PASSAIC COUNTY TECHNICAL INSTITUTE
WAYNE, NEW JERSEY

FORENSIC SCIENCE II CURRICULUM
August 2015

Forensic Science Curriculum

August 2015

I. Course Description

Forensic Science II is an integral component of the Criminal Justice/Public Safety Curricula offered in grade 12. Law enforcement agencies have expanded their investigative functions, and rely on the advice and technical support from the scientific community. Forensic Science is the application of the science process and content knowledge to laws that are enforced by police departments and other law enforcement agencies.

This comprehensive program includes both theoretical and practical/hands-on instruction. Students receive challenging college preparatory level instruction, including: regular laboratory investigations, the daily infusion of technology, projects and activities, readings and discussions, guest presentations and demonstrations from industry personnel. In addition, students are exposed to career opportunities in the area of Criminalistics and Forensic Science.

Students apply the scientific method and employ related science disciplines to consider aspects of evidence relevant to crime scenes. Forensic Science II is the application of Biology, Chemistry, Physical Science, Mathematics, Psychology and Technology to the analysis of criminal acts and law enforcement. This course focuses on the development of critical thinking skills and the examination of evidence as it relates to crimes and case studies. Instruction includes many of the most relevant tools, practices and techniques utilized today in the field of Forensic Science.

II. Course Objectives/Outline

Content Area:	Forensic Science		Grade(s)	12
Unit Plan Title:	Practices of Forensics and CSI	Time Frame	10 Weeks	

Learning Objectives

- Explore the science of forensic investigation to law and its application of deductive reasoning skills. LS1.A; LS1.D
- Explain how to secure a crime scene and describe the proper steps taken for searching, recording, packaging and processing physical evidence from a crime scene. ETS1.B, LS1.A; LS1.D, PS1.A
- Plan and conduct a forensic investigation of a crime scene. ETS1.B
- **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-2**
- **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-LS3-2**
- Explain the formation of fingerprint patterns and identify the different types of fingerprints and techniques performed to develop proper prints. LS1.A; LS3.B
- **Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2**
- Use aspects of particulate models (i.e., particle spacing, motion, and forces of attraction) to reason about observed differences between solid, liquid and gas phases of certain materials. PS1.A
- **Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. HS-PS1-3**
- Explain the formation of human blood cells and the typing and screening techniques performed to differentiate human blood from non-human blood. LS1.A; LS1.B; LS3.B
- **Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. HS-LS3-3**
- Explain the connection between the sequence and the subcomponents of a biomolecule and its properties. LS1.A
- **Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship amongst net force on a macroscopic object, its mass and its acceleration. HS-PS2-1**
- Explain the formation of blood spatter patterns and create representations of different blood spatter. LS1.A: PS2.A
- Perform and calculate ***Point of Origin*** and ***Point of Convergence*** of blood spatter. PS2.A
- Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. PS2.A
- **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-PS2-2**
- Predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. PS2.A
- **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-LS3-1**

- Describe the structure and function of a DNA molecule and the importance of DNA replication. LS1.A
- **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. HS-LS1-1**
- Conduct and perform a DNA Fingerprint. LS3.A

