Hillside Township School District

Science
Forensic Science Curriculum
Grades 11-12

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Board of Education Approved:
August 22, 2016
## Hillside Township School District

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Hillside Township School District

District Mission Statement
The mission of the Hillside Public Schools is to ensure that all students at all grade levels achieve the New Jersey Core Curriculum Content Standards and make connections to real-world success. We are committed to strong parent-community school partnerships, providing a safe, engaging, and effective learning environment, and supporting a comprehensive system of academic and developmental support that meets the unique needs of each individual.

Academic Area Overview
The Hillside Township School District is committed to excellence. We believe that all children are entitled to an education that will equip them to become productive citizens of the twenty-first century. We believe that an education grounded in the fundamental principles of science will provide students with the skills and content necessary to become our future leaders.

A sound science education is grounded in the principles of inquiry and rigor. Children are actively engaged in learning as they model real-world scientific behaviors to construct knowledge. They have ample opportunities to manipulate materials in ways that are developmentally appropriate to their age. They work in an environment that encourages them to take risks, think critically, make models, note patterns and anomalies in those patterns. Children are encouraged to ask questions, not just the "how" and the "what" of observed phenomena, but also the "why".

Our program provides teachers with cost-effective science materials that are aligned to state and national standards, incorporate instructional strategies that are research-based, and provides teachers with a deep understanding of science and the pedagogical underpinnings of science. Our teachers receive quality professional development through a district partnership with the Merck Institute for Science Education as well as the Martinson Foundation at Fairleigh Dickinson University. Our K-8 kit based program encourages "hands-on science" and is endorsed by the National Science Foundation.

Equality and Equity in Curriculum
The Hillside Township School District ensures that the district’s curriculum and instruction are aligned to the State’s Core Curriculum Content Standards and addresses the elimination of discrimination and the achievement gap, as identified by underperforming school-level AYP reports for State assessment, by providing equity in educational programs and by providing opportunities for students to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972
Hillside Township School District

Next Generation Science Standards

In 2014, NJ adopted the Next Generation Science Standards with the goal of ensuring our students graduate ready for college and career. The standards for science practice describe varieties of expertise that science educators at all levels should seek to develop in their students. These practices rest on important “processes and proficiencies” with longstanding importance in science education. The Science Framework emphasizes process standards of which include planning investigations, using models, asking questions and communicating information. Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. Throughout the year, students should continue to develop proficiency with the eight science practices. Crosscutting concepts can help students better understand core ideas in science and engineering. When students encounter new phenomena, whether in a science lab, field trip, or on their own, they need mental tools to help engage in and come to understand the phenomena from a scientific point of view. Familiarity with crosscutting concepts can provide that perspective. A next step might be to simplify the phenomenon by thinking of it as a system and modeling its components and how they interact. These preliminary studies may suggest explanations for the phenomena, which could be checked by predicting patterns that might emerge if the explanation is correct, and matching those predictions with those observed in the real world. More information regarding the Next Generation Science Standards can be found at:
http://www.nextgenscience.org/

Forensic Science Overview

Students in the Forensic Science course continue to develop knowledge in the core disciplinary ideas described in the Next Generation Science Standards (NGSS) including science as inquiry. The course will introduce students to the scientific methodologies used in forensic investigations. The objectives of this course are to apply the Next Generation Science Standards (NGSS) Crosscutting Concepts that bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering.
Unit 1: Introduction to Forensics and Fingerprinting

