Hillside Township School District

Science
Forensic Science Curriculum

Grades 11-12

Curriculum Contributors:
Teresa Tenreiro

Supervisor
Lisa Corona

Directors
Dr.Christy Oliver-Hawley

Superintendent of Schools
Dr. Antoine Gayles

Board of Education Approved:

Hillside Township School District

Table of Contents

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

New Jersey Student Learning Standards for Science

The New Jersey Student Learning Standards for Science (NJSLS-S) describe the expectations for what students should know and be able to do as well as promote three-dimensional science instruction across the three science domains (i.e., physical sciences, life science, Earth and space sciences). From the earliest grades, the expectation is that students will engage in learning experiences that enable them to investigate phenomena, design solutions to problems, make sense of evidence to construct arguments, and critique and discuss those arguments (in appropriate ways relative to their grade level). The foundation of the NJSLS-S reflects three dimensions — science and engineering practices, disciplinary core ideas, and crosscutting concepts. The performance expectations are derived from the interplay of these three dimensions. It is essential that these three components are integrated into all learning experiences. Within each standard document, the three dimensions are intentionally presented as integrated components to foster sensemaking and designing solutions to problems. Because the NJSLS-S is built on the notions of coherence and contextuality, each of the science and engineering practices and crosscutting concepts appear multiple times across New Jersey Department of Education January 2022 Page 1 of 200 topics and at every grade level. Additionally, the three dimensions should be an integral part of every curriculum unit and should not be taught in isolation.

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.

Hillside Township School District

Introduction to Forensics and Fingerprinting Unit

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
✓ Forensic Scientists use evidence to reconstruct the events of a crime. ✓ Fingerprints are unique to individuals and can be used as evidence in arguing which individuals were present at a crime scene. ✓ There are multiple common causes of death. ✓ There are various categories associated with the manner of death. ✓ Various characteristics can be determined from human remains, including height and sex.	✓ How do we catch and convict criminals? ✓ Can fingerprints identify a criminal with absolute certainty? What should be the standard of proof? ✓ How do forensic anthropologists identify human remains?

NJ Student Learning Standards (NJSLS-S)	KNOWLEDGE Students will know:	SKILLS & PRACTICES Students will be able to:	CROSSCUTTING CONCEPTS: Students will be apply to apply:
Focus on Practices and Crosscutting Concepts	**Forensic Science Intro** • History of Forensic Science o Alphonse Bertillon - devised first scientific system of personal identification o Edmond Locard - demonstrated how the application of scientific method work in the crime laboratory - Locard's exchange principle	**SKILLS:** • Use an equation to calculate probability • Follow procedures while investigating a crime scene **PRACTICES:** • Asking Questions and Defining Problems	**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**

	• Ethics and standards
	  o Frye standard - is the procedure/technique/principle "generally accepted" by a meaningful segment of the scientific community
	  o Daubert ruling - does the expert's testimony rest on reliable foundation and is relevant to the case
	• Deductive vs. Inductive reasoning
	• Testimonial Evidence is a witness statement.
	• Physical Evidence is an object or material relevant to the crime.
	  o Can prove that there was a crime in the first place
	  o Can back up or disprove witness statements
	  o Can link a suspect to victim or crime scene
	  o Can determine identify of person linked to crime
	  o Can allow investigators to reconstruct the crime
	• Class data can be used to narrow a suspect down to one person out of a large group of people based on known characteristics.
	• The Crime Scene - information at crime scenes must be gathered in a systematic way. The following procedures must be taken:
	  o Preservation and isolation of the scene
	  o Observations and documentation
	  o Note-taking
	  o Photographs and/or videotape
		○ Ask questions that arise from examining models or a theory to clarify relationships.
		• 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 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
			• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

	○ Sketches ○ Search for evidence ○ Collecting and packaging evidence ○ Chain of custody ○ Investigation Key Terms: evidence, expert witness, testimonial evidence, physical evidence, individual evidence, class evidence, deductive reasoning, inductive reasoning	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.	
NJSLS-S: **HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of	**Recovering Fingerprints & Death Investigation** ● 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. ● Forensic pathologists associated with the medical examiner's or coroner's office are responsible for determining the cause of an undetermined or unexpected death. ● The manner in which death occurred is classified in death certifications as one of five categories: homicide, suicide, accidental, natural, or undetermined.	**SKILLS:** ● 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.	**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.