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems (pp. 54-56, NRC, 2012) 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 careful observation of phenomena, or unexpected results, to clarify and/or seek additional information (HS-LS3-1) • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. (HS-ETS1-2) (HS-LS3-1) • Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-2) **Developing and Using Models** (pp. 56-59, NRC, 2012) Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. (HS-LS1-2) **Planning and Carrying Out Investigations** (pp. 59-61, NRC, 2012) Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include	**PS1.A: Structure and Properties of Matter**(pp. 106-109, NRC, 2012) • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3) *(secondary HS-PS2-6)* **PS2.A: Forces and Motion** (pp. 114-116, NRC, 2012) • Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) • Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2) **LS1.A: Structure and Function** (pp. 143-145, NRC, 2012) • Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) • 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, which carry out most of the work of cells. (HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)* • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of	**Patterns** (pp. 85-87, NRC, 2012) • Different patterns may be observed at each of the scales at which a system is studied an can provide evidence for causality in explanations of phenomena (HS-PS1-3) • Mathematical representations are needed to identify some patterns. (HS-PS2-1) **Cause and Effect** (pp. 87-89, NRC, 2012) • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1)(HS-LS3-1) (HS-LS3-2) **Scale, Proportion, and Quantity** (pp. 89-91, NRC, 2012) • 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) **Systems and System Models** (pp. 91-94, NRC, 2012) • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined (HS-PS2-2) • Models (e,g. physical, mathematical, computer) can be used to simulate systems and interactions--including energy, matter, and information flows--within and between systems at different scales (HS-LS1-2) **Structure and Function** (pp. 94-97, NRC, 2012) • Investigating or designing new systems or structures requires a detailed examination

investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled (HS-PS1-3)

Analyzing and Interpreting Data (pp. 61-63, NRC, 2012)

Analyzing data in 9–12 builds on K–8 experiences 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)
- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept and correlation coefficient for linear fits) to science and engineering questions and problems, using digital tools when feasible. (HS-LS3-3)

Using Mathematics and Computational Thinking (pp. 64-67, NRC, 2012)

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, computational, and/or

numerous parts and is itself a component of the next level. (HS-LS1-2)

LS1.D: Information Processing (pp. 149-150, NRC, 2012)

- In complex animals, the brain is divided into several distinct regions and circuits, each of which primarily serves dedicated functions, such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making about actions to take in the event of certain inputs.
- The integrated functioning of all parts of the brain is important for successful interpretation of inputs and generation of behaviors in response to them.

LS3.A: Inheritance of Traits (pp. 158-159, NRC, 2012)

- 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 (pp. 160-161, NRC, 2012)

- 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.

of the properties of different materials, the structures of different components, and the connection of components to reveal their function and/or solve a problem. (HS-LS1-1)

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Connections to Nature of Science

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)

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)

algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS2-2) **Constructing Explanations and Designing Solutions and Interpreting Data** (pp. 67-71, NRC, 2012) 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. • Construct and revise 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. (HS-LS1-1)(HS-ETS1-2) **Engaging in Argument from Evidence** (pp. 71-74, NRC, 2012) Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence. (HS-LS3-2)	(HS-LS3-2)(HS-LS3-3) **ETS1.B: Developing Possible Solutions** (pp. 206-208, NRC, 2012) • Complicated problems may need to be broken down into simpler components in order to develop and test solutions. (HS-ETS1-2)	

Common Core State Standards Connections:

- **Common Core Writing Standards:**
  WHST.11-12.1, WHST.11-12.2, WHST.11-12.4, WHST.11-12.5, WHST.11-12.6, WHST.11-12.8, WHST.11-12.9 ,WHST.11-12.10
- **Common Core Reading Standards:**
  RST.11-12.1, RST.11-12.2, RST.11-12.3, RST.11-12.4, RST.11-12.6, RST.11-12.7, RST.11-12.8, RST.11-12.9
- **Common Core Math Standards:**
  MP.2 -Reason abstractly and quantitatively.
  MP.4- Model with mathematics.

Content Area:	Forensic Science		Grade(s)	12
Unit Plan Title:	Investigation of Death	Time Frame	10 Weeks	

