Forensics Curriculum Map & Pacing Guide

CONTENT STANDARDS					
	Unit 1: Observation Skills and Deductive Reasoning	**Unit 2: Investigative Processes**	**Unit 3: Forensic Evidence**	**Unit 4: Blood and Toxicology**	**Unit 4: Death and The Human Body**
NGSS	HS-ETS1-2 HS-ETS1-3 HS-ETS1-1	HS-ETS1-2 HS-ETS1-3 HS-ETS1-1 HS-ETS1-4	HS-LS1-1 HS-PS4-2 HS-PS4-5	HS-PS1-2** HS-PS2-1** HS-PS2-4** HS-LS1-3**	HS-LS4-1 HS-PS1-2 HS-LS1-2 HS-LS1-3 HS-LS1-7 HS-PS1-5 HS-PS3-1**
CCSS Anchor ELA/Literacy	RST.11-12.1 *(HS-ETS1-2, ETS1-3)* RST. 11-12.2 *(HS-ETS1-1, ETS1-3)* RST. 11-12.7 *(HS-ETS1-1, ETS1-3)* RST.11-12.9 *(HS-ETS1-1, ETS1-3)* WHST.11-12.1.A *(HS-ETS1-1, ETS1-3)* WHST.11-12.1.B *(HS-ETS1-1, ETS1-3)* WHST.11-12.9 *(HS-ETS1-1, ETS1-2, ETS1-3)*	RST.11-12.3 *(HS-ETS1-2)* RST.11-12.8 *(HS-ETS1-1, ETS1-3)* RST.11-12.9 *(HS-ETS1-1, ETS1-3)* WHST.11-12.1.B *(HS-ETS1-1, ETS1-3)* WHST.11-12.1.A *(HS-ETS1-1, ETS1-3)* WHST.11-12.9 *(HS-ETS1-1, ETS1-2, ETS1-3)*	RST.9-10.8 *(HS-PS4-2)* RST.11-12.1*(HS-LS1-1, PS4-2)* RST. 11-12.2 *(HS-LS1-1, PS4-2, PS4-5)* RST.11-12.8 *(HS-PS4-2)* RST.11-12.9 *(HS-LS1-1, PS4-2, PS4-5)* WHST.11-12.1.B *(HS-PS4-2)* WHST.11-12.1.A *(HS-PS4-2)* WHST.9-12.2 *(HS-LS1-1, PS4-5)* WHST.9-12.9 *(HS-LS1-1)*	RST.11-12.1 *(HS-PS2-1)* RST.11-12.3 *(HS-PS1-2, PS2-1, PS2-4, LS1-3)* RST. 11-12.7*(HS-PS2-1)* RST.11-12.9 *(HS-PS1-2, PS2-1, PS2-4, LS1-3)* WHST.11-12.8 *(HS.LS1-3)* WHST.11-12.9 *(HS-PS2-1)* WHST.9-12.7*(HS.LS1-3)*	RST.11-12.1 *(HS-LS4-1, PS1-5)* RST. 11-12.2 *(HS-LS4-1, PS1-2, LS1-2, LS1-3, LS1-7)* RST.11-12.3 *(HS-LS1-2, LS1-7, PS 1-5)* RST. 11-12.7*(HS-LS1-2, LS4-1, PS1-2, LS1-7, PS1-5, PS3-1)* RST.11-12.8 *(HS-LS1-2, LS1-7, PS 1-5)* RST.11-12.9 *(HS-LS1-2, LS4-1, PS1-2, LS1-7, PS1-5, PS3-1)* WHST.11-12.1.B *(HS-LS4-1)* WHST.11-12.1.A *(HS-LS4-1)* WHST.9-12.2 *(HS-PS1-2, PS1-5)* WHST.9-12.5 *(HS-PS1-2)* WHST.11-12.9 *(HS-LS4-1)* WHST.11-12.8 *(HS.LS1-3)* WHST.9-12.7*(HS.LS1-3)* SL.11-12.2 *(HS-LS4-1)* SL.11-12.5 *(HS-LS1-2, LS1-7, PS3-1)*
CCSS Mathematics	MP.2 *(HS-ETS1-2, ETS1-1, ETS1-3)*	MP.2 *(HS-ETS1-2, ETS1-1, ETS1-3, ETS1-4)* MP.4 *(ETS1-4)*		MP.2 *(HS-PS2-1)* MP.4 *(HS-PS2-1, PS2-4)* HSN.Q.A.1 *(HS-PS2-1, PS2-4)* HSN.Q.A.2 *(HS-PS2-1, PS2-4)* HAS.SSE.A.1 *(HS-PS2-4)*	MP.2 *(HS-LS4-1, PS1-5)* MP.4 *(HS-PS3-1)* HSN-Q.A.1 *(HS-PS1-2, PS1-5, PS3-1)* HSN.Q.A.2 *(HS-PS3-1)*

