Summit High School
Summit, NJ

Forensic Science Curriculum
11th+12th Grade Science
One Semester Elective

Course Description: Forensics Science is a broad based science class that relates to physics, biology, chemistry and psychiatry to the law. Students will study crime scene investigation, evidence collection, fingerprints, DNA, blood and blood spatter, anthropology, toxicology, entomology, and death. Students will develop deductive reasoning skills. A variety of instructional strategies, including project based learning, STEAM, hands on activities, and data analysis will be utilized. This document includes the relevant Next Generation Science Standards as well as expanded details on instruction focus, instructional strategies, activities and assessments Lessons can be expanded with reference to current events, instructructional videos like "Crime Scene University", documentaries and Capstone Projects described in the textbook.. Utilization of community resources like guest speakers is encouraged.

Unit 1. Introduction to Forensic Science

<table>
<tr><th colspan="2">NEXT GENERATION SCIENCE STANDARD
ETS1.A; ETS1.B; ETS1.C</th></tr>
<tr><td colspan="2">Big Ideas: (Cross Cutting Concepts)
Systems and System Models
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-ETS1-4)

Cause and Effect
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1) Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS4-4)

Patterns
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-2)</td></tr>
<tr><th>Essential Questions
What provocative questions will foster inquiry, understanding, and transfer of learning?</th><th>Enduring Understandings
What will students understand about the big ideas?</th></tr>
<tr><td>- What factors affect observations and the ways we process what we see?

- What factors influence eyewitness testimony?

- How reliable is eyewitness testimony?

- What specific steps should be followed in a criminal investigation begin?

- How does proper handling of evidence lead to justice?</td><td>ETS1.A: Defining and Delimiting Engineering Problems
● 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. (HS-ETS1-1)
● Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)
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 engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (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)</td></tr>
</table>

Areas of Focus: Proficiencies	Examples, Outcomes, Assessments
Students will: DCI **HS-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **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. **HS-ETS1-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. - Describe the factors that influence eyewitness accounts - Become a better observer. - Learn to use set of observations or data useful in forensics science. - Describe the role of a forensic scientist. - Describe the role of a forensic scientist. - Classify evidence. - List and explain the rationale for the 7 steps involved in a proper crime scene treatment. - Explain the function and choice of a crime scene pattern. - Differentiate between proper handling of different types of evidence. - Describe the process and importance associated with chain of custody rules. - Scientific Method in Crime Scene Investigation - Use Locard's principle to describe the transfer of trace evidence and apply it to crime scene reconstruction.	**Instructional Focus:** ● see table below **Sample Assessments:** ● see table below **instructional Strategies:** ● see table below **Interdisciplinary Connections** - **ELA/Literacy: RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., qualitative data, video, multimedia) in order to address or solve a problem. - **ELA/Literacy: 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. - **ELA/Literacy: 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. - **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. - **ELA/Literacy: WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1- 2),(HS-PS1-5) - **ELA/Literacy: 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) - **Mathematics: MP.2** Reason abstractly and quantitatively. **Technology Integration** - Use still photos and moving images to test observational accuracy before and after studying material. **Global Perspectives** - Provide the different rules of jurisprudence in different countries relating to what evidence can be presented in court and relate them to the governmental structure.

Unit 1 Introduction to Forensic Science
Chapters 1 and 2 Forensic Science, 2nd ed. Bertino and Bertino

Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
1	Are Eyewitness Accounts Reliable? Students will study observations and memory and use experimental data	Argument Driven Inquiry with heterogeneous grouping	Dancing Bear Video Awareness Test Memory Game Website Optical Illusions	Slidest, video, paper. Position clearly stated with supporting evidence