Learning Objectives

- Explore the different factors and tests performed to determine brain death. LS1.A, LS1.D
- Provide examples and explain how organisms use feedback systems to maintain their internal environments. LS1.A
- Differentiate between cause, manner, and mechanism of death. LS1.A
- **Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. HS-PS1-5**
- **Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2**
- Conduct investigations into establishing the time of death of an individual based on Rigor, Algor, and Livor Mortis. PS1.B, PS3.B; LS1.A; LS1.C; ETS1.C
- **Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. HS-LS1-7**
- Explore how stomach content and eye changes provide additional evidence in establishing a time of death. LS1.A; LS1.B;
- Determine how Entomology plays a role in estimating time of death. LS1.A; LS2.D
- **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS1-4**
- Calculate PMI (Post-Mortem Interval) based on the life cycle of the Blowfly and other insects. LS1.B; LS2.B
- **Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce. HS-LS2-8**
- **Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system. HS-PS3-4**
- Identify, describe, and calculate the stages, factors, and rate of decomposition in humans. PS3.B; LS1.A
- **Construct and revise an explanation based on the evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. HS-LS2-3**
- Explain the proper protocol for performing a human autopsy. LS1.A; ETS1.C
- **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-2**
- Compare and contrast human anatomy to that of a fetal pig. LS1.A
- Perform a forensic autopsy on a fetal pig and determine cause and mechanism of death. LS1.A

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models (pp. 56-59, NRC, 2012) Modeling in 9–12 builds on K–8 experiences and	**PS1.B: Chemical Reactions** (pp. 109-111,NRC, 2012) • Chemical processes, their rates, and	**Patterns** (pp. 85-87, NRC, 2012) • Different patterns may be observed at each of the scales at which a system is studied an can

progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. (HS-LS1-2)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4)(HS-LS1-7)

Planning and Carrying Out Investigations (pp. 59-61, NRC, 2012)

Planning and carrying out investigations 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-PS3-4)

Constructing Explanations and Designing Solutions (pp. 67-71,NRC, 2012)

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.

- Construct and revise 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 whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-5)

PS3.B: Conservation of Energy and Energy Transfer (pp. 124-126,NRC, 2012)

- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.(HS-PS3-4)
- Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

LS1.A: Structure and Function (pp. 143-145,NRC, 2012)

- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)

LS1.B: Growth and Development of Organisms (pp. 145-147,NRC, 2012)

- In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex provide evidence for causality in explanations of phenomena (HS-PS1-5)

Cause and Effect (pp. 87-89, NRC, 2012)

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8)

Systems and System Models (pp. 91-94, NRC, 2012)

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models (HS-PS3-4)
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2) (HS-LS1-4)

Energy and Matter (pp. 94-96, NRC, 2012)

- Energy cannot be created or destroyed--it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7)
- Energy drives the cycling of matter within and between systems. (HS-LS2-3)

Connections to Nature of Science

Scientific Knowledge Is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-3)
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that

the future. (HS-LS2-3) • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) • 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) **Engaging in Argument from Evidence** (pp. 71-74, NRC, 2012) Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Evaluate the evidence behind currently accepted explanations to determine the merits of arguments. (HS-LS2-8)	organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4) **LS1.C: Organization for Matter and Energy Flow in Organisms** (pp. 147-148,NRC, 2012) • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-7) • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** (pp. 152-154,NRC, 2012) • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) **LS2.D: Social Interactions and Group Behavior** (pp. 156-157,NRC, 2012) • Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HSLS2-8) **ETS1.C: Optimizing the Design Solution** (pp. 208-210,NRC, 2012) • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the	may result in revision of an explanation. (HS-LS2-8)

	priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)	

Common Core

- **Common Core Writing Standards:**
  WHST.11-12.1, WHST.11-12.2 , WHST.11-12.3, WHST.11-12.4, WHST.11-12.7
- **Common Core Reading Standards:**
  RST.11-12.1, RST.11-12.2, RST.11-12.3, RST.11-12.4, RST.11-12.5, RST.11-12.6, RST.11-12.7, RST.11-12.8, RST.11-12.9
- **Common Core Math Standards:**
  MP.2 -Reason abstractly and quantitatively.
  MP.4- Model with mathematics.