<table>
<thead>
<tr>
<th>ENDURING UNDERSTANDINGS</th>
<th>ESSENTIAL QUESTIONS</th>
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<tr>
<td>✓ Forensic Scientists use evidence to reconstruct the events of a crime.</td>
<td>✓ How do we catch and convict criminals?</td>
</tr>
<tr>
<td>✓ Fingerprints are unique to individuals and can be used as evidence in arguing which individuals were present at a crime scene.</td>
<td>✓ Can fingerprints identify a criminal with absolute certainty? What should be the standard of proof?</td>
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<table>
<thead>
<tr>
<th>Next Generation Science Standards (NGSS)</th>
<th>KNOWLEDGE</th>
<th>SKILLS &amp; PRACTICES</th>
<th>CROSSCUTTING CONCEPTS: Students will be apply to apply:</th>
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<tr>
<td>Focus on Practices and Crosscutting Concepts</td>
<td>Forensic Science Intro</td>
<td>SKILLS:</td>
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<tr>
<td></td>
<td>• Testimonial Evidence is a witness statement.</td>
<td>• Use an equation to calculate probability</td>
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<td></td>
<td>• Physical Evidence is an object or material relevant to the crime.</td>
<td>• Follow procedures while investigating a crime scene</td>
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<td></td>
<td>o Can prove that there was a crime in the first place</td>
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<td></td>
<td>o Can back up or disprove witness statements</td>
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<td>o Can link a suspect to victim or crime scene</td>
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<td>o Can determine identify of person linked to crime</td>
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<td>PRACTICES:</td>
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<td>• Asking Questions and Defining Problems</td>
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<td>Ask questions that arise from examining models or a theory to clarify relationships.</td>
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<td></td>
<td>• Analyzing and Interpreting Data</td>
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<td>Patterns</td>
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<td></td>
<td></td>
<td>• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td>
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<td>Cause and Effect</td>
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<td></td>
<td></td>
<td>• Empirical evidence is required to differentiate between cause and</td>
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<td>Hillside Township School District</td>
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<tr>
<td>Can allow investigators to reconstruct the crime</td>
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<td>● Class data can be used to narrow a suspect down to one person out of a large group of people based on known characteristics.</td>
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<td>● Information at crime scenes must be gathered in a systematic way. The following procedures must be taken:</td>
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<td>○ Preservation and isolation of the scene</td>
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<td>○ Observations and documentation</td>
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<td>○ Note-taking</td>
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<tr>
<td>○ Photographs and/or videotape</td>
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<td>○ Sketches</td>
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<td>○ Search for evidence</td>
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<td>○ Collecting and packaging evidence</td>
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<td>○ Chain of custody</td>
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<td>○ Investigation</td>
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</tbody>
</table>

**Key Terms:**
evidence, expert witness, testimonial evidence, physical evidence, individual evidence, class evidence

Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

- **Obtaining, Evaluating, and Communicating Information**
  Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

- **Planning and Carrying Out Investigations.**
  Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

**NGSS:**

<table>
<thead>
<tr>
<th>HS-LS1-1</th>
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<tbody>
<tr>
<td><strong>Recovering Fingerprints</strong></td>
</tr>
</tbody>
</table>

**SKILLS:**

Patterns
Anthropometry/Bertillon Method was a way investigators kept track of criminals. This method was based on measurements of various parts. Powder is used to visualize latent prints, which can then be lifted using clear sticky tape. Chemical methods for developing latent prints by reacting with the residue left by the finger to create a visible mark.

Key Terms:
anthropometry, Bertillon method, latent print, plastic print, visible print

Use physical and chemical methods to develop latent fingerprints.
Practice safety in the science laboratory.

PRACTICES:

Analyzing and Interpreting Data
Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

Planning and Carrying Out Investigations.
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Cause and Effect
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
### Comparing Fingerprints

- All fingerprints fit three basic patterns.
  - Loop patterns feature a ridge that makes a “U” shape.
  - Whorl patterns feature a spiral shaped ridge.
  - Arch patterns feature a ridge that goes across the finger.
- Probability is used to determine the likelihood that a fingerprint belongs to a certain individual by comparing to population statistics.
- Individual ridge characteristics are compared between evidence and suspect.

#### Key Terms:
- loop pattern, whorl pattern, arch pattern, Henry Classification System, minutiae, AFIS

### SKILLS:

- Use an equation to calculate probability
- Using a key, identify individual ridge characteristics in an inked print

### PRACTICES:

- **Analyzing and Interpreting Data.**
  Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
- **Constructing Explanations and Designing Solutions**
  Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

### Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

### Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
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<th>TIME FRAME</th>
<th>TOPIC</th>
<th>PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS</th>
<th>RESOURCES/INTERDISCIPLINARY CONNECTIONS</th>
</tr>
</thead>
</table>
| September  | Forensic Science Intro | Case study 1.1: Strong Whiskey, TEp27  
Class discussion: What is evidence?  
Independent Project: Research local and state crime labs, TEp5  
Observational Skills Activity, *The Forensic Teacher*  
Activity: Eyewitness account of classroom “intruder”, TEp34  
Case Study 2.2: Ronald Cotton, TEp38  
Activity 2.1: Probability and Class Evidence, TEp43  
Activity 2.2: Can This Evidence be Individualized?, TEp46  
Debate: Public information on registered sex offenders, TEp52  
Case study 3.1: Jeffrey MacDonald, TEp63  
Activity 3.1: Evaluating a Crime Scene, TEp65  
Forensic Science Careers Presentation  
Ongoing: Case Studies - 3 per marking period reflecting an infamous case on a covered topic | *DiscoveryStreaming: Forensic Evidence Video: Nat. Geo. Crime Scene Evidence*  
*Ronald Cotton*  
Teacher Resource CD                                                                 |
| September  | Recovering Fingerprints | Laboratory Activity 4.1: Observing and Taking Fingerprints, TEp77  
Laboratory Activity 4.2: Developing Latent Fingerprints, TEp88  
Assessment: Quiz  
Fingerprint cards, *Ward’s Natural Science*  
Fingerprint ink set, *Ward’s Natural Science*  
Latent Fingerprint Kit, *Sargent Welch* | *Anthropometry - Measureable You!*  
*Video: Real CSI Latent Prints*  
Fingerprint cards, *Ward’s Natural Science*  
Fingerprint ink set, *Ward’s Natural Science*  
Latent Fingerprint Kit, *Sargent Welch* |
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| October | Comparing Fingerprints | Activity: Calculating Henry-FBI classification, TEp81  
| Activity: Identifying fingerprint minutiae, TEp85  
| Activity: Back to the Crime Scene, TEp87  
| Additional Projects #6, TEp102  
| Quiz: Fingerprints and Types of Evidence | **Interactive Fingerprint Analysis** Activity  
| Fingerprint types slides set, [Ward’s Natural Science](#)  
| Fingerprint identification chart, [Sargent Welch](#) |
# Unit 2: Analysis of Hair, Fiber, and Trace Evidence

## ENDURING UNDERSTANDINGS

- ✓ Class evidence such as hair and fiber is used to match individuals to crime scenes. Class evidence is not unique to individuals but is used with statistical analysis to place individuals at the crime scene.
- ✓ Hair can be used to analyze for drugs and poisons.
- ✓ Fibers can be identified and characterized by chemical and physical properties.

## ESSENTIAL QUESTIONS

- ✓ Can class evidence alone identify a criminal? What other types of evidence may be helpful?
- ✓ What information can hair provide?
- ✓ How are fibers used to link suspects to the crime scene or to victims?

## STANDARDS

### KNOWLEDGE

**Students will know:**

- Trace Evidence
  - Trace evidence is any physical evidence that is too small to make physical matches but large enough to be analyzed. Some examples include powders, metals, paint and lipstick.
  - The use of qualitative analysis can be used to identify unknown powders

**Key Terms:**

- Trace evidence, qualitative, quantitative, physical and chemical properties

### SKILLS & PRACTICES

**Students will be able to:**

- Perform tests to identify chemicals
- Practice safety in the science laboratory
- Analyze trace evidence from case studies and devise a plan to examine it in order to solve a crime

**SKILLS:**

**PRACTICES:**

- **Analyzing and Interpreting Data.**

### CROSSCUTTING CONCEPTS:

**Students we be able to apply:**

- Patterns
  - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

- Cause and Effect
  - Empirical evidence is required to differentiate between cause and
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<table>
<thead>
<tr>
<th>NGSS:</th>
<th>Hair Analysis</th>
<th>SKILLS:</th>
<th>Patterns</th>
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</thead>
<tbody>
<tr>
<td><strong>HS-LS1-1</strong></td>
<td>• Hair is one type of class evidence.</td>
<td>• Use a compound microscope</td>
<td>• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in</td>
</tr>
<tr>
<td></td>
<td>• Based on the Locard Exchange Principle, hair (and other materials) can be directly transferred to other materials.</td>
<td>• Record observations</td>
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<tr>
<td></td>
<td>• Hair can differ among individuals and animals based on texture, color and cuticle scale patterns.</td>
<td>• Make conclusions that will help to further students’ investigations</td>
<td></td>
</tr>
</tbody>
</table>

Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

- **Constructing Explanations and Designing Solutions**
  Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
<table>
<thead>
<tr>
<th>Key Terms:</th>
<th>Create arguments in support of or opposition to the use of specific forensic procedures and types of evidence.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locard Exchange Principle, polymers, cuticle, cortex, medulla, exemplar, false positive</td>
<td></td>
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</tbody>
</table>