Vision of a Graduate	V.1b *(HS-ETS1-1, ETS1-2, ETS1-3)* V.1c *(HS-ETS1-1, ETS1-3)* V.1d *(HS-ETS1-2, ETS1-3)* V.2c *(HS-ETS1-1, ETS1-3)* V.4a *(HS-ETS1-1, ETS1-2, ETS1-3)* V.4b *(HS-ETS1-1, ETS1-2, ETS1-3)* V.4c *(HS-ETS1-1, ETS1-3)* V.4d *(HS-ETS1-1, ETS1-3)*	V.1a *(HS-ETS1-2, ETS1-3)* V.1b *(HS-ETS1-2, ETS1-3)* V.1c *(HS-ETS1-2, ETS1-3)* V.1d *(HS-ETS1-2, ETS1-3)* V.2b V.3a *(HS-ETS1-2, ETS1-3)* V.3b *(HS-ETS1-2, ETS1-3)* V.3c *(HS-ETS1-2, ETS1-3)* V.3d *(HS-ETS1-2, ETS1-3)* V.4a *(HS-ETS1-1, ETS1-2, ETS1-3)*	V.1a *(HS-LS1-1)* V.1b *(HS-LS1-1-, PS4-2)* V.1c *(HS-PS4-5)* V.1d *(HS-LS1-1, PS4-2)* V.2a *(HS-PS4-2, PS4-5)* V.2b *(HS-LS1-1,PS4-2, PS4-5)* V.2c *(HS-LS1-1, PS4-5)* V.2d *(HS-LS1-1, PS4-5)* V.3d *(HS-PS4-2)* V.4c *(HS-PS4-2)*	V.1a *(HS-PS1-2, PS2-1, PS2-4, LS1-3)* V.1b *(HS-PS1-2, PS2-1, PS2-4)* V.1c *(HS-PS1-2, PS2-1, PS2-4, LS1-3)* V.1d *(HS-PS1-2, PS2-1, PS2-4, LS1-3)* V.2b *(LS1-3)* V.3d *(HS-PS1-2, PS2-1)*	V.1a *(HS-LS1-7, LS1-3, PS3-1)* V.1b *(HS-PS1-2, LS1-7)* V.1c *(LS1-3, PS1-2)* V.1d *(LS1-3, PS1-2, LS1-7, PS1-5)* V.2a *(HS-LS4-1 PS1-2)* V.2b *(HS-LS4-1, PS1-2, LS1-3)* V.2c *(HS-LS4-1, LS1-7, PS3-1, PS1-5)* V.2d *(HS-LS4-1)* V.3c *(HS-LS1-7)* V.4a *(HS-LS4-1, LS1-7)* V.4b *(HS-LS4-1)*