specialized cells.	• Forensic anthropology is concerned primarily with the identification and examination of human skeletal remains. • The gender of the decedent can be determined by the size and shape of various skeletal features, especially those in the pelvis and skull, or cranium. • The height of the victim when alive can be estimated by measuring the long bones of the skeleton, especially those in the lower limbs. Key Terms: anthropometry, Bertillon method, latent print, plastic print, visible print, homicide, rigor mortis, algor mortis, livor mortis	○ 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.	
NJSLS-S: **HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of	**Comparing Fingerprints** • All fingerprints fit three basic patterns. o Loop patterns feature a ridge that makes a "U" shape. o Whorl patterns feature a spiral shaped ridge. o 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.	**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	**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

proteins which carry out the essential functions of life through systems of specialized cells.	● Individual ridge characteristics are compared between evidence and suspect. <u>Key Terms:</u> loop pattern, whorl pattern, arch pattern, Henry Classification System, minutiae, AFIS	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.	about specific causes and effects.

Hillside Township School District

Introduction to Forensics and Fingerprinting Unit

TIME FRAME	TOPIC	PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS	RESOURCES/INTERDISCIPLINARY CONNECTIONS
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	Video: Nat. Geo. Crime Scene Evidence Ronald Cotton Crime Scenes 1 Crime Scenes 2 Crime Scenes 3 Teacher Resource CD
September	Recovering Fingerprints & Death Investigation	Laboratory Activity 4.1: Observing and Taking Fingerprints, TEp77 Laboratory Activity 4.2: Developing Latent Fingerprints, TEp88 Assessment: Quiz	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 Fingerprint Recognition - FBI Fingerprints & Other Biometrics Recording Legible Fingerprints

			Time of Death lab Missing Persons Case Experiment 30 - Forensic Anthropology 2: Examination of Grave Site Bones, Forensic Science Laboratory Manual and Workbook, 3rd Ed., Kubic & Petraco, CRC Press
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 Teacher Resource CD

Hillside Township School District

Analysis of Hair, Fiber, and Trace Evidence Unit

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
✓ 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. ✓ Glass fractures can reveal information related to the force and direction of an impact.	✓ 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? ✓ How can glass fragments and fractures be used in reconstructing a crime?

STANDARDS	KNOWLEDGE Students will know:	SKILLS & PRACTICES Students will be able to:	CROSSCUTTING CONCEPTS: Students we be able to apply:

NJSLS-S **Focus on Practices and Crosscutting Concepts**	**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 ● Explain how density and refractive index of glass is measured and utilized for forensic characterization. ● The flotation method is used to determine a glass fragment's density. Key Terms: trace evidence, qualitative, quantitative, physical and chemical properties	**SKILLS:** ● 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 **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	**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.

		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.	
NJSLS-S: **HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of	**Hair Analysis** ● Hair is one type of class evidence. ● Based on the Locard Exchange Principle, hair (and other materials) can be directly transferred to other materials. ● Hair can differ among individuals and animals based on texture, color and cuticle scale patterns. ● Drugs and other chemicals can be deposited into hair through the blood system. Key Terms:	**SKILLS:** ● Use a compound microscope ● Record observations ● Make conclusions that will help to further students' investigations ● Create arguments in support of or opposition to the use of specific forensic procedures and types of evidence **PRACTICES:**	**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

proteins which carry out the essential functions of life through systems of specialized cells.	Locard Exchange Principle, polymers, cuticle, cortex, medulla, exemplar, false positive	● 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. ● Engaging in Argument from Evidence ○ Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and	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.

		student-generated evidence.	
NJSLS-S **HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	**Fibers** ● Fibers can be identified using microscopes and by observing their chemical properties. o They are examples of trace and class evidence since fibers offer no individuality. o The ability of fibers to transfer to other materials allows it to be used as trace evidence. o There are two types of fibers: natural and synthetic ● Certain properties of fibers help investigators determine its origins: o Burning o Thermal decomposition o Chemical composition o Density o 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	**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

		reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● 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. ● Engaging in Argument from Evidence	components to reveal its function and/or solve a problem.

		○ Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.	