**PRACTICES:**

- **Constructing Explanations and Designing Solutions**
  Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

- **Engaging in Argument from Evidence**
  Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

**Cause and Effect**
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Structure and Function**
- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
### Fibers

- Fibers can be identified using microscopes and by observing their chemical properties.
  - They are examples of trace and class evidence since fibers offer no individuality.
  - The ability of fibers to transfer to other materials allows it to be used as trace evidence.
  - There are two types of fibers: natural and synthetic
- Certain properties of fibers help investigators determine its origins:
  - Burning
  - Thermal decomposition
  - Chemical composition
  - Density
  - Fluorescence

### Key Terms:
probative value, fabric, polypeptide, plastics, density

### SKILLS:
- Use a compound microscope
- Identify various substances
- Use fiber analysis data to support a claim
- Practice safety in the science laboratory
- Create arguments in support of or opposition to the use of specific forensic procedures and types of evidence

### PRACTICES:
- *Planning and Carrying Out Investigations.*
  Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

### Patterns
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

### Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

### Structure and Function
- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its
<table>
<thead>
<tr>
<th>Constructing Explanations and Designing Solutions</th>
<th>Engaging in Argument from Evidence</th>
<th>function and/or solve a problem.</th>
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<tbody>
<tr>
<td>Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td>
<td>Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.</td>
<td>function and/or solve a problem.</td>
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**UNIT 2: Analysis of Hair, Fiber, and Trace Evidence**

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<tr>
<th>TIME FRAME</th>
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<th>PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS</th>
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<tbody>
<tr>
<td></td>
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<td>Class Discussion: What is the importance of Trace Evidence?</td>
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<td>Laboratory Activity 9.3: Analysis of White Powders, TEp243</td>
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<td>Laboratory Activity 9.4: The Case of the Purloined Pennies, TEp247</td>
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<td>Case Study 9.2, TEp260</td>
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<td>Ongoing: Case Studies - 3 per marking period reflecting an infamous case on a covered topic</td>
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<td>Laboratory Activity 5.1: Observations of Hair, TEp108</td>
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<td>Class Discussion: Collection of Hair and Hair Toxicology</td>
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<td>Additional Projects #3, 4 and 5, TEp124</td>
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<td>Suggested Assignment: Collect samples of different areas of the home using tape. TEp129</td>
<td>Teacher Resource CD</td>
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<td>Activity 6.2: Sampling and Statistics, TEp129</td>
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<td>Laboratory Activity 6.1 Fabric Observation, TEp131</td>
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<td>Class Discussion: Types of Fibers and Fiber Analysis</td>
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<td>Laboratory Activity 6.5: Burn Tests, TEp143</td>
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<td>Laboratory Activity 6.6: Thermal Decomposition, TEp144</td>
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<td>Laboratory Activity 6.7: Chemical Tests, TEp146</td>
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<td>Laboratory Activity 6.9: Observing Fluorescence in Fibers, TEp151</td>
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<td>Case Study 6.1: Wayne Williams Case, TEp159</td>
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<td>Case Study 6.2: Amanda Davies Case, TEp160</td>
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<td>Assessment: Unit Test</td>
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Unit 3: Blood Evidence and DNA Analysis Unit

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<thead>
<tr>
<th>ENDURING UNDERSTANDINGS</th>
<th>ESSENTIAL QUESTIONS</th>
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<tbody>
<tr>
<td>✓ Blood spatter shapes and patterns can be used to interpret and reconstruct what happened at the crime scene.</td>
<td>✓ What can blood spatter patterns tell an investigator about a crime? How can these patterns be used to reconstruct a crime?</td>
</tr>
<tr>
<td>✓ Differences in DNA sequences can be analyzed with biotechnology to provide statistically significant matches to an individual, used to identify or clear a suspect.</td>
<td>✓ What information can DNA tell us about an individual?</td>
</tr>
<tr>
<td>✓</td>
<td>✓ In what ways can investigators use DNA evidence in a court of law?</td>
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</table>

