BERKELEY HEIGHTS PUBLIC SCHOOLS
BERKELEY HEIGHTS, NEW JERSEY

GOVERNOR LIVINGSTON HIGH SCHOOL
SCIENCE DEPARTMENT

FORENSIC SCIENCE
#SCS0001

Curriculum Guide

Date: April 2021

Dr. Melissa Varley, Superintendent
Mr. Scott McKinney, Assistant Superintendent
Mr. James Finley, District Supervisor

Developed by: Lisa Dhaibar
Gregory Dunkerton

This curriculum may be modified through varying techniques, strategies, and materials, as per an individual student's Individualized Educational Plan (IEP).

Approved by the Berkeley Heights Board of Education
at the regular meeting held on 4/29/2021 .

VISION STATEMENT

The science curriculum aims to provide students with authentic and enriching experiences that enhance critical thinking and problem solving skills. Students gain a deeper understanding and appreciation of science and are exposed to real-world technologies. Students are challenged to analyze and evaluate data, construct new ideas, develop arguments and explanations, and apply concepts through engineering tasks.

To achieve this, the curriculum guides are based on the model science curriculum developed by New Jersey Department of Education and are aligned to the Next Generation Science Standards. The Next Generation Science Standards were created based on the work done by the National Research Council and summarized in their publication, *A Framework for K-12 Science Education (NRC, 2011).* The work shifts the focus of science education towards the development of overarching enduring concepts and emphasizes the process of science. The standards are no longer isolated components but rather a three dimensional approach to teaching that focuses equally on ***Disciplinary Core Ideas***, ***Science and Engineering Practices,*** and ***Crosscutting Concepts***.
Disciplinary Core Ideas have the power to focus K–12 science curriculum, instruction, and assessments on the most important aspects of science. These core ideas:

- Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline;
- Provide a key tool for understanding or investigating more complex ideas and solving problems;
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge;
- Are teachable and learnable over multiple grades at increasing levels of depth and sophistication.

The ***Science and Engineering Practices*** describe behaviors that scientists engage in as they investigate and build models about the natural world. Additionally, they emphasize the key set of engineering practices that engineers use as they design and build models and systems. Scientific investigation requires not only skill but also knowledge that is specific to each practice.

Crosscutting Concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change. These concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically based view of the world (NSTA, 2014).

Throughout the curriculum, engineering tasks have been embedded, which engage students in the design cycle, encourage the development of 21st century skills, and incorporate college and career ready practices.

MISSION STATEMENT

The philosophy of this program is to develop scientifically literate individuals, who through this course will gain an appreciation of the scientific inquiry and methods used in assessing a crime scene, understand the history behind those methods and techniques, be aware of current trends in evaluating evidence, and recognize that in its broadest sense, forensic science is the application of science to law.

Topics to be covered in this course include understanding the goals and limitations of forensic science, identification and individualization of fingerprints, handwriting and footwear, ballistics with glass analysis, hair and fiber analysis, blood spatter analysis, comparative anthropology, identification and individualization of tool marks, the profiling process, and the relevance of DNA as evidence.

As a result of studying forensic science, students should recognize that scientific practices and processes are an integral part of criminal investigations. Students should also realize that the contributions of current technology and research are invaluable in an ever-changing field. In addition, students will learn the difference between identification and individualization by learning and using the skills of evaluation.

Students enrolled in forensic science will be expected to work both independently and cooperatively, think creatively, formulate questions based on their understanding, reason logically and critically, arrive at reasonable conclusions, demonstrate the skills they have learned through the completion of labs and demonstrations, share information with classmates through written and oral presentations, use equipment and technology the way it was intended and designed to be used, and use clues to solve a “mock” crime.

Students will demonstrate competency in the New Jersey Student Learning Standards, as evidenced by a passing grade on the multiple cumulative assessments, throughout the course. Forensic Science is intended for 11^{th} and 12^{th} grade students. Two point five (2.5) credits are given for successful completion of this course.