	and/or anecdotal data to answer questions.		Penny Lab, Innocence Project,estimator variables, The Science Behind the Dress NY Times article	
2	Line Up Reform and Photo Arrays	Project Based Learning With heterogeneous grouping.	Create a guidelines for police line up and police photo arrays. Picking Cotton Video,Innocence Project and Case Studies, system variables.	Pamphlet, Video, poster. Defend guidelines with scientific reasoning, case studies. etc.
3	Crime Scene Investigation	Project Based Learning With heterogeneous grouping.	Set up fictitious crime scene/s for students to sketch, photograph and bag evidence. Students should also use deductive reasoning skills to "solve" the crime. Describe in detail what crime scene investigators should do when they arrive at a crime scene. JonBenet Ramsey Documentary Amanda Knox documentary and Fantastic Lies (30 for 30) documentary can be shown any time in the semester to reinforce the Seven S' and types of evidence. Also shows the effect of media on criminal case. Amanda Knox Paper Fantastic Lies Questions	Sketch a Crime Scene. Photograph a Crime Scene. Collect and Bag Evidence at a Scene. JonBenet Ramsey written assessment.
4	Types of Evidence	STEAM	Study, define, give examples of different types of evidence Locardi's Exchange Principle Wayne Williams case Additional Chapter Reading in Textbook	Create a Graphic Organizer, Poster, pamphlet with definitions, examples and relationships of different types of evidence.
5	Trial by Fire	Argument Driven Inquiry	Periodically Assign reading of article with questions and class discussion. List evidence of guilt or innocence. Describe Lime St. Fire. List step required to appeal death sentence.	Split class into four teams. Position paper or debate guilt of CTW. Position paper or debate capital punishment.
6	Careers in Forensic Science	STEAM	Capstone Project #7 in Text Book. Work in Pairs or Individually. Job Fair	8.5 by 11 digitally created poster.
7	Create and Interpret Crime Scenes	Problem Based	Sketch Your Own Crime Scene. Create a 3-D model of scene. Write a sequence of evidence. "Solve" scenes created by other students.	Crime Scene Sketch Crime Scene Model Crime Scene Solution

Unit 2. Fingerprints

NEXT GENERATION SCIENCE STANDARD ETS1.A; ETS1.B; ETS1.C; PS1.A; PS4.A; PS4.C
Big Ideas: **Systems and System Models** 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-ETS1-4)

Patterns
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-2)

Interdependence of Science, Engineering, and Technology
Science and engineering complement each other in the cycle known as research and development. (HSHSHSHS PS4-5)

Influence of Engineering, Technology, and Science on Society and the Natural World
Modern civilization depends on major technological systems. (HS-PS4-2),(HSPS4-5)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
- How can fingerprints be used in crime scene investigations? - What are the limitations of fingerprint analysis? - What physical and chemical methods are available for the development and preservation of latent fingerprints?	**ETS1.A: Defining and Delimiting Engineering Problems** ● 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. (HS-ETS1-1) **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) **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) **PS1.A: Structure and Properties of Matter** ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2) **PS4.A: Wave Properties** ● Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2) **PS4.C: Information Technologies and Instrumentation** ● Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4- 5)
Areas of Focus: Proficiencies (Cumulative Progress Indicators)	**Examples, Outcomes, Assessments**
Students will:	**Instructional Focus:** ● see table below **Sample Assessments:** ● see table below **Instructional Strategies:** ● see table below **Instructional Strategies:** **Interdisciplinary Connections** - **ELA/Literacy: 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) - **ELA/Literacy: WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1- 2),(HS-PS1-5)

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **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. **HS-ETS1-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within **HS-PS1-2** 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-PS4-2** Evaluate questions about the advantages of using a digital transmission and storage of information. **HS-HSHSHSPS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. **HS-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	- **ELA/Literacy: WHST.9-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating an understanding of the subject under investigation. - **ELA/Literacy: RST.9-10.8** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4) - **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. - Mathematics: MP.2 Reason abstractly and quantitatively. **Technology Integration** - Internet research of fingerprinting history - Utilizing the automated fingerprint identification system (AFIS) - Digital imaging for fingerprint enhancement. - Microscopic analysis of fingerprints **Global Perspectives** – How to utilize global fingerprint databases to identify suspects wanted in multiple countries.
- Historical development of fingerprinting - Development of fingerprints on human fingers - Identify fingerprint patterns: loop, whorl and arches - Understand that fingerprint analysis is imperfect because it depend on human interpretation of data - Make a ten card - Compare latent, plastic and patent fingerprints - Compare development methods of latent fingerprints - Preserve developed prints.	

