Lindenwold Public Schools

Unit number 4: Ballistics and Blood Evidence
23 instructional days

Targeted Standards

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. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

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. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]

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. [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.]

HS-PS2-3. Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]

Science and Engineering Practices

Asking Questions and Defining Problems

Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

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. (HS-LS3-3)

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

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. (HS-LS3-2)

Constructing Explanations and Designing Solutions
Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

Disciplinary Core Ideas

LS3.A: Inheritance of Traits
Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)

LS3.B: Variation of Traits
In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)

Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)

PS2.A: Forces and Motion
Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-3)

Crosscutting Concepts

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1),(HS-LS3-2),(HS-PS2-1)

Systems can be designed to cause a desired effect. (HS-PS2-3)

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). (HS-LS3-3)

Science is a Human Endeavor

Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3)

Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Theories and laws provide explanations in science. (HS-PS2-1)

Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1)

Rationale and Transfer Goals:

Blood is a suspension of solid, mostly cellular material in a fluid that consists of water containing many dissolved materials. Blood can be identified and collected and then typed. Other bodily fluids can also be collected from a crime scene, victim or suspect. Besides collecting samples of bodily fluids, trajectory or patterns of blood can be analyzed to determine what happened during the crime and where individuals or other objects were located during the incident. Students will describe the tests used to characterize a stain as blood or other bodily fluids and be able to identify blood stain patterns to obtain information about the crime scene. The student will demonstrate proper technique for collection and preservation of blood evidence.

Both fires and explosions arise from combustion, a class of reactions studied in general chemistry. The differences between a fire and an explosion are the amounts of energy produced by the combustion and how the oxygen is made available for the reaction. While most students who have had chemistry or physical science have experienced training in both chemical reactions and energy, this will allow for a more practical application of the topic. Students will demonstrate proper technique for collection and preservation of arson evidence as well for the proper

analysis of flammable residues.In fires and explosions, it is critical to find the point of origin. Finding the origin can help determine the type of explosive or accelerant used. Students will also describe the proper technique for investigating the scene of a fire and be able to explain the basic principles of the chemistry of fire.

Enduring Understandings:

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

Blood splatter 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 individuals, used to identify or clear suspects.

Essential Questions:

What can blood splatter 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?

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?

Content/Objectives		Instructional Actions	
Content ***What students will know***	**Skills** ***What students will be able to do***	**Activities/Strategies** ***How we teach content and skills***	**Evidence (Assessments)** ***How we know students have learned***
• Serology is the study of blood. • Blood splatter evidence can be analyzed by calculating/observing	• Gather and interpret measurements. • Interpret graphs • Practice safety in the science laboratory	• Structure lessons around questions that are authentic, relate to students' interests,	• Case study- Sam Sheppard Case • Lab activity- Blood Pattern Analysis • O.J. Simpson case study

various characteristics and shapes of fallen blood. ● Forensic scientists rely on various methods to test for the presence of blood. ● Point of origin helps investigators to compare blood splatter evidence with testimonial evidence of witnesses and victims. ● DNA is found in the nuclei of living cells and is the genetic make-up of individuals. ● Bullets are identified by their 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. ● Tools can be any object and are defined by the purpose for which the object is used. Tool marks are created on a surface softer than the tool. ● Shoeprints/footprints can provide information about	● Follow experimental procedures ● Record observations ● Construct an argument based on evidence provided in a case study ● Gather and use information to solve problems ● Make measurements and construct a graph to interpret data	social/family background and knowledge of their community. ● Provide students with multiple choices for how they can represent their understanding. ● Provide opportunities for students to connect with people of similar backgrounds. ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures. ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding. ● Use project-based science learning to connect science with observable phenomena.	● Lab Activity- Extracting DNA from a banana ● Lab activity- Matching Tool marks ● Lab activity- Related shoe size to height ● Lab activity- Comparing Bite marks ● Quizzes ● Forensics Benchmark #2

a crime scene such as direction of approach or the sequence of an event.		• Structure the learning around exploring 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.	

Spiraling for Mastery
Where does this unit spiral back to other units from this or previous years in order to ensure that students retain mastery of what they've learned?

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• DNA is found in the nuclei of living cells and is the genetic make-up of individuals • Bullets are identified by their 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.	• Drugs and other chemical can be deposited into hair through the blood system. • Physical evidence is an object or material relevant to the crime which can prove or back up statements involving a crime. • Physical evidence is an object or material relevant to the crime which can link a suspect or identify a person involved in a crime.	• Lab activity- Blood Pattern Analysis • Lab activity- Matching Tool marks • Lab activity- Comparing Bite mark

Key resources:

Lindenwold Public Schools

Trajectory Kit Forensic Science Kits and Accessories Shoeprint Kit Making Tracks Kit Video: The killer's Trail Introduction to Blood Spatter Analysis Kit Presumptive Blood Test Lab Kit
21st Century Life & Careers: 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
areer Readiness, Life Literacies, & Key Skills: 9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice). 9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.

9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.

Interdisciplinary Connections

NJSLS ELA

RST.11-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. (HS-LS3-1), (HS-LS3-2), (HS-PS2-1)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS2-1)

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)

WHST.9-12.1 Write arguments focused on discipline-specific content. (HS-LS3-2)

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a selfgenerated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS2-3)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-1)

NJSLS Mathematics
MP.2 Reason abstractly and quantitatively. (HS-LS3-2), (HS-LS3-3), (HS-PS2-1)

MP.4 Model with mathematics. (HS-PS2-1)

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-1)

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-1)

Companion Standards for ELA in Science and Technical Subjects: Reading
Key Ideas and Details
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS2-1)

Companion Standards for ELA in Science and Technical Subjects: Writing
Text Types and Purposes
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS2-1)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-1)