<table>
<thead>
<tr>
<th>STANDARDS</th>
<th>KNOWLEDGE Students will know:</th>
<th>SKILLS &amp; PRACTICES Students will be able to:</th>
<th>CROSSCUTTING CONCEPTS: Students will be able to apply:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSS:</td>
<td>Blood Evidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS-LS3-1</td>
<td>● Serology is the study of blood. Red blood cells have antigens on their surface - A and B. There are four blood types: A, B, AB and O. Humans have antibodies against antigens not present in our bodies. Blood typing determines the blood type of an individual by exposing a sample of blood to antibodies. Agglutination occurs when those antibodies and antigens are combined.</td>
<td>SKILLS: ● Gather and interpret measurements. ● Interpret graphs. ● Practice safety in the science laboratory. ● Follow experimental procedures. ● Record observations.</td>
<td>Cause and Effect ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
</tr>
<tr>
<td>HS-LS3-2</td>
<td>● Blood-spatter evidence can be analyzed by calculating/observing various aspects. ● Forensic scientists use various methods to test for the presence of blood that includes the following tests:</td>
<td>PRACTICES: ● Planning and Carrying Out Investigations.</td>
<td>Structure and Function ● Investigating or designing new systems or structures requires a detailed examination of the</td>
</tr>
<tr>
<td>HS-LS3-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS-PS2-1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Kastle-Meyer Presumptive blood testing, luminol testing.  
| Point of origin helps investigators to compare blood-spatter evidence with testimonial evidence of witnesses and victims. Inconsistencies between the two can be determined. The PO is used to calculate the height about the floor level where the wound was inflicted.  
| Key Terms: satellites, spikes, point of origin, area of convergence, angle of impact  
| Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.  
| - Analyzing and Interpreting Data.  
| Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible  
| - Using Mathematics and Computational Thinking  
| Use mathematical representations of phenomena or design solutions to support claims.  
| properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.  
| Patterns  
| - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
### What is DNA?

- DNA is found in the nuclei of living cells and is the genetic make-up of individuals.
- Genes are portions of DNA which code for a specific protein which determine a specific trait. DNA is wound into a specific structure called chromosomes.

### Key Terms:
- DNA
- nucleus
- genes
- protein
- chromosomes
- CODIS

### SKILLS:
- Practice safety in the science laboratory
- Follow experimental procedures
- Record observations

### PRACTICES:
- **Planning and Carrying Out Investigations.**
  - Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly
  - **Analyzing and Interpreting Data.**
    - Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation

### Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

### Structure and Function
- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

### Patterns
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
Hillside Township School District

<table>
<thead>
<tr>
<th>NGSS:</th>
<th>DNA Analysis in Forensics</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-LS3-1</td>
<td>DNA Fingerprinting is a method used by investigators. Pieces of DNA are cut using restriction enzymes and compared with known DNA of suspects.</td>
</tr>
<tr>
<td>HS-LS3-2</td>
<td>In cases where there is little DNA evidence at a crime scene, investigators can use the PCR technique to make more copies to work with.</td>
</tr>
<tr>
<td>HS-LS3-3</td>
<td>The use of mitochondrial DNA can be used to identify missing persons.</td>
</tr>
</tbody>
</table>

**Key Terms:**
DNA fingerprinting, restriction enzymes, PCR, Mitochondrial DNA

<table>
<thead>
<tr>
<th>SKILLS:</th>
<th>Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>● Follow experimental procedures</td>
</tr>
<tr>
<td></td>
<td>● Compare DNA fingerprint data to identify a criminal</td>
</tr>
<tr>
<td></td>
<td>● Practice safety in the science laboratory</td>
</tr>
</tbody>
</table>

**PRACTICES:**
**Analyzing and Interpreting Data.**

<table>
<thead>
<tr>
<th>Cause and Effect</th>
<th>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</th>
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<tbody>
<tr>
<td>Structure and Function</td>
<td>Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td>
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</tbody>
</table>

**Patterns**
<p>| Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. | • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. |</p>
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<thead>
<tr>
<th>TIME FRAME</th>
<th>TOPIC</th>
<th>PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS</th>
<th>RESOURCES/INTERDISCIPLINARY CONNECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>January - February</td>
<td>What is DNA?</td>
<td>Class Discussion: What does DNA say about us? Laboratory Activity 12.1: Extracting DNA from a Banana, TEp341 (modified to use cheek cells instead)</td>
<td>Inside DNA The Killer's Trail Teacher Resource CD</td>
</tr>
<tr>
<td>February</td>
<td>DNA Analysis in Forensics</td>
<td>Class Discussion: The Advances of DNA technologies Activity 12.1: Simulation of RFLP, TEp345 Activity 12.2: Statistical Sampling Lab, TEp352 Activity 12.3: Simulation of DNA Replication Using PCR, TEp355 Gel Electrophoresis Virtual Lab Recovering the Romanovs Virtual Lab/Module Project: Both Sides of the Issue; Establishment of a DNA Databank, TEp366 Assessment: Unit Test</td>
<td>The Case for Innocence Create a DNA Fingerprint PCR Analysis Diagram Gel Electrophoresis Virtual Lab Recovering the Romanovs Teacher Resource CD</td>
</tr>
</tbody>
</table>
### Unit 4: Toxicology

#### ENDURING UNDERSTANDINGS

- ✓ The concentration of a substance determines its toxicity. The same substance may be helpful or harmful to a person, depending on the dose.