Content Area:	Forensic Science		Grade(s)	12
Unit Plan Title:	Anthropological Studies	Time Frame	10 Weeks	

Learning Objectives

- Investigate the formation and development of human bones. LS1.A; LS1.B
- **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS1-4**
- Identify the bones of the human skeletal system. LS1.A
- **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. HS-LS1-1**
- **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-2**
- Differentiate between the various bones used to determine gender, ethnicity, stature, and age of unknown skeletal remains. LS1.A; LS3.A
- **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-LS3-1**
- Calculate the stature of unknown skeletal remains. LS3.A; ETS1.B
- Identify the morphology and development of teeth used for the determination of age in unknown skeletal remains. LS1.A; LS1.B; LS3.A
- **Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2**
- Perform a Web quest identifying unknown skeletal remains. ETS1.C
- Explore how facial reconstruction from human skeletal remains is used as a tool in the investigation of a missing person. LS3.A; ETS1.B
- **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. HS-ETS1-3**
- Perform a facial reconstruction. LS1.A; LS3.A

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems (pp. 54-56, NRC, 2012) 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) **Developing and Using Models** (pp. 56-59, NRC, 2012) Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. (HS-LS1-2) • Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4) **Constructing Explanations and Designing Solutions** (pp. 67-71,NRC, 2012) 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. • Construct and revise 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. (HS-LS1-1) • Design a solution to a complex real-world	**LS1.A: Structure and Function** (pp. 143-145,NRC, 2012) • Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) • 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, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.) • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) **LS1.B: Growth and Development of Organisms** (pp. 145-147,NRC, 2012) • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4) **LS3.A: Inheritance of Traits** (pp. 158-159, NRC, 2012) • Each chromosome consists of a single very long DNA molecule, and each gene	**Cause and Effect** (pp. 87-89, NRC, 2012) • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1) **Systems and System Models** (pp. 91-94, NRC, 2012) • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2) (HS-LS1-4) **Structure and Function** (pp. 94-97, NRC, 2012) • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and the connection of components to reveal their function and/or solve a problem. (HS-LS1-1) - ***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 and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-3)

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)	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) **ETS1.B: Optimizing the Design Solution** (pp. 206-208,NRC, 2012) • 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) **ETS1.C: Optimizing the Design Solution** (pp. 208-210,NRC, 2012) • 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)	

Common Core

- **Common Core Writing Standards:**
  WHST.11-12.2, WHST.11-12.3, WHST.11-12.4, WHST.11-12.6, WHST.11-12.7, WHST.11-12.8, WHST.11-12.10
- **Common Core Reading Standards:**
  RST.11-12.1, RST.11-12.2, RST.11-12.3, RST.11-12.4, RST.11-12.5, RST.11-12.6, RST.11-12.7, RST.11-12.8, RST.11-12.9
- **Common Core Math Standards:**
  MP.2 -Reason abstractly and quantitatively.
  MP.4- Model with mathematics.

Content Area:	Forensic Science		Grade(s)	12
Unit Plan Title:	Forensic Toxicology and The Criminal Mind	Time Frame	10 Weeks	

Learning Objectives

- Explore the History of Toxicology. PS1.B
- Differentiate between the different toxic agents and their modes of transmission. PS1.B; PS2.B
- **Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. (HS-PS2-6)**
- Differentiate between the five main drug schedules based on their physiological and psychological effect on humans. PS1.B; LS1.A
- Identify what constitutes a controlled substance. PS1.B
- Explore the different classes of drugs/toxins, including Alcohol, and their associated physiology on the human body. PS1.B; LS1.A
- **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 (HS-LS1-1)**
- **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. (HS-LS1-2)**
- Explain how both screening and confirmatory test are used to identify drugs/toxins. PS1.B
- Use chemical reactions to identify unknown substances (toxins/drugs). PS1.B
- **Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. (HS-PS1-2)**
- Identify the most common bioterrorism agents and their associated physiological effects on the human body. PS1.B; LS1.A; LS1.D
- **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS1-4**
- Identify the parts and workings of the human brain. LS1.A; LS1.B; LS1.D
- **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-LS3-1**
- **Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. HS-LS3-3**
- Explain the different psychological theories and test used to understand the criminal mind. LS3.A; LS3.B; LS1.D
- Describe the role of a criminal profiler. LS1.D

