Unit 4: Ballistics and Blood Evidence

Content Area: **Science**
Course(s):
Time Period: **MP2**
Length: **23 days**
Status: **Published**

NJSLS - Science

9-12.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.
9-12.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.
9-12.HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
9-12.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.
9-12.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.

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 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) 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 the 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 Moon

Newton's second law accurately predicts changes in the moon 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, 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 bloodstain patterns to obtain information about the crime scene. The student will demonstrate proper techniques for the 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 techniques for the collection and preservation of arson evidence as well as 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 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 - What will students know?

- Serology is the study of blood.
- Blood splatter evidence can be analyzed by calculating/observing 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 compare blood splatter evidence with testimonial evidence of witnesses and victims.
- DNA is found in the nuclei of living cells and is the genetic makeup 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 smaller than the tool.
- Shoeprints/footprints can provide information about a crime scene such as the direction of approach or

the sequence of an event.

Skills - What will students be able to do?

- Gather and interpret measurements.
- Interpret graphs
- Practice safety in the science laboratory
- Follow experimental procedures
- Record observations
- Construct an argument based on evidence provided in a case study
- Gather and use the information to solve problems
- Make measurements and construct a graph to interpret data

Activities - How will we teach the content and skills?

- Case study- Sam Sheppard Case
- Lab acvity- Blood Pattern Analysis
- O.J. Simpson case study
- Lab Actvity - Extracting DNA from a banana
- Lab actvity - Matching Toolmarks
- Lab actvity - Related shoe size to height
- Lab activity - Comparing Bite marks

Evidence/Assessments - How will we know what students have learned?

- Quizzes
- Forensics Benchmark # 2

Spiraling for Mastery

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	• Drugs and other chemicals can be deposited into hair through the blood system.	• Lab acvity- Blood Pattern Analysis • Lab acvity- Matching Tool

• 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.	• Physical evidence is an object or material relevant to the crime that can prove or back up statements involving a crime. • Physical evidence is an object or material relevant to the crime that can link a suspect or identify a person involved in a crime.	marks • Lab acvity- Comparing Bite mark

Key Resources

Trajectory Kit

Forensic Science Kits and Accessories

Shoeprint Kit

Making Tracks Kit

Video: The Killer's Trail

Introduction to Blood Spaer Analysis Kit

Presumptive Blood Test Lab Kit

Career 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 project 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 (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGl.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
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 (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
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 (e.g., NJSLSA.SL5).

Interdisciplinary Connections/Companion Standards

LA.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.
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.