#### ESSENTIAL QUESTIONS

- ✓ What makes a substance poisonous?

#### STANDARDS

<table>
<thead>
<tr>
<th>NGSS:</th>
<th>KNOWLEDGE</th>
<th>SKILLS &amp; PRACTICES</th>
<th>CROSSCUTTING CONCEPTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HS-LS1-2</strong></td>
<td><strong>Poisons and the History of Toxicology</strong></td>
<td><strong>SKILLS:</strong></td>
<td>Structure and Function</td>
</tr>
</tbody>
</table>
| **HS-PS2-6**| - The dosage of a substance determines whether it is poisonous and how poisonous it is.  
- Elements of toxicology:  
  - Chemical and physical form of a substance  
  - How it enters the body  
  - Body weight and the physiological conditions of the victim (age and sex)  
  - Time period of exposure  
  - Presence of other chemicals in the body or in the dose  
  - The lethal dose (LD<sub>50</sub>) is used to measure toxicity.  
  
**Key Terms:** toxins, chronic exposure, acute toxicity, LD<sub>50</sub> | - Read and interpret tables  
- Practice safety in the science laboratory  
- Use a case study to identify the connections between hair analysis and toxicology  
- Planning and Carrying Out Investigations. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of | Structure and Function  
  - Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.  
  
**Stability and Change**  
- Feedback (negative or positive) can stabilize or destabilize a system.  
  
**Cause and Effect**
<table>
<thead>
<tr>
<th>Hillside Township School District</th>
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<tbody>
<tr>
<td>data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.</td>
</tr>
<tr>
<td>- Analyzing and Interpreting Data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.</td>
</tr>
<tr>
<td>- Constructing Explanations and Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the</td>
</tr>
<tr>
<td>• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
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<tr>
<td>Scale, Proportion, and Quantity</td>
</tr>
<tr>
<td>• Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).</td>
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</tbody>
</table>
Hillside Township School District

<table>
<thead>
<tr>
<th>NGSS:</th>
<th>Drugs and Crime</th>
<th>SKILLS:</th>
<th>Structure and Function</th>
</tr>
</thead>
</table>
| HS-LS1-2 | ● Drugs can affect the function and structure of living systems.  
| HS-PS2-6 | ● The use and purchase of controlled drugs can lead to increased violence, crime and health and social problems.  
|          | There are several categories of controlled drugs:  
|          |   o Hallucinogens  
|          |   o Stimulants  
|          |   o Narcotics  
|          |   o Depressants  
|          |   o Prescription and over-the-counter drugs  
| Key Terms: | controlled drugs, hallucinogens, stimulants, narcotics, depressants  
|          |          | ● Perform tests to identify chemicals  
|          |          | ● Compare and contrast legal issues to support an opinion and defend an argument  
|          |          | ● Practice safety in the science laboratory  
|          |          | ● Summarize drug analysis techniques using a case study  
|          |          | PRACTICES:  
|          | Structure and Function  
|          | ● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.  
|          | Stability and Change |
| Analyzing and Interpreting Data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. | Obtaining, Evaluating, and Communicating Information Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a process or system) in multiple formats (including orally, graphically, textually, and mathematically). | Feedback (negative or positive) can stabilize or destabilize a system. Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Scale, Proportion, and Quantity • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). |
# Toxicology Unit