COURSE PROFICIENCIES

COURSE OBJECTIVES

The Forensics curriculum consists of six units (and 5 other optional units) reflective of the NJDOE Model Curriculum. Each unit is structured to emphasize a three dimensional learning environment and therefore incorporates science and engineering processes, disciplinary core ideas, and crosscutting concepts. The standards, which encompass these three components, are addressed throughout these units are presented below and sorted based on domain.

LS: Life Science

LS1: From Molecules to Organisms: Structures and Processes
- HS-LS1-1
- HS-LS1-1

LS2: Ecosystems: Interactions, Energy, and Dynamics
- HS-LS2-8

LS3: Heredity: Inheritance and Variation of Traits
- HS-LS3-1
- HS-LS3-3

LS4: Biological Evolution: Unity and Diversity
- HS-LS4-1

PS: Physical Science

PS2: Motion and Stability: Forces and Interactions
- HS-PS2-1
- HS-PS2-2

ETS: Engineering, Technology and the Application of Science

ETS1: Engineering Design
- HS-ETS1-1
- HS-ETS1-2

STUDENT PROFICIENCIES

The student proficiencies represent the broad skills that students will gain by completing the course. These skills spiral throughout the K-12 science progression and are leveled appropriately according to grade level and science domain.

Science and Engineer Practice

- Asking Questions and Defining Problems - A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.
- Developing and Using Models - A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.
- Planning and Carrying Out Investigations - Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.
- Analyzing and Interpreting Data - Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.
- Using Mathematics and Computational Thinking - In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.
- Constructing Explanations and Designing Solutions - The products of science are explanations and the products of engineering are solutions.
- Engaging in Argument from Evidence -Argumentation is the process by which explanations and solutions are reached.
- Obtaining, Evaluating, and Communicating Information -Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

Crosscutting Concepts

- Patterns - Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- Cause and Effect - Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
- Scale, Proportion, and Quantity - In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
- Systems and System Models - A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
- Energy and Matter - Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
- Structure and Function - The way an object is shaped or structured determines many of its properties and functions.
- Stability and Change - For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

Nature of Science

- Scientific Investigations Use a Variety of Methods
- Science Knowledge Is Based on Empirical Evidence
- Scientific Knowledge Is Open to Revision in Light of New Evidence
- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Science Is a Way of Knowing
- Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science Is a Human Endeavor
- Science Addresses Questions About the Natural and Material World

College and Career Ready Practices

- Apply appropriate academic and technical skills.
- Communicate clearly and effectively and with reason.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Employ valid and reliable research strategies.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Use technology to enhance productivity.
- Work productively in teams while using cultural global competence.

METHODS OF EVALUATION

1. Homework and class work.
2. Class participation.
3. Tests and quizzes.
4. Completion of labs.
5. Presentations.
6. Notebook.
7. Research projects.
8. Final Crime Scene Project.

Final Crime Scene Team Project - Duration: 3 Weeks

Conduct a Full Crime Scene Investigation of a Staged Crime, Using the Skills Developed Throughout the Semester

- Observing and securing the crime scene
- Collecting appropriate evidence from the crime scene
- Presenting evidence supporting/refuting suspects' guilt
- Submitting a proposed solution to the crime

Graded Components Include:

- Input in the folder report
- Construction of a video/iMovie
- Personal contributions – individual area of expertise

Each Student will Act as an Expert in One of the Following Assigned Roles

- Team leader
- Fingerprint analyst
- Hair analyst
- Shoeprint analyst
- Handwriting analyst
- Graphologist
- Sketch artist

MODIFICATIONS & ACCOMMODATIONS

Modifications and Accommodations for Special Education students, students with 504s, English Language Learners and Gifted and Talented students may include but are not limited to the following:

Special Education

- Individualized Education Plans (IEPs)
- Exemplars of varied performance levels
- Multimedia presentations
- Sheltered instruction
- Consultation with ESL teachers
- Manipulatives
- Tiered/Scaffolded Lessons
- Mnemonic devices
- Visual aids
- Modeling
- Guided note-taking
- Study Guides
- Modified homework
- Differentiated pre-typed class notes and example problems
- Use of the special education teacher to re-instruct in flexible small groups for the struggling learner
- Manipulatives
- Flipped Instruction
- Word banks
- Reduced choice on assessments
- Preferential seating
- Choice activities
- Modified time requirements
- Modified notes
- Modified lesson, assessment and study guide format
- Provide an enriched curriculum and activities
- Independent projects
- Contracts/behavior support plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Functional learning incorporated into each lesson
- Exploration Activities
- Assessment read aloud
- Small group assessments