Hillside Township School District

UNIT 2: Analysis of Hair, Fiber, and Trace Evidence

TIME FRAME	TOPIC	PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS	RESOURCES/INTERDISCIPLINARY CONNECTIONS
October-November	Trace Evidence	Activity 9.1: How Well Can You Identify Trace Evidence?, TEp232 Class Discussion: What is the importance of Trace Evidence? Laboratory Activity 9.3: Analysis of White Powders, TEp243 Laboratory Activity 9.4: The Case of the Purloined Pennies, TEp247 Case Study 9.2, TEp260 Ongoing: Case Studies - 3 per marking period reflecting an infamous case on a covered topic Glass Fragment Lab Handout	Trace Evidence Slide Set, Ward's Natural Science Teacher Resource CD
November	Hair Analysis	Class Discussion: The Crime Scene, TEp106-108 Laboratory Activity 5.1: Observations of Hair, TEp108 Class Discussion: Collection of Hair and Hair Toxicology Additional Projects #3, 4 and 5, TEp124	Hair and Fiber Analysis Kit, Ward's Natural Science Wards Hair Types Kit, Sargent Welch Microscope Image Gallery - Hair Teacher Resource CD
November-December	Fibers	Class Discussion: Using Fibers as Evidence Activity 6.1: Collection and Observation, TEp129 Suggested Assignment: Collect samples of different areas of the home using tape. TEp129	Hair and Fiber Analysis Kit, Ward's Natural Science Wards Fiber Types Kit, Sargent Welch Trace Evidence Slide Set, Ward's Natural Science Wayne Williams Case Microscope Image Gallery - Fibers Teacher Resource CD

		Activity 6.2: Sampling and Statistics, TEp129 Laboratory Activity 6.1 Fabric Observation, TEp131 Class Discussion: Types of Fibers and Fiber Analysis Laboratory Activity 6.5: Burn Tests, TEp143 Laboratory Activity 6.6: Thermal Decomposition, TEp144 Laboratory Activity 6.7: Chemical Tests, TEp146 Laboratory Activity 6.9: Observing Fluorescence in Fibers, TEp151 Case Study 6.1: Wayne Williams Case, TEp159 Case Study 6.2: Amanda Davies Case, TEp160 Assessment: Unit Test	

Hillside Township School District

Blood Evidence and DNA Analysis Unit

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

STANDARDS	KNOWLEDGE Students will know:	SKILLS & PRACTICES Students will be able to:	CROSSCUTTING CONCEPTS: Students will be able to apply:
NJSLS-S: 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.	**Blood Evidence** ● 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. ● 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: Kastle-Meyer Presumptive blood testing, luminol testing.	**SKILLS:** ● Gather and interpret measurements. ● Interpret graphs. ● Practice safety in the science laboratory. ● Follow experimental procedures. ● Record observations. **PRACTICES:** ● Planning and Carrying Out Investigations.	**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

HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. **HS-LS3-3** Make and defend a claim based on evidence that inheritable genetic variations may result from:	• 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	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.

(1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. **HS-PS2-1** Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.		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.	

NJSLS-S: **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. **HS-LS3-2** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during	**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	**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.

replication, and/or (3) mutations caused by environmental factors. **HS-LS3-3** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.		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.	

NJSLS-S: **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. **HS-LS3-2** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis,	**DNA Analysis in Forensics** ● DNA Fingerprinting is a method used by investigators. Pieces of DNA are cut using restriction enzymes and compared with known DNA of suspects. ● 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. ● The use of mitochondrial DNA can be used to identify missing persons. Key Terms: DNA fingerprinting, restriction enzymes, PCR, Mitochondrial DNA	**SKILLS:** ● Follow experimental procedures ● Compare DNA fingerprint data to identify a criminal ● 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.	**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

(2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. **HS-LS3-3** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.		• 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.	explanations of phenomena.