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems (pp. 54-56, NRC, 2012) 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)	**PS1.B: Chemical Reactions**(pp.109-111,NRC, 2012) • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2) **PS2.B: Types of Interactions**(pp.116-118,NRC, 2012)	**Patterns** (pp. 85-87, NRC, 2012) • Different patterns may be observed at each of the scales at which a system is studied an can provide evidence for causality in explanations of phenomena (HS-PS1-2) **Cause and Effect** (pp. 87-89, NRC, 2012) • Empirical evidence is required to differentiate between cause and correlation and make

Developing and Using Models (pp. 56-59, NRC, 2012)
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4)
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Analyzing and Interpreting Data (pp. 61-63, NRC, 2012)
Analyzing data in 9–12 builds on K–8 experiences 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.

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept and correlation coefficient for linear fits) to science and engineering questions and problems, using digital tools when feasible. (HS-LS3-3)

Constructing Explanations and Designing Solutions (pp. 67-71,NRC, 2012)
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.

- Construct and revise 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

- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6)

LS1.A: Structure and Function (pp. 143-145,NRC, 2012)

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)

LS1.B: Growth and Development of Organisms (pp. 145-147,NRC, 2012)

- In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

LS3.A: Inheritance of Traits (pp. 158-159, NRC, 2012)

- 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

claims about specific causes and effects. (HS-LS3-1)

Scale, Proportion, and Quantity (pp. 89-91, NRC, 2012)

- 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)

Systems and System Models (pp. 91-94, NRC, 2012)

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales. (HS-LS1-2), (HS-LS1-4)

Structure and Function (pp. 94-97, NRC, 2012)

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and the connection of components to reveal their function and/or solve a problem. (HS-PS2-6), (HS-LS1-1)

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)

do so in the future. (HS-PS1-2), (HS-LS1-1) **Obtaining, Evaluating, and Communicating Information** (pp. 74-77,NRC, 2012) Obtaining, evaluating, and communicating information in 9-12 builds on K-8 and progresses to evaluating the validity and reliability of the claims, methods, and design. • Communicate scientific and technical information (e.g., about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	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** (pp. 160-161, NRC, 2012) • 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-LS3-3)	
Common Core		
• **Common Core Writing Standards:** WHST.11-12.1, WHST.11-12.2, WHST.11-12.3, WHST.11-12.4, WHST.11-12.5, WHST.11-12.6, WHST.11-12.7 • **Common Core Reading Standards:** RST.11-12.1, RST.11-12.2, RST.11-12.3, RST.11-12.4, RST.11-12.5, RST.11-12.6, RST.11-12.7, RST.11-12.8, RST.11-12.9, RST.11-12.10		

III. Methods of Student Evaluation

Assessment of student achievement each marking period will be determined by evaluations comprised of a combination of teacher-made examinations on major topics and quizzes, which will take forms to include oral, written, and/or demonstration. In addition, students will be graded on laboratory experiments, projects, critical thinking skills, presentations, class work, homework, and class participation. The course will have a final examination, which together with four marking periods will constitute a basis for the final course grade.

Assessment can be divided into two general categories: formal (graded) and informal/classroom-based (both graded and ungraded). The key to effectively assessing a student's mastery of skills is to match the assessment method to the learning objective.