- Organizational Support
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Content-focused assessment (not grading for spelling/grammar)
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

Gifted & Talented

- Provide one-to-one teacher support
- Curriculum Compacting
- Advanced problems to extend the critical thinking skills of the advanced learner
- Supplemental reading material for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix
- Curriculum Compacting
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Manipulatives
- Tiered Lessons
- Flipped Instruction
- Multimedia Presentations
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Conclusions and analysis of exploratory activities
- Career based learning incorporated into each lesson
- Exploration Activities
- Student choice

ELLs

- Exemplars of varied performance levels
- Multimedia presentations
- Sheltered instruction
- Consultation with ESL teachers
- Manipulatives
- Tiered/Scaffolded Lessons
- Mnemonic devices
- Visual aids

- Modeling
- Guided note-taking
- Study Guides
- Modified homework
- Differentiated pre-typed class notes and example problems
- Individualized instruction plans
- Manipulatives
- Flipped Instruction
- Words banks
- Reduced choice on assessments
- Preferential seating
- Choice activities
- Modified time requirements
- Modified notes
- Modify lesson, assessment and study guide format
- Provide an enriched curriculum and activities
- Contracts/management plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

504s

- Exemplars of varied performance levels
- Multimedia presentations
- Sheltered instruction
- Tiered/Scaffolded Lessons
- Mnemonic devices
- Visual aids
- Modeling
- Guided note-taking
- Study Guides

- Differentiated pre-typed class notes and example problems
- Manipulatives
- Words banks
- Reduced choice on assessments
- Preferential seating
- Modified time requirements
- Modified notes
- Modify lesson, assessment and study guide format
- Modified homework
- Independent projects
- Contracts/management plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Organizational Support
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Content-focused assessment (not grading for spelling/grammar)
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

Students at Risk of Failure

- Exemplars of varied performance levels
- Multimedia presentations
- Tiered/Scaffolded Lessons
- Modeling
- Guided note-taking
- Study Guides
- Differentiated pre-typed class notes and example problems
- Individualized instruction plans
- Words banks
- Reduced choice on assessments
- Preferential seating
- Choice activities
- Modified time requirements

- Modified notes
- Modified lesson, assessment and study guide format
- Modified homework
- Provide an enriched curriculum and activities
- Contracts/management plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

SCOPE AND SEQUENCE
COURSE OUTLINE/STUDENT OBJECTIVE

Unit 1: Goals of Forensic Science

Duration: 2 Weeks

Overview: This is an introduction to Forensic Science where students will learn the history of forensic science, crime scene vocabulary, and techniques to analyze a crime scene. They will recognize the goal of forensic science as the identification, individualization, and evaluation of physical evidence. Additionally, students will develop an appreciation of those that contributed to the field of forensic science.

Standards:

- **HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3.** Evaluate a solution to a complex real-world problem-based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What are the goals of forensic science?
- What are the major components and areas of study in a crime lab?
- What types of evidence are important to solve a crime scene?

Student Learning Objectives:
Students will know and be able to…

-
- Evaluate Physical Evidence
- Analyze a Crime Scene by Looking for Patterns and Evidence
- Reconstruct the Crime, Using Data from the Analysis
- Develop a Working Understanding of the Crime Lab
- Engage in the Following Forensic Activities

Possible Activities

- Create a history of forensics timeline
- Watch the “Bone Collector” video and respond to discussion questions
- Perform the “Lying Activity” to develop an understanding of suspect interrogation
- Compare and contrast class vs. individualistic evidence

- Develop methods of questioning
- Analyze a crime scene by looking for patterns and evidence
- Reconstruct the crime using data from the analysis

Unit 2: Fingerprinting

Duration: 3 weeks

Overview: Students will learn the uses of fingerprinting and practice rolling and lifting fingerprints. They will identify class and individualistic evidence in fingerprints.