**** = partial implementation**

VISION OF A GRADUATE STANDARDS

V.1: Critical & Innovative Thinker	**V.2: Communicator**	**V.3: Collaborator**	**V.4: Culturally Competent Citizen**
Student is able to: • V.1a: Demonstrate authenticity and inventiveness in their work, generating original ideas and selecting the best, most effective, imaginative ones. • V.1b: Effectively analyze and evaluate evidence, arguments, claims and beliefs, and alternative points of view. • V.1c: Are proactive in problem solving by locating and identifying resources independently in order to take ownership of their learning. • V.1d: Apply knowledge in new contexts and across disciplines to further their understanding and see that learning can be transferred to other situations and content areas.	**Student is able to:** • V.2a: Speak and listen effectively for a variety of purposes. • V.2b: Use language effectively to enhance meaning and impact in order to accomplish goals. • V.2c: Use a variety of modes of expression (visual, spoken, written, performing arts, etc.) including the effective use of technology, to create and share ideas. • V.2d: Demonstrate an awareness of audience and adjust style and tone accordingly.	**Student is able to:** • V.3a: Collaborate with others to complete a task, or problem solve, by generating new and unique solutions. • V.3b: Use intrapersonal skills (examples: self-discipline, self-management, self-motivation, and self-reflection) to become better collaborators. • V.3c: Use interpersonal skills (examples: active listening, dependability, flexibility, and patience) to learn and work with individuals from diverse backgrounds. • V.3d: Receive and apply constructive criticism from peers and adults to improve their own work.	**Student is able to:** • V.4a: Demonstrate increasing comfort and skills in working with difference and diversity in its many forms: race/ethnicity, nationality, class, gender, sexual orientation/preference, age and ability. • V.4b: Demonstrate cultural awareness by taking the opportunity to learn about other people's languages, religions, governments, histories, homes, families or daily lives. • V.4c: Demonstrate empathy for all human beings and have an open mind towards others' situations by treating all with respect, kindness, and dignity. • V. 4d: Understand how to identify their own emotions and those of others to

				foster understanding and deeper connections within our community.
UNIT 1	ENDURING UNDERSTANDINGS / ESSENTIAL QUESTIONS **LEARNING OBJECTIVES, ESSENTIAL QUESTIONS, AND EVIDENCE STATEMENTS**	CONTENT **PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS (DCIs)**	ASSURED EXPERIENCES & ASSESSMENTS	INSTRUCTIONAL STRATEGIES & PATHWAYS **SCIENCE AND ENGINNERING PRACTICES (SEPs) & Cross Cutting Concepts (CCCs)**
Observation Skills and Deductive Reasoning	**Learning Objectives** Students will… • explain why observation skills are important to forensic investigators. • use deductive reasoning to synthesize a situation where only partial information is known. • create an argument for and against the use of eyewitness testimony in crime scene investigation. • understand and evaluate the purpose of the Innocence Project. • develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed word as they relate to the individual, global society and the environment. • cite evidence of the development of scientific technology in the advancement of forensic science; • draw conclusions as to how forensic science relates to the application of law in our criminal justice system; • recognize or recall specific vocabulary, such as but not limited	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. **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 (tradeoffs) may be needed. 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. **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.	- Brain Games Episode S1, Ep3 Questions - Observation Skills Quiz/Kahoot - Learning to See - You're an Eyewitness - What Influences our Observations - The Evidence Box - Innocence Project Research Assignment - Innocence Project Bingo - Deadly Picnic Deductive Reasoning Lab - Murder Mystery Lab: Who killed Mr. Kelley? - Making a Murderer Case Study sub-unit - Careers in Forensic Science	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. • Design a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.(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. ***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

	to: expert witness, analytical skills, deductive reasoning, eyewitness, fact, forensic, logical, observation, opinion, perception **<u>Essential Questions:</u>** • How are the sciences applied to legal and criminal investigations? • How are biology, chemistry, physics, geology, etc. relevant to forensics? • Based on improvements in technology, careers are continuously evolving in the field of forensic science; what new jobs do you predict will emerge? **<u>Evidence Statements</u>** **Observable features of the student performance by the end of the course:** **ETS1-2:** 1. Using scientific knowledge to generate the design solution a. Students restate the original complex problem into a finite set of two or more sub-problems (in writing or as a diagram or flow chart). b. For at least one of the sub-problems, students propose two or more solutions that are based on student-generated data and/or scientific information from other sources. c. Students describe* how solutions to the sub-problems are	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. **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. • 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.		benefits is a critical aspect of decisions about technology. **Asking Questions and Defining Problems** Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Analyze complex real-world problems by specifying criteria and constraints for successful solutions ***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. **Planning and Carrying Out Investigations** 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