Hillside Township School District

Blood Evidence and DNA Analysis Unit

TIME FRAME	TOPIC	PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS	RESOURCES/INTERDISCIPLINARY CONNECTIONS
December-January	Blood Spatter Analysis	Class Discussion: Using Blood Spatter as Evidence Case Study 11.1: The Sam Sheppard Case, TEp317 Laboratory Activity 11.4: Blood Pattern Analysis, TEp322 ABO Blood Typing Lab Presumptive Blood Test Lab O.J. Simpson Case Study/Analysis Ongoing: Case Studies - 3 per marking period reflecting an infamous case on a covered topic Assessment: Quiz	Video: The Killer's Trail (NOVA) Introduction to Blood Spatter Analysis Kit, Ward's Natural Science Bloodstain Pattern Analysis ABO Blood Typing Lab Kit Presumptive Blood Test Lab Kit Trajectory Kit, Ward's Natural Science Teacher Resource CD
January - February	What is DNA?	Class Discussion: What does DNA say about us? Laboratory Activity 12.1: Extracting DNA from a Banana, TEp341 (modified to use cheek cells instead)	Inside DNA The Killer's Trail Teacher Resource CD
February	DNA Analysis in Forensics	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	The Case for Innocence Create a DNA Fingerprint PCR Analysis Diagram Gel Electrophoresis Virtual Lab Recovering the Romanovs Teacher Resource CD

Hillside Township School District

Toxicology Unit

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
✓ The concentration of a substance determines its toxicity. The same substance may be helpful or harmful to a person, depending on the dose.	✓ What makes a substance poisonous?

STANDARDS	KNOWLEDGE Students will know:	SKILLS & PRACTICES Students will be able to:	CROSSCUTTING CONCEPTS: Students will be able to apply:
NJSLS-S: **HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **HS-PS2-6** Communicate scientific and technical	**Poisons and the History of Toxicology** ● The dosage of a substance determines whether it is poisonous and how poisonous it is. ● Elements of toxicology: o Chemical and physical form of a substance o How it enters the body o Body weight and the physiological conditions of the victim (age and sex) o Time period of exposure o Presence of other chemicals in the body or in the dose ● The lethal dose (LD_{50}) is used to measure toxicity. Key Terms: toxins, chronic exposure, acute toxicity, LD_{50}	**SKILLS:** ● Read and interpret tables ● Practice safety in the science laboratory ● Use a case study to identify the connections between hair analysis and toxicology **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	**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.

information about why the molecular-level structure is important in the functioning of designed materials. .		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. ● Constructing Explanations and Designing Solutions ○ Construct an explanation based on valid and reliable evidence obtained from	**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).

		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. ● 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. ● Asking Questions and Defining Problems ○ Ask questions that arise from examining models or a theory to clarify relationships.	

NJSLS-S: **HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **HS-PS2-6** Communicate scientific and technical information about why the molecular-level structure is	**Drugs and Crime** ● Drugs can affect the function and structure of living systems. ● 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	**SKILLS:** ● 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:** ● 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	**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** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

important in the functioning of designed materials.		○ 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).	**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).

Hillside Township School District

Toxicology Unit

TIME FRAME	TOPIC	PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS	RESOURCES/INTERDISCIPLINARY CONNECTIONS
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

Hillside Township School District

Handwriting & Document Analysis Unit

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
✓ 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. ✓ Describe the types of services offered by modern mobile devices, such as cell phones, and the potential investigative value they have. ✓ Explain the role of IP in forensic investigation of Internet communications. ✓ Discuss the technique used to investigate unauthorized computer intrusion.	✓ 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? ✓ How are electronic crimes processed?

STANDARDS	KNOWLEDGE Students will know:	SKILLS Students will be able to:	CROSSCUTTING CONCEPTS: Students will be able to apply:
NJSLS-S: **Focus on Practices and Crosscutting Concepts**	**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: o Line quality o Word and letter spacing o Height, width and letter size ratios o Pen lifts and separations	**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	**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**

	○ Connecting strokes ○ Beginning and end strokes ○ Unusual letter formation ○ Shading or pen pressure ○ Slant ○ Baseline habits ○ Flourishes or embellishments ○ Placement of diacritics ● Computer forensics involves the preservation, acquisition, extraction, and interpretation of computer data. ● The central processing unit (CPU) is the brain of the computer—the main chip responsible for doing the actual computing. ● Random-access memory (RAM) is volatile memory that is lost when power is turned off. ● Programs are loaded into RAM because of its faster read speed. ● The hard disk drive (HDD) is typically the primary location of data storage within the computer. ● The types of computer evidence can be grouped under two major subheadings: visible and latent data. ● Mobile device forensic analysis can provide an overlay to physical evidence and timelines as well as computer forensic timelines to give a clearer picture of the events preceding and following a crime event. <u>Key Terms:</u> class characteristics, individual characteristics, exemplar, diacritics	function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● 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.	• 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.