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

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What is the structure and organization of skin tissue?
- What can fingerprints be used for?
- How do you roll and lift fingerprints?
- What are the class and individualistic evidence that fingerprints can provide?

Student Learning Objectives:
Students will know and be able to…

- Draw and label a model representing cross section of skin
- Discuss the Purpose of Fingerprinting
- Research the History of Fingerprinting
- Identify the fundamental principles of fingerprints
- Classify the major fingerprint pattern types
- List contributions of identification to an investigation
- Individualizing minutiae of fingerprints
- Engage in fingerprint rolling
- Compare and contrast prints
- Compare unknown samples, with those collected and stored in database
- Research different fingerprint analysis techniques
- Discuss the way many agencies are moving to digital printing
- Solve for an unknown print.

Possible Activities

- Develop latent prints, using each of the following methods:
    - Ninhydrin
    - Iodine
    - Superglue

- Perform fingerprint dusting and lifting
- Fingerprint an individual using an ink pad
- Scan and analyze digital fingerprinting
- Conduce a fingerprint match test of unknown prints

Unit 3: Handwriting Analysis

Duration: 2 weeks

Overview: Students will analyze handwriting samples for individualistic characteristics, and use this to match unknown handwriting to an exemplar. In order to perform this task, they will identify and define major components of a person's handwriting. They will also decipher personality based on graphology analysis.

Standards:

- **HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What characteristics makes handwriting unique?
- Can handwriting style be used to determine personality?

Student Learning Objectives:
Students will know and be able to…

- Collect background knowledge on individualization of handwriting
- Identify and define the major components of a person's handwriting:
- Recognize the characteristics that individualize a person's' writing
- Compare handwriting of different samples
- Test the validity of graphology and explain how graphology might be used to solve a crime
- Engage in Handwriting Activities
- Solve for an unknown handwriting sample.

Possible Activities

- Create a database of handwriting samples
- Analyze and individualize own handwriting
- Analyze and individualize writing of others
- Compare unknown writing samples with those collected and stored in database
- Draw a conclusion based on handwriting evidence
- Analyze your own handwriting
- Analyze a partner's handwriting
- Conduct an unknown handwriting analysis and handwriting match test
- Complete the "Graphology Activity"

Unit 4: Footwear Analysis

Duration: 2 weeks

Overview: Students will learn how to collect footwear evidence through a variety of methods, to analyze it for both class and individualistic evidence, and to determine its value.

Standards:

- **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.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What are the methods that can be used for collecting footwear evidence?
- What do I look for when identifying class versus individualistic evidence on shoes and shoe impressions?
- How can shoewear evidence be used?

Student Learning Objectives:
Students will know and be able to…

- Research background on individualization of footwear
- Identify where and how to find footwear evidence
- Understand how to collect footwear evidence
- Compare footwear evidence
- Assess value of footwear evidence
- Identify the types of individualistic marks
- Differentiate between identification and individualization of footwear

Possible Activities

- Conduct a lab on deductive reasoning using footwear analysis (Deadly Picnic)
- Conduct a footwear analysis
- Collect footwear samples
- Paint/ink prints with analysis report
- Create an ink box developer print
- Perform a digital analysis of ink box developer print
- Create a Plaster of Paris mold
- Conduct a dual print analysis

Unit 5: Hair and Fiber Analysis

Duration: 2 weeks

Overview: Students will learn to find and identify class and individualistic evidence of hair and fibers. Students will also compare the hair and fibers from a variety of organisms.

Standards:

- **HS-LS1-2.** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What can hair and fibers be used for?
- How do I analyze hair and fibers?
- What are pieces of class and individualistic evidence from hair and fibers?
- Where can hair and fibers be found?

Student Learning Objectives:
Students will know and be able to…

- Develop microscopy skills used in a forensic lab
- Identify hair anatomy as seen under the microscope
- Compare and contrast animal and human hair
- Analyzing hair and fibers

Possible Activities

- Observe the anatomy and characteristics of hair under the microscope
- Construct a wet mount slide and analyze own hair
- Draw and analyze partners hair
- Draw and analyze animal hair (dog, cat, and farm animal)
- Draw and analyze natural and synthetic fibers
- Complete the scale impression lab
- Solve for an unknown hair sample.