Unit 2 Fingerprints

Chapters 4 Forensic Science, 2nd ed. Bertino and Bertino				
Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
1	History of Fingerprints	STEAM	Fingerprint Timeline	Timeline
2	What are fingerprints? Development and Uniqueness of Ridge Patterns	TPS Class Discussion with Guided questions	TPS Class Discussion with Guided questions.	Class Discussion
3	Fingerprints as Evidence	Argument Driven Inquiry	Summarize how fingerprints are used as evidence. Classification of fingerprints, classification of ridge patterns.Ten Card Lab (create ten cards, classify fingerprints, identify fingerprints, lift fingerprints). IAFIS, limitations, Reliability - Brandon Mayfield, success rate Fingerprint Court Challenges	Position Paper Reliability of Fingerprint Evidence
4	Fingerprint Scanners and Security	Project Based	Who, what, when, where, how and why?	Poster, slides, prezi

Unit 3. DNA

NEXT GENERATION SCIENCE STANDARD ETS1.B; LS1.A; LS1.C; LS4.A; LS3.A
Big Ideas: **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 tech **Systems and System Models** 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-ETS1-4) **Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems. (HS-PS4-2),(HSPS4-5) **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1),(HS- LS4-4) **Structure and Function**

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

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
- How is DNA evidence used in forensic science? - Is DNA fingerprinting 100% accurate? - How has DNA evidence impacted the release of convicted criminals?	**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) **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, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.) **LS1.C: Organization for Matter and Energy Flow in Organisms** ● The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) **LS4.A: Evidence of Common Ancestry and Diversity** ● Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences an anatomical and embryological evidence. (HS-LS4-1) **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)
Areas of Focus: Proficiencies **(Cumulative Progress Indicators)**	**Examples, Outcomes, Assessments**
Students will: **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. **HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins that carry out the essential functions of life through systems of specialized cells. **HS-LS1-6** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. **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	**Instructional Focus:** ● see table below **Sample Assessments:** ● see table below **Instructional Strategies:** ● see table below **Instructional Strategies:** ● DNA Powerpoint ● Library Assignment: Gel Electrophoresis Virtual Lab with worksheet. ● Short YouTube videos: "What is DNA and How does it Work?" "How is DNA Fingerprinting Used to Identify Criminals?" "Forensic Science: DNA Evidence" ● Lecture **Interdisciplinary Connections** - **ELA/Literacy: RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., qualitative data, video, multimedia) in order to address or solve a problem. - **ELA/Literacy: 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.

of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and the order of appearance of structures in embryological development.]	- **ELA/Literacy: 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. - **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. - **ELA/Literacy: WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1- 2),(HS-PS1-5) - **ELA/Literacy: WHST.9-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating an understanding of the subject under investigation. - **ELA/Literacy: 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) - Mathematics: MP.2 Reason abstractly and quantitatively.
- Describe the make-up of a DNA molecule. - Explain how DNA codes for genetic information - Discuss how DNA for every living organism varies. - Explain how crime-scene evidence is collected for DNA analysis. - Discuss how DNA evidence is analyzed and compared to others. - Describe how DNA fingerprinting is carried out and what can be learned. - Demonstrate the use of DNA technologies to carry out DNA fingerprinting. - Discuss the limitations and error associated with DNA analysis	**Technology Integration** - Gel Electrophoresis Virtual Lab - DNA phenotyping - Internet site NOVA Neanderthal on Trial (explanation of mitochondrial DNA and use in science) **Global Perspectives** - Limitations of DNA Fingerprinting