	interconnected to solve all or part of the larger problem. 2. Describing criteria and constraints, including quantification when appropriate a. Students describe* criteria and constraints for the selected sub-problem. b Students describe* the rationale for the sequence of how sub-problems are to be solved, and which criteria should be given highest priority if tradeoffs must be made. **Observable features of the student performance by the end of the course: ETS1-3:** 1. Evaluating potential solutions a. In their evaluation of a complex real-world problem, students: i. Generate a list of three or more realistic criteria and two or more constraints, including such relevant factors as cost, safety, reliability, and aesthetics that specifies an acceptable solution to a complex real-world problem; ii. Assign priorities for each criterion and constraint that allows for a logical and systematic evaluation of alternative solution proposals; iii. Analyze (quantitatively where appropriate) and describe the strengths and weaknesses of the solution			on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

	with respect to each criterion and constraint, as well as social and cultural acceptability and environmental impacts; iv. Describe possible barriers to implementing each solution, such as cultural, economic, or other sources of resistance to potential solutions; and v. Provide an evidence-based decision of which solution is optimum, based on prioritized criteria, analysis of the strengths and weaknesses (costs and benefits) of each solution, and barriers to be overcome. 2. Refining and/or optimizing the design solution a. In their evaluation, students describe which parts of the complex real-world problem may remain even if the proposed solution is implemented. **Observable features of the student performance by the end of the course:** **ETS1-1:** 1. Identifying the problem to be solved a. Students analyze a major global problem. In their analysis, students: i. Describe* the challenge with a rationale for why it is a major global challenge; ii. Describe*, qualitatively and quantitatively, the extent and depth of the problem and its major consequences to			

	society and/or the natural world on both global and local scales if it remains unsolved; and iii. Document background research on the problem from two or more sources, including research journals. 2. Defining the process or system boundaries, and the components of the process or system a. In their analysis, students identify the physical system in which the problem is embedded, including the major elements and relationships in the system and boundaries so as to clarify what is and is not part of the problem. b. In their analysis, students describe* societal needs and wants that are relative to the problem (e.g., for controlling CO2 emissions, societal needs include the need for cheap energy). 3. Defining the criteria and constraints a. Students specify qualitative and quantitative criteria and constraints for acceptable solutions to the problem.			
Concepts: Observation Skills, Deductive Reasoning, Locard's Principle & Trace Evidence, Eyewitness Testimony, Wrongful Conviction, Innocence Project, Exoneration by DNA Evidence				
UNIT 2	**ENDURING UNDERSTANDINGS / ESSENTIAL QUESTIONS** **LEARNING OBJECTIVES, ESSENTIAL QUESTIONS,**	**CONTENT** **PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS (DCIs)**	**ASSURED EXPERIENCES & ASSESSMENTS**	**INSTRUCTIONAL STRATEGIES & PATHWAYS** **SCIENCE AND ENGINNERING PRACTICES**

	AND EVIDENCE STATEMENTS			(SEPs) & Cross Cutting Concepts (CCCs)
Investigative Processes	**Learning Objectives:** Students will… • Explain why observation skills are important to forensic investigators. • Use deductive reasoning to synthesize a situation where only partial information is known. • Create an argument for and against the use of eyewitness testimony in crime scene investigation. • Understand and evaluate the purpose of the Innocence Project. • Students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed word as they relate to the individual, global society and the environment. **Essential Questions:** • How does evidence collected from a crime scene help the law enforcement solve crimes? • How do forensic scientists approach the initial investigation of a crime scene? • How do forensic scientists proceed once the initial investigation has been established? • How is evidence classified? • What types of physical evidence are found at a crime scene?	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. **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 (tradeoffs) may be needed. 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. **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-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **ETS1.A: Defining and Delimiting Engineering Problems** • Criteria and constraints also include satisfying any requirements set by	• Real world case studies (Steven Avery, Marvin Anderson, Jon Benet Ramsey, Casey Anthony, Frye vs. United States, and Daubert vs. Merrill Dow Pharmaceuticals) • Investigative Processes Escape Room Challenge • Jenga Review Game • Interactive Crime Scene • 7 Steps of CSI Analysis Essay • Dollhouse Crime Scene Project • Design & Search the Crime Scene Lab • Locard's Exchange Principle Lab • Types of Evidence Card Sort • 7 Steps of CSI Card Sort • Crime Scene Description: Writing Assignment and Sketch • Crime Scene Investigation Quiz or Kahoot • Dead and Breakfast Project and Quiz Assessment	**Constructing Explanations and Designing Solutions** • Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. • • Design a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. ***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. **Asking Questions and Defining Problems** Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating

	• How do forensic scientists locate, collect, and analyze various types of evidence? • What aspects of evidence determine its classification? **<u>Evidence Statements:</u>** **Observable features of the student performance by the end of the course:** **ETS1-2:** 1. Using scientific knowledge to generate the design solution a. Students restate the original complex problem into a finite set of two or more sub-problems (in writing or as a diagram or flow chart). b. For at least one of the sub-problems, students propose two or more solutions that are based on student-generated data and/or scientific information from other sources. c. Students describe* how solutions to the sub-problems are interconnected to solve all or part of the larger problem. 2. Describing criteria and constraints, including quantification when appropriate a. Students describe* criteria and constraints for the selected sub-problem. b Students describe* the rationale for the sequence of how sub-problems are to be solved, and which criteria should be given	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. • 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. <u>HS-ETS1-4.</u> 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. **ETS1.B: Developing Possible Solutions** • 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.		empirically testable questions and design problems using models and simulations. • Analyze complex real-world problems by specifying criteria and constraints for successful solutions ***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. **Planning and Carrying Out Investigations** 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. 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—

	highest priority if tradeoffs must be made. **Observable features of the student performance by the end of the course: ETS1-3:** 1. Evaluating potential solutions a. In their evaluation of a complex real-world problem, students: i. Generate a list of three or more realistic criteria and two or more constraints, including such relevant factors as cost, safety, reliability, and aesthetics that specifies an acceptable solution to a complex real-world problem; ii. Assign priorities for each criterion and constraint that allows for a logical and systematic evaluation of alternative solution proposals; iii. Analyze (quantitatively where appropriate) and describe the strengths and weaknesses of the solution with respect to each criterion and constraint, as well as social and cultural acceptability and environmental impacts; iv. Describe possible barriers to implementing each solution, such as cultural, economic, or other sources of resistance to potential solutions; and			within and between systems at different scales.

	v. Provide an evidence-based decision of which solution is optimum, based on prioritized criteria, analysis of the strengths and weaknesses (costs and benefits) of each solution, and barriers to be overcome. 2. Refining and/or optimizing the design solution a. In their evaluation, students describe which parts of the complex real-world problem may remain even if the proposed solution is implemented. **Observable features of the student performance by the end of the course: ETS1-1:** 1. Identifying the problem to be solved a. Students analyze a major global problem. In their analysis, students: i. Describe* the challenge with a rationale for why it is a major global challenge; ii. Describe*, qualitatively and quantitatively, the extent and depth of the problem and its major consequences to society and/or the natural world on both global and local scales if it remains unsolved; and iii. Document background research on the problem from two or more sources, including research journals.			