<table>
<thead>
<tr>
<th>TIME FRAME</th>
<th>TOPIC</th>
<th>PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS</th>
<th>RESOURCES/INTERDISCIPLINARY CONNECTIONS</th>
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</thead>
</table>
| March      | Poisons and the History of Toxicology      | Class Discussion: Dosage and Poisons Group research on a poison/toxin Additional Projects #2, TEp228 Assessment: Quiz | **Discovery Streaming:** Trace Evidence, Toxicology and DNA  
Introduction to Toxicology Lab Activity, *Ward’s Natural Science*  
Teacher Resource CD                                                                                           |
| March - April | Drugs and Crime                            | Class Discussion: What is a Drug? Laboratory Activity 7.1: Spot Test Lab, TEp175 Laboratory Activity 7.2: Is It Ibuprofen?, TEp178 Urinalysis Lab, *The Forensic Teacher* Project: Both Sides of the Issue; Legalization of Drugs, TEp203 Responding to Alcohol Internet Activity Assessment: Unit Test | **Drug Identification Chart,** *Ward’s Natural Science*  
*“Y’Ur in the Game: Urinalysis Lab”, The Forensic Teacher*, Winter 2010  
Teacher Resource CD  
**Responding to Alcohol Internet Activity**                                                                 |
## Unit 5: Handwriting Analysis

### Enduring Understandings
- ✓ Documents can be authenticated using specific unique and identifiable handwriting characteristics as well as the types of ink and paper and other artifacts from the creation process.

### Essential Questions
- ✓ What does a person’s handwriting say about them?
- ✓ Can an investigator use handwriting samples in a court of law?
- ✓ Can handwriting samples identify a person?

### Standards

#### Knowledge
**Students will know:**

**Document Evidence and Handwriting Analysis**
- Handwriting samples show unique characteristics known as class characteristics and individual characteristics that help investigators to use samples in a court of law.
- Handwriting experts examine twelve characteristics:
  - Line quality
  - Word and letter spacing
  - Height, width and letter size ratios
  - Pen lifts and separations
  - Connecting strokes
  - Beginning and end strokes
  - Unusual letter formation
  - Shading or pen pressure
  - Slant

#### Skills
**Students will be able to:**

**Skills:**
- Use handwriting analysis data to identify patterns
- Collaborate with peers to perform an investigation

**Practices:**
- *Analyzing and Interpreting Data.*
  Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

### Crosscutting Concepts:

- Scale, Proportion, and Quantity
  - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

- Patterns
  - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
### Key Terms:
- Class characteristics
- Individual characteristics
- Exemplar
- Diacritics

### Forgery
- There are three types of forgery: blind, simulated and traced.
- Forgeries include erasures of words or letters which are evident by examining the paper’s surface. This is known as obliteration and they can either be physical or chemical.
- Inks from suspected forgeries can be analyzed using the method of chromatography.
- Counterfeiting is one of the oldest crimes in the world and has been decreasing due to changes in the materials used to create our currency.

### Key Terms:
- Forgery
- Blind forgery
- Simulated forgery
- Traced forgery
- Obliterate
- Chromatography
- Counterfeiting

### Engaging in Argument from Evidence
- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

### SKILLS:
- Design an experiment using the method of paper chromatography
- Draw conclusions based on experimental evidence
- Practice safety in the science laboratory

### PRACTICES:
- **Planning and Carrying Out Investigations.**
  Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, scale, proportion, and quantity)
- **Patterns**
  - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

### NGSS:
#### Focus on Practices and Crosscutting Concepts
risk, time), and refine the design accordingly.

- **Analyzing and Interpreting Data.** Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

- **Constructing Explanations and Designing Solutions**

  Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
## Handwriting Analysis Unit

<table>
<thead>
<tr>
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<th>PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS</th>
<th>RESOURCES/INTERDISCIPLINARY CONNECTIONS</th>
</tr>
</thead>
</table>
| April      | Document Evidence and Handwriting Analysis | Activity 16.1: Analyze Your Own Handwriting, TEp481  
Class Discussion: What does our handwriting say about us?  
Case Study 16.1: Anonymous Writing, TEp481 | Teacher Resource CD  
Document Analysis Lab Activity, *Ward’s Natural Science* |
| April - May| Forgery                      | Activity 16.2: Simulated Forgery, TEp484  
Activity 16.3: Blind, Simulated and Traced Forgery, TEp486  
Activity 16.6: Detecting Deliberately Disguised Handwriting, TEp490  
Laboratory Activity 16.1: Finding Erasures, TEp493  
Laboratory Activity 16.4: Ink Comparison Using Paper Chromatography, TEp499  
Laboratory Activity 16.5: Know Your Money, TEp502  
Laboratory Activity 16.6, Testing for Counterfeit Currency, TEp503  
Additional Projects #1, TEp511  
Assessment: Unit Test | Teacher Resource CD  
Ink Chromatography Activity, *Ward’s Natural Science* |
## Unit 6: Ballistics and Impressions

### ENDURING UNDERSTANDINGS

-✓ Guns, tools, teeth, and other weapons leave unique microscopic impressions that can be analyzed and matched to reconstruct a crime scenario.