Unit 3 DNA
Chapter 7 Forensic Science, 2nd ed. Bertino and Bertino

Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
1	How can DNA be Used as Evidence?	Project Based Learning	What is DNA and How Does it Work youtube How is DNA Fingerprinting Used to Identify Criminals youtube DNA Evidence Collection	Slides Storybook Prezi
2	Electrophoresis	Procedure Data Analysis Project Based Learning	Worksheets Activity 7-2 The Break-In Activity 7-4 Identification of September 11 Victim Demo,Make a GEL? DNA Fingerprinting Kit order info Simple DNA Extraction	DNA extraction Lab Worksheets Slides Storybook Prezi
3	DNA Phenotyping	Argument Driven Inquiry	DNA Phenotyping	Position Paper/Debate

Unit 4-5. Death, Entomology and Anthropology

<table>
<tr><th colspan="2">NEXT GENERATION SCIENCE STANDARD
LS1.A; LS2.B; LS2.C; LS4.C; LS3.A</th></tr>
<tr><td colspan="2">Big Ideas:
Systems and System Models
● 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-LS2-5)

Energy and Matter
● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)
● 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),(HS-LS2-4)
● Energy drives the cycling of matter within and between systems. (HS-LS2-3)

Cause and Effect
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1),(HS-LS3-2) (HS-LS4-2),(HS-LS4-4),(HS-LS4-5)

Patterns
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS- LS4-1),(HS-LS4-3)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
● Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1),(HS- LS4-4)</td></tr>
<tr><th>Essential Questions
What provocative questions will foster inquiry, understanding, and transfer of learning?</th><th>Enduring Understandings
What will students understand about the big ideas?</th></tr>
<tr><td>- What information can be obtained from the physical and chemical conditions of a corpse?

- How do anthropology and entomology relate to forensic science?</td><td>LS1.A: Structure and Function
● 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)
● Feedback mechanisms maintain a living system’s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
● Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
LS2.C: Ecosystem Dynamics, Functioning, and Resilience
● A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)</td></tr>
</table>

	LS4.C: Adaptation ● Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5) **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)
Areas of Focus: Proficiencies (Cumulative Progress Indicators)	**Examples, Outcomes, Assessments**
Students will: **HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **HS-LS1-3** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. **HS-PS1-5** 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-PS1-6** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* **HS-LS2-4** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. **HS-LS2-6** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. **HS-LS4-1.** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and the order of appearance of structures in embryological development.]	**Instructional Focus:** ● see table below **Sample Assessments:** ● see table below **Instructional Strategies:** ● see table below **Instructional Strategies:** **Interdisciplinary Connections** - **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS2-1),(HS- LS2-2) - **HSS-ID.A.1** Represent data with plots on the real number line. (HS-LS2-6) - **HSS-IC.A.1** Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS-LS2-6) **Technology Integration** - Internet search of case studies. **Global Perspectives** - Analysis of how various geographic factors (temperature, humidity, elevation) affect the onset and length of bug life cycles, as well as variations in decomposition.
- Contrast cause and mechanism of death. - Explain how the developments of rigor, algor, and livor mortis occur following death.	

- Discuss factors that may impact the onset of the above-mentioned mortises. - Discuss the stages of decomposition a corpse undergoes. - Explain how time of death can be estimated using insects as evidence. - Discuss various examples of lifecycles / succession of insects. - Estimate the time of death using insect evidence, livor, rigor, and algor mortis data. - Compare and contrast the three types of Forensic Entomology.	

Unit 4 Death and Forensic Entomology
Chapters 11 and 12 Forensic Science, 2nd ed. Bertino and Bertino

Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
1	Forensics Entomology	Inquiry	Maggot Lab Case Reviews Activity 11-2 Mini Projects for Forensic Entomology Activity 11-4 Factors Affecting PMI	Lab Mini Project
2	Manner, Cause and Mechanism of Death and PMI	Inquiry / STEAM	Scenario Textbook reading Steps in an Autopsy Medical Examiner WS Cause of Death and PMI WS Activity 12-1 Calculating PMI w Rigor Activity 12-2 Calculating PMI w Algor Activity 12-4 Analysis of Evidence from Death Scenes Mortis WS Death Pamphlet Decomposition books or movies: Body Farm, and Beyond the Body Farm by William Bass	Written Assessment Death Pamphlet