Formal Assessments

- Evaluation
- Class participation
- Creative assignments
- Homework and class work assignments
- Reports and presentations
- Research methodology
- Technological applications
- Unit tests
- Various speaking and listening assignments
- Multiple choice exams
- Quizzes (announced and unannounced)
- Essays
- Formal lab reports
- Scientific journal reviews
- Projects
- Short answer and problem solving tests
- Tests and quizzes on blackboard
- Case Study analysis

Informal Assessments

- Instructor's observations of note-taking, and organization of notebooks and assignments
- Cooperative learning activities, including labs
- Creative project assignments
- Laboratory behavior
- Observing citizenship and appropriate social responses
- Instructor's observations of time management skills

IV. Instructional Strategies Based on Instructional Goals

- Graphs and other visuals
- Engaging in discussions
- Reading silently and aloud
- Listening and speaking activities
- Watching and responding to media
- Brainstorming
- Listening
- Mapping
- Revising and editing
- Participating in small and large groups
- Researching to make connections to texts and classroom discussions
- Collaborative projects
- Answering questions (oral and written)
- Summarizing
- Debating
- Analyzing texts, discussions, etc.
- Peer teaching
- Competing in teams/debating
- Playing games
- Creating games
- Note taking and note making
- Writing

V. Scope and Sequence

Key: I – Introduced, D-developed in Depth, R-Reinforced

	Skill to be Learned	9	10	11	12
1.	Explain the science of forensic investigation.				IDR
2.	Use the instruments, apparatus, and technologies of forensic science correctly.				IDR
3.	Use and apply observational, deductive reasoning and lateral thinking skills properly.				IDR
4.	Explain the importance of securing and reporting a crime scene.				DR
5.	Describe the proper steps taken for searching, recording, and reconstructing a crime scene.				DR
6.	Describe proper techniques for securing and packaging all types of physical evidence.				DR
7.	Explain how fingerprints are formed.				DR
8.	Identify the major fingerprint patterns and techniques for developing prints.				DR
9.	Distinguish between the different types of trace evidence (hair, fibers, etc.) and the techniques used to identify each.				IDR
10.	Understand the formation and typing of blood cells.				DR
11.	Describe the techniques used to screen for human blood.				IDR
12.	Identify blood spatter patterns				IDR
13.	Calculate Point of Origin and Point of Convergence.				IDR
14.	Explain the structure and function of a DNA molecule and the importance of DNA replication.				R
15.	Identify and explain the process and purpose of DNA Fingerprinting.				IDR
16.	Describe how the Computerized Database System for the identification of DNA works.				IDR
17.	Identify factors and test performed to determine death.				IDR
18.	Identify the different manners, causes, and mechanisms of death.				IDR

19.	**Determine time of death using the following factors: rigor, algor, and livor mortis, stomach content, and eye changes.**				**IDR**
20.	**Describe how insects and their life cycle determine PMI.**				**IDR**
21.	**Describe the stages, factors and speed of decomposition.**				**IDR**
22.	**Describe and perform a forensic autopsy.**				**IDR**
23.	**Understand how bones develop and identify the bones of the human skeletal system.**				**IDR**
24.	**Use various bones to determine gender, ethnicity, stature, and age of unknown skeletal remains.**				**IDR**
25.	**Perform a facial reconstruction.**				**IDR**
26.	**Identify toxic agents.**				**DR**
27.	**Describe the different drug schedules, the types main groups of controlled substances, and other toxins.**				**DR**
28.	**Explain how both screening and confirmatory test are used to identify drugs/toxins.**				**IDR**
29.	**Understand the parts and workings of the brain.**				**IDR**
30.	**Explain the different psychological theories and test used to understand the criminal mind.**				**IDR**
31.	**Describe the role of a criminal profiler.**				**IDR**

VI. Pacing Chart

Unit 1 – Practices of Forensics and CSI

- **Introduction to Forensic Science (Deductive Reasoning): (3 weeks)**
  Students will be introduced to Forensic Science, the process of scientific investigation and scientific thinking. Students will employ scientific practices by observing, measuring, organizing, analyzing data, inferring, modeling and communicating findings.

- **Crime Scene Investigation: (3 weeks)**
  Students will integrate crime-scene investigation techniques including: steps taken to thoroughly record a crime-scene, conduct a systematic search and the proper handling and packaging of evidence.
- **Physical/Biological Evidence: (4 weeks)**
- Students will review the common types of physical evidence encountered at a crime- In addition, students will be able to explain the purpose physical evidence plays in reconstructing the events surrounding the commission of a crime.