	2. Defining the process or system boundaries, and the components of the process or system a. In their analysis, students identify the physical system in which the problem is embedded, including the major elements and relationships in the system and boundaries so as to clarify what is and is not part of the problem. b. In their analysis, students describe* societal needs and wants that are relative to the problem (e.g., for controlling CO_2 emissions, societal needs include the need for cheap energy). 3. Defining the criteria and constraints a. Students specify qualitative and quantitative criteria and constraints for acceptable solutions to the problem.			
Concepts: Investigative Processes, Types of Evidence, Collection of Evidence, Errors in CSI, Searching the Crime Scene, Photographing the Crime Scene.				
UNIT 3	**ENDURING UNDERSTANDINGS / ESSENTIAL QUESTIONS** **LEARNING OBJECTIVES, ESSENTIAL QUESTIONS, AND EVIDENCE STATEMENTS**	**CONTENT** **PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS (DCIs)**	**ASSURED EXPERIENCES & ASSESSMENTS**	**INSTRUCTIONAL STRATEGIES & PATHWAYS** **SCIENCE AND ENGINNERING PRACTICES (SEPs) & Cross Cutting Concepts (CCCs)**
Forensic Evidence: Hair, Fibers, Fingerprints, Handwriting, Ballistics and Arson	**Learning Objectives:** Students will… • Identify the anatomical structure of hair and explain how macroscopic and microscopic characteristics of	**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. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the	• Case Studies (Real World Applications) • Hair Inquiry Activity • Hair Review Maze • Hair Analysis Lab • Hair Analysis Task Cards • Hair Infographic	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent

	hair can be used in crime scene investigation. • Evaluate the significance of hair evidence found at a crime scene. • Explain the difference between mitochondrial DNA and nuclear DNA as it pertains to hair. • Solve a case using hair specimens. • Identify various types of fibers and explain how microscopic properties of fibers can be used in crime scene investigation. • Test fibers using a burn analysis to determine the identity of an unknown fiber. • Classify fingerprints found at a crime scene. • Identify minutiae patterns found in an unknown fingerprint and compare those patterns to minutiae patterns of a suspect print. • Solve a crime using fingerprint analysis and appropriate lifting techniques. • Construct an explanation of DNA's significance to the field of Forensics and evaluate it's use in solving crimes. • Follow procedures for extracting and processing DNA through the process of gel electrophoresis. • Read DNA profiles and compare them to suspect DNA profiles. • Describe how DNA has evolved over the past thirty years and understand how this evolution connects to the work of the Innocence Project.	instructions for characteristic traits passed from parents to offspring. *Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.* **LS1.A: Structure and Function** • Systems of specialized cells within organisms help them perform the essential functions of life. • 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. *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)* **HS-PS4-2**: Evaluate questions about the advantages of using digital transmission and storage of information. *Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.* **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-PS4-5**: Communicate technical information about how some technological devices use the principles of wave behavior	• Hair Review Stations • Cat Hair Case • Hair Open Response Exam • Trace Evidence: Hair Activity • Hair Measurement and Match • Fibers WebQuest • Hair and Fibers Review Worksheet • Fiber Burn Analysis Lab Investigation • Fiber Scavenger Hunt • Fiber Lab • Microscopic Fiber Activity • Bed Sheet Thread Count Activity • Weave Pattern Analysis Lab • Altered Fingerprints: A Challenge to Law Enforcement • Study your Fingerprints • Giant Balloon Fingerprints • Studying Latent Fingerprints • How to Print a Ten Card • Is it a Match? • Fingerprint Matching • Textile Identification • Fiber Quiz • Fingerprint Analysis Lab Activity • Fun with Fingerprints activity	student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct 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. **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. **Asking Questions and Defining Problems** Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. **Stability and Change** • Systems can be designed for greater or lesser stability.