NJSLS-S: **Focus on Practices and Crosscutting Concepts**	**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. <u>Key Terms:</u> forgery, blind forgery, simulated forgery, traced forgery, obliterate, chromatography, counterfeiting	**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, risk, time), and refine the design accordingly. ● Analyzing and Interpreting Data.	**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.

		○ 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.	

Hillside Township School District

Handwriting Analysis Unit

TIME FRAME	TOPIC	PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS	RESOURCES/INTERDISCIPLINARY CONNECTIONS
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 Personal Cell Phone Analysis Questions - see Criminalistics textbook from NJIT (Pearson)	Document Analysis Lab Activity, Ward's Natural Science Teacher Resource CD
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	Ink Chromatography Activity, Ward's Natural Science Teacher Resource CD

Hillside Township School District

Ballistics and Impressions Unit

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
✓ Guns, tools, teeth, and other weapons leave unique microscopic impressions that can be analyzed and matched to reconstruct a crime scenario.	✓ 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 can footprints be used to reconstruct a crime scene?

STANDARDS	KNOWLEDGE Students will know:	SKILLS Students will be able to:	CROSSCUTTING CONCEPTS: Students will be able to apply:
NJSLS-S: **HS-PS2-3** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	**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: caliber, lands, grooves, cartridge casing	**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	**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.

		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.	**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.
Focus on Practices and Crosscutting Concepts	**Toolmarks and Other Impressions** ● Tools can be any object and is defined by the purpose for which the object is used. Toolmarks are created on a surface softer than the tool. ● Both class and individual characteristics can be used to identify a tool used in a crime. ● Toolmarks are taken into the lab for examination or cast replicas are created.	**SKILLS:** ● Participate in class discussions ● Collaborate with peers to draw conclusions ● Gather and use information to solve problems ● Make measurements and construct a graph to interpret data PRACTICES: ● Analyzing and Interpreting Data.	**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

	● Shoeprints/footprints can provide information about a crime scene such as direction of approach and departure, point of entry, exit and the sequence of events and personal traits. ● Shoeprints can be matched to a shoe using class evidence. ● Tire treads are similar to shoeprints in that they can provide both class and individual characteristics used in identification. <u>Key Terms:</u> Casts	○ 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). ● Using Mathematics and Computational Thinking ○ Use mathematical and/or computational representations of phenomena or design solutions to support explanations. ○ Use mathematical representations of phenomena or design solutions to support and revise explanations.	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.

		○ Create or revise a simulation of a phenomenon, designed device, process, or system.	

Hillside Township School District

Ballistics and Impressions Unit

TIME FRAME	TOPIC	PERFORMANCE TASKS ACTIVITIES/PROJECTS ASSESSMENTS	RESOURCES/INTERDISCIPLINARY CONNECTIONS
May	Firearms	Class Discussion: What evidence does a gunshot leave behind? Case Study 15.1: The Case of People v. Contreras, TEp454 Project: Both Sides of the Issue; Gun Control Laws, TEp474	Trajectory Kit, Ward's Natural Science Forensic Science Kits and Accessories Teacher Resource CD
May-June	Toolmarks and Other Impressions	Laboratory Activity 15.5: Matching Toolmarks, TEp458 Class Discussion: Where can shoeprints be used as evidence?, TEp460 Checkpoint Question #18, TEp473 Laboratory Activity 15.7: Relating Shoe Size to Height, TEp464 Analyzing Tire Tracks Activity, *The Forensic Teacher* Laboratory Activity 15.8: Comparing Bite Marks, TEp467 Laboratory Activity 15.9: The Case of the Bitten Bonbon, TEp468 Assessment: Unit Test	Inkless Shoe/Footprint Kit, Ward's Natural Science Forensic Files Mini-Episodes "Making Tracks. Literally.", *The Forensic Teacher*, Spring 2010 Teacher Resource CD

Modifications

Teacher Note: Teachers identify the modifications that they will use in the unit.

- Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities

NGSS Resources

Appendix F Science & Engineering Practices
Appendix G Crosscutting Concepts