Unit 2 – Investigation of Death

- **Manner, Cause and Mechanisms of Death: (3 weeks)**
- Students will be able to define death, distinguish between cause, mechanisms, and the five manners of death.
- **Time of Death: (4 weeks)**
- Students will use evidence of rigor, algor, livor mortis, stomach content, and entomology to calculate the approximate time of death of an individual. In addition, students will be able to describe the stages of decomposition of a corpse.
- **Autopsy Process: (3 weeks)**
- Students will discuss the history of Forensic Pathology, the steps of death investigation, and the proper protocol of conducting an autopsy and generating an Autopsy Report.

Unit 3 – Anthropological Studies

- **Skeletal System: (3 weeks)**
- Students will describe the anatomy and physiology of the human skeletal system.
- **Methods of Skeletal Remains Identification: (4 weeks)**
- Students will define and describe the role of a Forensic Anthropologist and explain how they use ethnicity, gender, stature
- and age to identify unknown skeletal remains.
- **Facial Reconstruction: (3 weeks)**
- Students will learn the proper technique and steps taken to reconstruct a human face in order to identify a missing person and connect a possible suspect to a crime.

Unit 4 – Forensic Toxicology and The Criminal Mind

- **Toxicology: (4 weeks)**
- Students will define toxicology and identifying the different types of toxic agents.
  Students will analyze and describe the major groups of controlled substances and the toxic agents associated with each.
- **Anatomy of the Human Brain: (2 weeks)**
- Students will describe the anatomy and physiology of the human brain.
- **Introduction to Forensic Psychology: (4 weeks)**
- Students will identify the role of a Forensic Psychologist in a criminal investigation and describe the criminal mind (nature vs. nurture).

VII. Proficiencies

Upon successful completion of the requirements for this course, students will be able to:

1. Explain the science of forensic investigation.
2. Use instruments, different apparatus, and technologies of forensic science correctly.
3. Practice the application of observation, deductive reasoning and lateral thinking skills properly.
4. Explain the importance of securing and reporting a crime scene.
5. Describe the proper steps taken for searching, recording, and reconstructing a crime scene.
6. Describe proper techniques for securing and packaging all types of physical evidence.
7. Explain how fingerprints are formed.
8. Identify the major fingerprint patterns and techniques for developing prints.
9. Distinguish between the different types of trace evidence (hair, fibers, etc.) and the techniques used to identify each.
10. Recognize the formation and typing of blood cells.
11. Describe the techniques used to screen for human blood.
12. Identify blood spatter patterns.
13. Calculate Point of Origin and Point of Convergence.
14. Explain the structure and function of a DNA molecule and the importance of DNA replication.
15. Identify and explain the process and purpose of DNA Fingerprinting.
16. Describe how the Computerized Database System for the identification of DNA works.

17. Identify factors and test performed to determine death.
18. Identify the different manners, causes, and mechanisms of death.
19. Determine time of death using the following factors: rigor, algor, and livor mortis, stomach content, and eye changes.
20. Describe how insects and their life cycle determine PMI.
21. Describe the stages, factors and speed of decomposition.
22. Describe and perform a forensic autopsy and prepare a formal Autopsy Report.
23. Recognize how bones develop and identify the bones of the human skeletal system.
24. Use various bones to determine gender, ethnicity, stature, and age of unknown skeletal remains.
25. Perform a facial reconstruction.
26. Identify different types of toxic agents.
27. Describe the different drug schedules, the types of controlled substances associated with each schedule, and other toxins.
28. Explain how both screening and confirmatory test are used to identify drugs/toxins.
29. Recognize the parts and workings of the brain.
30. Explain the different psychological theories and test used to understand the criminal mind.
31. Describe the role of a criminal profiler.