodine fuming.
  - Identify whether a fingerprint is an arch, loop, or whorl pattern and the minutiae it contains.
  - Provide examples of questioned documents

**Character Attributes**

- Integrity
- Honesty

**Technology Competencies**

- Use of stereomicroscope

**Develop Teaching and Learning Plan**

<p>Teaching Strategies:</p> <ul style="list-style-type: none"> <li>• Present students with <b>phenomena</b> of remains left at a natural or man-made disasters and ask how they should be handled.</li> <li>• Lecture/discussion on why/how fingerprints are used</li> <li>• Demonstration of magnetic powder dusting technique for fingerprints</li> <li>• Demonstration of superglue fuming technique</li> <li>• Comparison of prints side-by-side on Smartboard looking for minutiae points</li> </ul>	<p>Learning Activities:</p> <ul style="list-style-type: none"> <li>• Development and collection of fingerprints at students desks</li> <li>• Discovery, development, and collection of fingerprints around school</li> <li>• Superglue fuming technique</li> <li>• Class reading: <i>Reasonable Doubt</i> – problems that exist in forensic science           <ul style="list-style-type: none"> <li>• Real-world dusting for prints</li> <li>• Video clip: <i>Death Grip</i> (Vernon Mathis Robinson case)</li> </ul> </li> </ul>
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**Assessments**

<b>Performance Task(s)</b>	<b>Other Evidence</b>
<p>Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)</p>	<p>Application that is functional in a classroom context to evaluate student achievement of desired results</p>
<p>Goal: Collect fingerprints from surfaces around the school</p> <p>Role: Dactyloscopist (fingerprint expert)</p> <p>Audience: Superior officer, judge/jury</p>	<p>Formative</p> <ul style="list-style-type: none"> <li>• Jumpstarts</li> <li>• Exit tickets</li> <li>• Reading guides</li> <li>• Demonstration of proper fingerprint development/collection technique</li> <li>• Video clip: <i>Death Grip</i> (Vernon Mathis Robinson case)</li> </ul>

<p>Situation: Prints left at crime scene</p> <p>Product or Performance: Fingerprint cards with documentation</p> <p>Standards for Success: Can locate fingerprints on surfaces students are likely to touch, can identify print as arch, loop, or whorl, and can identify at least one minutiae point on each print</p>	<ul style="list-style-type: none"> <li>● Article: <i>Reasonable Doubt</i> – problems that exist in forensic science</li> <li>● Article: <i>Remains of the Day</i> – details difficulties in separating 9/11 victims remains from those of the terrorists</li> </ul> <p>Summative</p> <ul style="list-style-type: none"> <li>● Quizzes/tests</li> <li>● Proper identification of arch, loop, whorl on fingerprint sheets</li> <li>● Proper identification of minutiae for purposes of matching 2 fingerprints</li> </ul>
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**Suggested Resources**

- Textbook: *Introduction to Forensic Science and Criminalistics*, Gaensslen, Harris & Lee
- <http://www.popularmechanics.co.za/science/reasonable-doubt/>
- <http://www.newsweek.com/terror-remains-911-hijackers-78327>

Committee Member(s): John Boothby Unit Title: <b>Biological Evidence</b>	Course/Subject: Forensic Science Grade Level: 11-12 # of Weeks: 3
<b>Identify Desired Results</b>	
<b>Common Core Standards</b>	
<ul style="list-style-type: none"> <li>● HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</li> <li>● HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</li> </ul>	
<b>Enduring Understandings</b> Generalizations of desired understanding via essential questions (Students will understand that ...)	<b>Essential Questions</b> Inquiry used to explore generalizations
<ul style="list-style-type: none"> <li>● Blood and other biological material must be handled carefully to avoid decomposition and contamination.</li> <li>● Blood typing allows for exclusion of suspects, but cannot individualize.</li> <li>● The structure of DNA determines its function in organisms.</li> <li>● The value of multiple pieces of evidence can be quantified by multiplying the likelihood of each independent event together to get a total probability of the events' occurring together.</li> <li>● DNA evidence is increasingly used (RFLP, PCR, STR), and CODIS (Combined DNA Index System) plays an increasingly important role in matching a suspect to a crime.</li> </ul>	<ul style="list-style-type: none"> <li>● How has biological technology revolutionized forensic science?</li> <li>● How does the structure of DNA allow for individualization?</li> <li>● What is the value of multiple pieces of coinciding evidence?</li> </ul>
<b>Expected Performances</b> What students should know and be able to do	
Students will know the following: <ul style="list-style-type: none"> <li>● Antigens on the surface of blood cells stimulate the production of antibodies, causing agglutination (clotting). This phenomenon allows for the identification of blood type.</li> </ul>	