Unit 6: Ballistics and Firearms

Duration: Time Permitting

Overview: Students will examine the anatomy of firearms to understand how they inherently lend themselves to individualization. Students will then apply their general understanding to different types of firearms. The second half of the unit looks at the effects of firearms, such as the analysis of glass fractures.

Standards:

- **HS-PS2-2.** Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
- **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.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What are the general rifling characteristics forensic scientists use to individualize bullets?
- What are the mechanics of a bullet?

Student Learning Objectives:
Students will know and be able to…

- Distinguish between Different Types of Firearms (single action, double action, automatic, and semi-automatic) and their individual components
- Explain the basic operations of a firearm, including loading and discharging
- Develop skills in measuring and recognizing different caliber bullets.
- Identify the different components of a bullet. (Slug, casing, powder)
- Implement techniques for analyzing glass fracture
- Sequence of bullet holes based on constructed rules
- Analyze significant marks on bullets for individualization including fire pin indentations, breech-face marks, extractor marks, and ejector marks
- Solve for an unknown bullet.

Possible Activities

- Develop a model for the operations of a firearm and connect it to the impact it may have on crime scene evidence
- Ballistics comparison activity.
- Bullets comparison activity
- Lands and grooves observations with dissecting scope.

- Conduct Glass Fracture Analysis
    - Observe and sketch glass with bullet holes
    - Establish sequence and surface of bullet holes
    - Piece glass fragments together
- Perform a Slug Analysis
    - Identify general rifling characteristics (GRC)
    - Determine the lands and grooves, groove angles, and striation
    - Discuss why these can be individualizing marks
    - Determine which two slugs came from the same gun. (supplied by Mountainside Police Department)

Unit 7: Tool Mark Analysis

Duration: Time Permitting

Overview: Students will look at non-traditional weapons and examine ways that forensic specialists determine what has been used. This includes looking at impact, markings, and characteristics (i.e. mass, material, etc.)

Standards:

- **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.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- How can toolmarks left at a crime scene be analyzed and used in forensic science?

Student Learning Objectives:
Students will know and be able to…

- Develop skills in measuring and recognizing different tools and their potential to leave marks.
- Identify the difference between class and individual toolmarks.
- Solve for an unknown toolmark left in a piece of wood (hammer, screwdriver, and pliers).

Possible Activities

- Toolmark comparison activity.

Unit 8: Forensic Serology and Blood Spatter

Duration: 2 weeks

Overview: Students look at the different ways that blood spatter data can be used to determine the details of a crime. Students will consider limiting factors and variables that should be included in this analysis.

Standards: 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.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:
- What can blood spatter tell us about what happened at a crime scene?
- What components of blood can be used by a forensic scientist?

Student Learning Objectives:
Students will know and be able to…
- Discuss the nature of blood, including the role of antigens and antibodies in determining blood type.
- Demonstrate the effect that drop height and angle has on blood spatter.
- Determine the angle at which a blood drop fell.
- Determine the height the blood drop fell from.
- Recognize that there is a limit to diameter, based on volume
- Determine whether a blood spatter mark was left from blow back or cast off.
- Explain the importance of skeletonization to a Crime Scene Investigation
- Determine the focal point of a blood spatter impact.
- Analyze blood spatter to find point of origin
- Determine the difference between a swipe and a wipe.

Possible Activities
- Blood spatter lab. Stations addressing each of the student learning objectives.
- Research a case where blood spatter was used as evidence.
- Revisit the OJ Simpson case study for discussion.
- Research Skeletonization

Unit 9: Forensic Anthropology

Duration: 2 weeks

Overview: Students will use different body parts to determine information about an organism. They will be able to use patterns of body dimensions to gain information from remains.

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.
- **HS-LS4-1.** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What information can we get from bones and bitemarks?
- What are the relationships between body dimensions?
- What is the difference between bone and cartilage?