Unit 5 Forensic Anthropology

Chapter 14 Forensic Science, 2nd ed. Bertino and Bertino				
Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
1	What is Forensics Anthropology	inquiry	Forensics Anthropology Bone Identification Comparison of Male and Female Hips and Skulls	test
2	Osteobiography	Project based	Activity 14-6 Height and Body Proportions Lab	Osteobiography
3	Forensics Anthropology Data Analysis	Data Based	Tracks of a Killer Lab Medical Examiner WS Activity 14-4 Estimation of Body Size from Individual Bones Activity 14-1 Determining the Age of a Skull ACtivity 14-2 Bones Male or Female Activity 14-4 Estimation of Body Size from Individual Bones	Labs Activities

Unit 6. Blood and Blood Spatter

NEXT GENERATION SCIENCE STANDARD PS2.B, LS1.A	
Big Ideas: **Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4) **Systems and System Models** 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)	
Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
- How can the blood left at a crime scene can be used to determine the sequence of events of the crime? - How is blood used to identify suspects and victims?	**PS2.B: Types of Interactions** ● 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. (secondary to HS-PS1-1),(secondary to HS-PS1-3),(HS-PS2-6) ● Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2- 4),(HS-PS2-5) **LS1.A: Structure and Function** ● 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) ● Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
Areas of Focus: Proficiencies (Cumulative Progress Indicators)	**Examples, Outcomes, Assessments**
Students will: **HS-PS2-4** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **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. **HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **HS-LS1-3** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. - Explain the composition of blood. - Differentiate between the various blood types. - Explain the importance of Rh proteins when determining blood type. - Demonstrate how to determine the blood type from a sample. - Calculate the probability of individuals having a specific blood type. - Explain how splatter patterns can be used to determine what happened. - Discuss how gravity and cohesion act on blood droplets. - Differentiate between the six various patterns of blood splatter.	**Instructional Focus:** ● see table below **Sample Assessments:** ● see table below **Instructional Strategies:** ● see table below **Interdisciplinary Connections** - **ELA/Literacy**: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3) **Technology Integration** - Internet search of case studies. **Global Perspectives** - Statistic analysis of the biochemistry of blood from various cultures.

Unit 6 Blood and Blood Spatter
Chapter 8 Forensic Science, 2nd ed. Bertino and Bertino

Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
2	How is Blood Type Used in Forensic Science	Project Based	Chapter 8 Blood Slides Blood Basics WS Blood Typing Game Transfusion Reactions WS Blood Type Pamphlet with Quiz Parent Antigen Guide Probability Calculation	Pamphlet, Poster, Presi, Slide
3	Interpretation of Blood Spatter Patterns	Steam	Activity 8-3 Blood Spatter Analysis: Effect of Height on Blood Drops Activity 8-4 Area of Convergence Activity 8-7 Crime Scene Investigation Activity 8-2 Modeling Blood Spatter Patterns Blood Spatter Crime Scene	Blood Spatter Crime Scene and Interpretation
		TPS, Class Discussion with Guided questions Project Based	Summarize how fingerprints are used as evidence. Classification of fingerprints, classification of ridge patterns.Ten Card Lab (create ten cards, classify fingerprints, identify fingerprints, lift fingerprints). IAFIS, limitations, Reliability - Brandon Mayfield, success rate	Ten Card Lab. Powerpoint or Prezi. Written Test.
4	Breakout EDU	Breakout EDU	Shady Sam BO Edu Game	Breakout EDU Game

Unit 7. Drugs and Toxicology

NEXT GENERATION SCIENCE STANDARD ETS1.A; PS1.A; PS1.B; PS4.C, LS2.C
Big Ideas: **Systems and System Models** 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-ETS1-4) **Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-2) **Energy and Matter** The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)

Scale, Proportion, and Quantity
The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)