- Blood and other biological material is collected/preserved/packaged/ analyzed in order to minimize decomposition and contamination to maximize its validity.
- Every cell in the body contains DNA except for red blood cells.
- Blood serum (plasma contains the platelets) is the fluid portion of blood, and contains cells, nutrients, chemical messaging molecules, and ingested substances.
- Except for identical twins, individuals have a unique DNA sequence that can be distinguished from all other people on the planet.
- Punnett squares show the probability of inheriting a particular trait.

Students will be able to do the following:

- Perform preliminary tests to indicate the presence of blood and confirmatory tests to indicate the specific blood type
- Demonstrate blood type inheritance in a Punnett square
- When presented with multiple pieces of evidence, students will multiply the likelihood of each together to determine the total probability.
- Perform the steps of gel electrophoresis
- Interpret the banding pattern in an electrophoresis gel

#### Character Attributes

- Integrity
- Honesty

#### Technology Competencies

- Use of DNA electrophoresis equipment

### Develop Teaching and Learning Plan

#### Teaching Strategies:

- Present students with **phenomena** of various biological evidence found at a crime scene and ask them how the various evidence should be handled.
- Class activity using clothing colors to calculate total probability of leaving 2 different colored threads at a crime scene
- Demonstration of micropipetting technique, pouring of gel, loading of gel
- Use of virtual lab for students to become familiar with gel electrophoresis process

#### Learning Activities:

- Probability activity
- Punnett squares showing inheritance of blood types
- Blood typing lab
- PCR/DNA electrophoresis lab
- Virtual Lab on [learn.genetics.utah.edu](http://learn.genetics.utah.edu) (gel electrophoresis and PCR)
- New York Times video clip: *How DNA changed the world of forensic science* – focuses on how hair evidence used prior to DNA analysis has been shown to be unreliable

<b>Assessments</b>	
<b>Performance Task(s)</b>	<b>Other Evidence</b>
Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	Application that is functional in a classroom context to evaluate student achievement of desired results
<p>Goal: Use preliminary and confirmatory blood tests to ascertain the most likely suspect in a murder investigation</p> <p>Role: Forensic biologist</p> <p>Audience: Judge/jury</p> <p>Situation: Blood typing of two suspects accused of murder, seeing whether their blood matches that of the victim</p> <p>Product or Performance: Lab sheet with data table and questions</p> <p>Standards for Success: Accurate data and conclusion</p>	<p>Formative</p> <ul style="list-style-type: none"> <li>● Jumpstarts</li> <li>● Exit tickets</li> <li>● Probability questions</li> <li>● Blood typing using phenolphthalein (preliminary test) and simulated antisera (confirmatory test)</li> <li>● Punnett squares</li> <li>● Hair analysis lab</li> </ul> <p>Summative</p> <ul style="list-style-type: none"> <li>● Quiz/test</li> <li>● Blood typing lab, correctly interpreting results</li> <li>● PCR lab packet</li> </ul>
<b>Suggested Resources</b>	
<ul style="list-style-type: none"> <li>● Textbook: <i>Introduction to Forensic Science and Criminalistics</i>, Gaensslen, Harris &amp; Lee</li> <li>● <a href="http://learn.genetics.utah.edu">learn.genetics.utah.edu</a></li> <li>● <a href="http://www.nytimes.com/video/us/100000002886783/how-dna-changed-the-world-of-forensics.html">http://www.nytimes.com/video/us/100000002886783/how-dna-changed-the-world-of-forensics.html</a></li> </ul>	