### ESSENTIAL QUESTIONS

-✓ What evidence from a gun can be left behind at a crime scene?
-✓ What characteristics would you look for to determine the kind of weapon used in a crime?
-✓ How could footprints be used to reconstruct a crime scene?

### STANDARDS

<table>
<thead>
<tr>
<th>KNOWLEDGE</th>
<th>SKILLS</th>
<th>CROSSCUTTING CONCEPTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will know:</td>
<td>Students will be able to:</td>
<td>Students will be able to apply:</td>
</tr>
</tbody>
</table>

### Firearms

- There are several types of firearms legal in our society such as handguns, rifles, shotguns and BB guns.
- Bullets are identified by its caliber (diameter). The weight, dimensions, shape and type of bullet are considered class evidence.
- The lands and grooves made on bullets that are rifled are known as class characteristics and can be used to identify weapons.

### Key Terms:

<table>
<thead>
<tr>
<th>KNOWLEDGE</th>
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<th>CROSSCUTTING CONCEPTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will know:</td>
<td>Students will be able to:</td>
<td>Students will be able to apply:</td>
</tr>
</tbody>
</table>

**SKILLS:**

- Construct an argument based on evidence provided in a case study

**PRACTICES:**

- *Constructing Explanations and Designing Solutions*

Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

**Scale, Proportion, and Quantity**

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

**Patterns**

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for
### NGSS: Focus on Practices and Crosscutting Concepts

<table>
<thead>
<tr>
<th><strong>Tool marks and Other Impressions</strong></th>
<th><strong>SKILLS:</strong></th>
<th><strong>Scale, Proportion, and Quantity</strong></th>
</tr>
</thead>
</table>
| • Tools can be any object and is defined by the purpose for which the object is used. Tool marks are created on a surface softer than the tool. | • Participate in class discussions  
• Collaborate with peers to draw conclusions  
• Gather and use information to solve problems | • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another |

### Hillside Township School District

- caliber, lands, grooves, cartridge casing

- **Engaging in Argument from Evidence**
  Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

### Causality

**Structure and Function**
- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

**Cause and Effect**
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
### Key Terms:

- **Casts**

### PRACTICES:

- **Analyzing and Interpreting Data.**
  - Make measurements and construct a graph to interpret data

- **Obtaining, Evaluating, and Communicating Information**
  - Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
  - Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).  
  - **Using Mathematics and Computational Thinking**
  - Use mathematical and/or computational representations of phenomena or design solutions to support explanations. Create or revise a simulation of a phenomenon, designed device, process, or system.

### Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

### Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

### Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Hillside Township School District

Ballistics and Impressions Unit

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<tr>
<th>TIME FRAME</th>
<th>TOPIC</th>
<th>PERFORMANCE TASKS</th>
<th>ACTIVITIES/PROJECTS</th>
<th>ASSESSMENTS</th>
<th>RESOURCES/INTERDISCIPLINARY CONNECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>Firearms</td>
<td>Class Discussion: What evidence does a gunshot leave behind?</td>
<td>Case Study 15.1: The Case of People v. Contreras, TEp454</td>
<td>Project: Both Sides of the Issue; Gun Control Laws, TEp474</td>
<td>Trajectory Kit, <a href="#">Ward’s Natural Science Forensic Science Kits and Accessories</a> Teacher Resource CD</td>
</tr>
<tr>
<td>May-June</td>
<td>Tool marks and Other Impressions</td>
<td>Laboratory Activity 15.5: Matching Tool marks, TEp458</td>
<td>Class Discussion: Where can shoeprints be used as evidence?, TEp460</td>
<td>Checkpoint Question #18, TEp473</td>
<td>Laboratory Activity 15.7: Relating Shoe Size to Height, TEp464 Analyzing Tire Tracks Activity, <em>The Forensic Teacher</em> Laboratory Activity 15.8: Comparing Bite Marks, TEp467 Laboratory Activity 15.9: The Case of the Bitten Bonbon, TEp468</td>
</tr>
</tbody>
</table>