Influence of Engineering, Technology, and Science on Society and the Natural World
Modern civilization depends on major technological systems. (HS-PS4-2),(HSPS4-5)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
- What are common chemical and biological substances that have adverse effects on the human body and can be used intentionally or unintentionally to cause death.	**ETS1.A: Defining and Delimiting Engineering Problems** ● 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. (HS-ETS1-1) **PS1.A: Structure and Properties of Matter** ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2) **PS1.B: Chemical Reactions** ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and 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-PS1-4),(HS-PS1-5) ● 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),(HS-PS1-7) **PS4.C: Information Technologies and Instrumentation** ● Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4- 5) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ● Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)
Areas of Focus: Proficiencies (Cumulative Progress Indicators)	**Examples, Outcomes, Assessments**
Students will:	**Instructional Focus:** ● see table below **Sample Assessments:** ● see table below **Instructional Strategies:** ● see table below **Interdisciplinary Connections** - **ELA/Literacy: RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., qualitative data, video, multimedia) in order to address or solve a problem. - **ELA/Literacy: 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 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **HS-PS1-2** 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-PS1-4** Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. **HS-HSHSHSHSPS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. **HS-LS2-2** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	- **ELA/Literacy: 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. - **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. - **ELA/Literacy:** WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1- 2),(HS-PS1-5) - **ELA/Literacy:** WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating an understanding of the subject under investigation. - **ELA/Literacy:** 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) - Mathematics: MP.2 Reason abstractly and quantitatively. **Technology Integration** - Research the 2001 Anthrax outbreak using the UCLA Department of Epidemiology website and two other sources. **Global Perspectives** - Bioterrorism, bioweapons - Drug Use - Function of the Centers for Disease Control and Prevention
- Identify and describe the five classes of controlled substance - Identify common poisons - Provide history of use of poison - Relate reduction of rate of poison to improved chemical analysis of biological samples - Methamphetamine and environmental impact of meth labs - Accidental drug overdose is more common that intentional drug overdose - Historically, there are many well-documented uses of poison for murder and mass murder. However, the use of poisons has significantly decreased due to improvements of chemical analysis of biological samples. - Heavy metals (Hg, Pb), bacterial toxins (anthrax, devil's breath) and pesticides provide significant risk to human welfare.	

Unit 8 Drugs and Toxicology
Chapter 7 Forensic Science, 2nd ed. Bertino and Bertino

Lesson	Instructional Focus	Instructional Strategy	Activities / Tools	Assessment
1	Drug Toxicity and Controlled Substances	STEAM	Case Studies Drug Abuse Worksheet (introductory activity) Controlled Substances WS Alcohol	Three Dimensional Model - Neurochemistry of Drug

			Factors Affecting Toxicity Mouse Party	
2	Illegal Use of Performance Enhancing Drugs	Argument Driven Inquiry	EPO Doping Drug Doping Lab Iron Cowboy Movieclip (use of saline) Case Studies (Steroids)	Position Paper/Debate
3	Presumptive Test	Lab	Presumptive Drug Test Lab Colorful Flames Lab	Lab
4	Alcohol	Project Based	How does a breathalyzer work?	Poster
4	Pharmaceutical Products	STEAM	Drug Poster	Drug Poster
5	Union County Narcotics Unit - Guest Lecture	Guest Lecture	Lecture Preliminary Assignment	Quizlet Peardeck Summary Activity
6	History of Poison	STEAM	History of Poison timeline Current Event / Reason History Anthrax Assignment (if time permits)	Timeline and Case Study Presentation

Career-Ready Practices

CRP1: Act as a responsible and contributing citizen and employee.
CRP2: Apply appropriate academic and technical skills.
CRP3: Attend to personal health and financial well-being.
CRP4: Communicate clearly and effectively and with reason.
CRP5: Consider the environmental, social and economic impacts of decisions.
CRP6: Demonstrate creativity and innovation.
CRP7: Employ valid and reliable research strategies.
CRP8: Utilize critical thinking to make

Supports for English Language Learners:

