Forensic Science

Forensic Science is an in-depth exploration into the theories, practices, and laboratory procedures of the forensic scientist, as well as other areas related to the field of criminology. Forensic science focuses on career opportunities, safety, history of forensic science, criminal investigation, forensic serology and Deoxyribonucleic acid (DNA) testing, forensic studies in anthropology, toxicology, fingerprinting, firearms, physics, and document examination. This course encourages critical thinking, use of the scientific method, integration of technology, development of student leadership skills, and application of knowledge and skills related to practical questions and problems.

Forensic Science: Career Opportunities

Students will:

1. Describe career opportunities in forensic and criminal investigations. (AL.FCI.1)

Forensic Science: Safety

Students will:

2. Explain safety precautions for forensic and criminal investigators. (AL.FCI.2)

Forensic Science: History of Forensic Science

Students will:

3. Identify major participants in the history of forensic science and analyze the major advancements and their implications chronologically to present day. (AL.FCI.3)

Forensic Science: Criminal Investigations

Students will:

4. Describe the responsibilities of various personnel involved in crime scene investigations. (AL.FCI.5) Examples: police, detectives, laboratory specialists, medical examiners
    - Explain techniques for searching, sketching, and recording data from a crime scene

5. Explain proper methods to collect and preserve evidence from a crime scene. (AL.FCI.6)
    - Differentiate between physical evidence and witness evidence
    - Compare the three main pattern types that result in an individual's unique fingerprint
    - Explain different methods of latent fingerprint development
    - Identify the origins of impressions, including footwear, tire tread, tools, and dental
    - Explain methods to identify hair, fiber, glass, ballistic, and blood evidence

Forensic Science: Forensic Anthropology – Skeletal Remains

Students will:

6. Identify the importance of skeletal remains in forensics. (AL.FCI.10)
    - Determine age, sex and race by comparing bones and skulls
    - Use dental records to identify and solve for an unknown identify

Forensic Science: Fingerprinting

Students will:

7. Explain fingerprinting methods and identification techniques. (AL.FCI.12)

Forensic Science: Document Examination

Students will:

8. Explain techniques used to determine the validity of forensic documents. (AL.FCI.15)
   Examples: handwriting analysis, ink chromatography

Forensic Science: Inheritance and Variation of Traits
(Forensic Serology and Deoxyribonucleic Acid Testing)

Students will:

9. Compare presumptive and confirmatory forensic tests. (AL.FCI.7)
   - Examples: blood type comparison, DNA testing

10. Describe the importance of genetic information to forensics.
    - Use the process of gel electrophoresis for DNA fingerprinting. (AL.FCI.8)

The performance expectations were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)	**LS1.A: Structure and Function** • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) **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. (HS-LS3-2)	**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) - - - - - - - - - - - - - - - - - - ***Connections to Nature of Science*** **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)

Common Core State Standards Connections:
ELA/Literacy -

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-LS3-1),(HS-LS3-2)
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)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-4)

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Forensic Science: Chemical Reactions
(Forensic Anthropology - Decomposition)
(Forensic Toxicology)

Students will:

11. Describe the decomposition process. (AL.FCI.9)
    - Calculate time of death by determining the state of rigor mortis, livor mortis, and algor mortis.
    - Identify stages of decomposition to determine cause of death.
    - Identify the entomological life cycles to determine time of death.

12. Describe and compare the general categories of drugs and poisons, illustrating their effects on humans. (AL.FCI.11)
    - Explain ways poisons are detected during autopsy.

The performance expectations were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) • Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)	ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)	**Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7)

Common Core State Standards Connections:
ELA/Literacy -

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-PS1-5)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)

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Forensic Science: Forces and Interactions
(Firearms Forensics)

Students will:

13. Distinguish between class and individual characteristics of firearms. (AL.FCI.13)

14. Use laws of physics to explain forensic evidence. (AL.FCI.14)
    - Analyze blood spatter patterns to determine speed, height and direction.
    - Investigate trajectories of collected evidence of projectiles.

The performance expectations were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. ● 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. (HS-PS2-5) **Analyzing and Interpreting Data** Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. ● 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) **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. ● Use mathematical representations of phenomena to describe explanations. (HS-PS2-2),(HS-PS2-4) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. ● Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3) - ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4) ● Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4)	**Disciplinary Core Ideas** **PS2.A: Forces and Motion** ● Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) **ETS1.A: Defining and Delimiting an Engineering Problem** ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. *(secondary to HS-PS2-3)* **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS2-3)	**Crosscutting Concepts** **Patterns** ● Different patterns may be observed and can provide evidence for causality in explanations of phenomena. (HS-PS2-4) **Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) **Systems and System Models** ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

Forensic Science: Forces and Interactions
(Firearms Forensics)

Common Core State Standards Connections:
ELA/Literacy -

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)

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)

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Forensic Science: Engineering Design

(Engineering, technology, and science core disciplinary ideas are integrated into grade level science performance expectations.)

Students will:

15. Design a mock crime scene and explain the criminal investigation procedures, including purpose and types. (AL.FCI.4)

Students who demonstrate understanding can:

HS-ETS1-2	**Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems.**
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, and reliability.**
HS-ETS1-4	**Use a computer simulation to model real-world problem with numerous criteria and constraints relevant to the problem.**

The performance expectations were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. ● Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. ● Use mathematical models and/or computer simulations to predict the effects of a solution. (HS-ETS1-4) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. ● Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2) ● Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)	**ETS1.B: Developing Possible Solutions** ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) ● Both physical models and computers can be used in various ways to aid in the design process.. (HS-ETS1-4) **ETS1.C: Optimizing the Design Solution** ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)	**Systems and System Models** ● Models (e.g., physical, mathematical, computer models) can be used. (HS-ETS1-4) - ***Connections to Engineering, Technology, and Applications of Science*** - **Influence of Science, Engineering, and Technology on Society and the Natural World** ● New technologies can have deep impacts on society. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3)

Forensic Science: Engineering Design

Engineering, technology, and science core disciplinary ideas are integrated into grade level science performance expectations.

Common Core State Standards Connections:

ELA/Literacy -

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-ETS1-1),(HS-ETS1-3)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3)
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-ETS1-1),(HS-ETS1-3)

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