Student Learning Objectives:
Students will know and be able to…

- Observe cranial differences and identify patterns between different groups
- Develop a relationship between different body dimensions
- Observe different types of bone and cartilage under the microscope

Possible Activities

- Complete the “Sherlock Bones Activity”
- Perform the “Body Dimensions” lab
- Compare bones and cartilage under the microscope
- Complete the “Coloring Anatomy Plates Activity

Unit 10: DNA

Duration: Time Permitting

Overview: DNA plays an important role in determining identity due to its unique characteristics. Students will look at these characteristics and the technology that has developed to allow for its analysis. The unit culminates with students engaging in DNA profiling and looking at specific case studies where DNA profiling helped to determine victim identity.

Standards:

- **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**.**

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4

Essential Questions:

- Can DNA evidence alone put you into jail?
- Can DNA evidence alone get you out of jail?

Student Learning Objectives:
Students will know and be able to…

- Describe structure and general function of DNA including the importance of nucleotide sequence.
- Explain the process of PCR (polymerase chain reaction) and how forensic scientists use it.
- Differentiate between RNA and DNA.
- Explain an overview of protein synthesis and the role of mRNA, rRNA, and tRNA
- Explain the process of STR (Short Tandem Repeat) and how forensic scientists use it.
- Research a case where DNA was used as evidence for a conviction.
- Research a case where DNA was used to provide an exoneration or was used to get someone out of jail.

Possible Activities

- Develop a model of DNA based on it's function
- Use the Protein Synthesis Gizmo Simulation to develop the process of protein synthesis
- Complete the DNA profiling activity or the offline activity
- Look at a variety of case studies related to DNA profiling

Unit 11: Profiling and Serial Killers

Duration: 3 weeks

Overview: Students will learn the methods of profiling, and the pros and cons. They will also conduct research on the types of serial killers. As a case study, students will present research on a particular killer, his or her background, motives, and crimes.

Standards: Standards:

- **HS-LS2-8.** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Technology: 8.1.12.A.3; 8.1.12.C.1; 8.2.12.C.4; 8.2.12.C.5; 8.2.12.B.2; B.2.12.B.5
21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2
Cross-Curricular: RST.11-12.1; RST.11-12.2; WHST.9-12.1; SL.11-12.5; MP.2; MP.4;

Essential Questions:

- What are the methods profilers use to find killers?
- What motives drive a killer?

Student Learning Objectives:
Students will know and be able to…

- Discuss the pathology of a serial killer
- Breakdown the history of profiling
- Examine and evaluate methods and goals of profiling

Possible Activities

- Research and present profiling methodologies
- Conduct a Case Study of a Serial Killer
- Research existing profiles of known serial killers
- Summarize crime(s)
- Compare a profile to the person apprehended

VOCABULARY FOR FORENSIC SCIENCE

This is a list of vocabulary, which students will master upon completion of the course:

1. Physical evidence.
2. Identification of evidence
3. Individualization of evidence.
4. Crime scene reconstruction.
5. Forensic science.
6. Physical science unit.
7. Biology unit.
8. Toxicology.
9. Ballistic/firearm analysis
10. Tool mark analysis.
11. Document examination.
12. Forensic pathologist.
13. Decomposition.
14. Forensic anthropology.
15. Forensic entomology.
16. Forensic psychiatry.
17. Criminal profiling techniques.
18. Loop – arch – whorl patterns.
19. Minutia.
20. Manufacturing/wear marks
21. Cuticle – cortex – medulla patterns
22. Caucasoid – mongoloid – negroid.
23. Serial killer typologies.
24. Serial killer motivations.

RESOURCES/ACTIVITIES GUIDE

Text Resources

Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science*. 8th ed. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2004.

Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science Instructor's Manual with Transparency Masters*. 8th ed. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2004.

Saferstein, Richard, Clifton E. Meloan, and Richard E. James. *Criminalistics: An Introduction to Forensic Science Lab Manual*. 8th ed. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2004.

Websites

http://www.oml.gov/sci/techresources/Human_Genome/elsi/forensics.shtml – 65k – July 19, 2004

http://www.police.sas.ab.ca/prl/for.html – 14k

http://www.dir.yahoo.com/Science/Forensics/ - 28k

http://www.forensics.com/ - 14k – July 19, 2004