Sensory Supports	Graphic Supports	Interactive Supports
Real-life objects (realia)	Charts	In pairs or partners
Manipulatives	Graphic organizers	In triads or small groups
Pictures & photographs	Tables	In a whole group
Illustrations, diagrams, & drawings	Graphs	Using cooperative group structures
Magazines & newspapers	Timelines	With the Internet (websites) or software programs
Physical activities	Number lines	In the home language
Videos & films		With mentors
Broadcasts		
Models & figures		

from https://wida.wisc.edu

Differentiation Strategies:

Accommodations	Interventions	Modifications
Allow for verbal responses	Multi-sensory techniques	Modified tasks/ expectations
Repeat/confirm directions	Increase task structure (e.g., directions, checks for understanding, feedback)	Differentiated materials
Permit response provided via computer or electronic device	Increase opportunities to engage in active academic responding (e.g., writing, reading aloud, answering	Individualized assessment tools based on student need

sense of problems and persevere in solving them. **CRP9**: Model integrity, ethical leadership and effective management. **CRP10**: Plan education and career paths aligned to personal goals. **CRP11**:. Use technology to enhance productivity. **CRP12**: Work productively in teams while using cultural global competence.		

	questions in class)	
Audio Books	Utilize prereading strategies and activities: previews, anticipatory guides, and semantic mapping	Modified assessment grading

Summit Public Schools

Summit, New Jersey

Curricular Addendum

Career-Ready Practices **CRP1**: Act as a responsible and contributing citizen and employee. **CRP2**: Apply appropriate academic and technical skills. **CRP3**: Attend to personal health and financial well-being. **CRP4**: Communicate clearly and effectively and with reason. **CRP5**: Consider the environmental, social and economic impacts of decisions. **CRP6**: Demonstrate creativity and innovation. **CRP7**: Employ valid and reliable research strategies. **CRP8**: Utilize critical thinking to make sense of problems and persevere in solving them. **CRP9**: Model integrity, ethical leadership and effective management. **CRP10**: Plan education and career paths aligned to personal goals. **CRP11**:. Use technology to enhance productivity. **CRP12**: Work productively in teams while using cultural global competence.	**Interdisciplinary Connections** ● Close Reading of works of art, music lyrics, videos, and advertisements ● Use Standards for Mathematical Practice and Cross-Cutting Concepts in science to support debate/inquiry across thinking processes **Technology Integration** Ongoing: ● Listen to books on CDs, Playaways, videos, or podcasts if available. ● Use document camera or overhead projector for shared reading of texts. Other: ● Use Microsoft Word, Inspiration, or SmartBoard Notebook software to write the words from their word sorts. ● Use available technology to create concept maps of unit learning.

Instructional Strategies:
Supports for English Language Learners:

Sensory Supports	Graphic Supports	Interactive Supports
Real-life objects (realia)	Charts	In pairs or partners
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Illustrations, diagrams, & drawings	Graphs	Using cooperative group
Magazines & newspapers	Timelines	structures
Physical activities	Number lines	With the Internet (websites) or software programs
Videos & films		In the home language
Broadcasts		With mentors
Models & figures		

from https://wida.wisc.edu

Media Literacy Integration

- Use multiple forms of print media (including books, illustrations/photographs/artwork, video clips, commercials, podcasts, audiobooks, Playaways, newspapers, magazines) to practice reading and comprehension skills.

Global Perspectives

- The Global Learning Resource Library

Differentiation Strategies:

Accommodations	Interventions	Modifications
Allow for verbal responses	Multi-sensory techniques	Modified tasks/ expectations
Repeat/confirm directions	Increase task structure (e.g., directions, checks for understanding, feedback)	Differentiated materials
Permit response provided via computer or electronic device	Increase opportunities to engage in active academic responding (e.g., writing, reading aloud, answering questions in class)	Individualized assessment tools based on student need
Audio Books	Utilize prereading strategies and activities: previews, anticipatory guides, and semantic mapping	Modified assessment grading