	• Explain how serological evidence can be significant in solving crimes. • Identify different characteristics of firearms and cartridges as they pertain to ballistics. • Draw evidence from striation patterns, breech markings, and firing pin patterns and explain their significance in different scenarios. • Explain how arson investigators determine if an arson crime has occurred. **Essential Questions:** • How do objects that were used at a crime scene, but are no longer there, provide evidence? • Why are fingerprints important evidence? • How are fingerprints collected and analyzed in order to identify an individual? • How is the composition of a substance determined by forensic scientists? • What special considerations need to be taken into account when searching for and collecting trace evidence? • Why is hair such an important piece of evidence? • What characteristics of hair allow it to be used as evidence? • What characteristics of fibers allow them to be used as evidence? • What other examples of trace evidence (besides hair and fiber)	and wave interactions with matter to transmit and capture information and energy. *Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology. Assessments are limited to qualitative information. Assessments do not include band theory.* **PS3.D: Energy in Chemical Processes** • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. *(secondary)* **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. **PS4.B: Electromagnetic Radiation** • Photoelectric materials emit electrons when they absorb light of a high-enough frequency. **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	• Fingerprint Jeopardy • Analysis of Ransom Note and Expert Testimony • Analysis of Handwriting Sample and Expert Testimony • Examination of U.S. Currency : Is it Real or Forgery? • DNA Profiling QR Quest • DNA Case Study Project • Gel Electrophoresis virtual lab • The Case of the Desert Bones- DNA Investigation • DNA Extraction Lab • DNA Profiling Review Game (Kahoot!) • DNA Profiling Quiz • Ballistics Share-a-Thon • Ballistics Flipbook • Ballistics Review Stations (Around the Room) • Ballistics Quiz • Arson WebQuest • Arson Case Study Podcast • Arson Quiz • Forensic Evidence Classroom Escape Challenge • Forensic Evidence Review Game • Forensic Evidence Mystery Picture	***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** • Modern civilization depends on major technological systems. • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. **Obtaining, Evaluating, and Communicating Information** 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 designs. • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). **Cause and Effect** • Systems can be designed to cause a desired effect. *Connections to Engineering, Technology, and Applications of Science*

	might be found at a crime scene, and what methods would you use to collect and analyze them? • What kind of evidence can be taken from a rape victim? • How is DNA's structure related to inheritance? • What can DNA tell scientists? • How is DNA collected from a crime scene? • How can forensic scientists use trace evidence to explain what happened at a crime scene? • How has technology aided the solving of crimes? • Why is a particular microscope used in certain procedures in forensic science? • What technology can scientists use to look at DNA? • How are the unique characteristics of firearms important to criminal investigations? • What evidence do firearms provide? • What allows investigators to determine if someone fired a weapon? **Evidence Statements** **Observable features of the student performance by the end of the course: LS1-1** 1. Articulating the explanation of phenomena a. Students construct an explanation that includes the idea that regions of DNA called genes determine the	and interpreting the information contained in them.		Interdependence of Science, Engineering, and Technology • Science and engineering complement each other in the cycle known as research and development (R&D). Influence of Engineering, Technology, and Science on Society and the Natural World • Modern civilization depends on major technological systems.

	structure of proteins, which carry out the essential functions of life through systems of specialized cells. 2. Evidence a. Students identify and describe* the evidence to construct their explanation, including that: i. All cells contain DNA; ii. DNA contains regions that are called genes; iii. The sequence of genes contains instructions that code for proteins; and iv. Groups of specialized cells (tissues) use proteins to carry out functions that are essential to the organism. b. Students use a variety of valid and reliable sources for the evidence (e.g., theories, simulations, peer review, students' own investigations). 3. Reasoning a. Students use reasoning to connect evidence, along with 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, to construct the explanation. Students describe* the following chain of reasoning in their explanation: i. Because all cells contain DNA, all cells contain genes that can code for the formation of proteins. ii. Body tissues are systems of specialized cells with similar structures and			

	functions, each of whose functions are mainly carried out by the proteins they produce. iii. Proper function of many proteins is necessary for the proper functioning of the cells. iv. Gene sequence affects protein function, which in turn affects the function of body tissues **Observable features of the student performance by the end of the course: PS-4-2** 1. Addressing phenomena or scientific theories a. Students evaluate the given questions in terms of whether or not answers to the questions would: i. Provide examples of features associated with digital transmission and storage of information (e.g., can be stored reliably without degradation over time, transferred easily, and copied and shared rapidly; can be easily deleted; can be stolen easily by making a copy; can be broadly accessed); and b. In their evaluation of the given questions, students: i. Describe* the stability and importance of the systems that employ digital information as they relate to the advantages and			

	disadvantages of digital transmission and storage of information; and ii. Discuss the relevance of the answers to the question to real-life examples (e.g., emailing your homework to a teacher, copying music, using the internet for research, social media). 2. Evaluating empirical testability Students evaluate the given questions in terms of whether or not answers to the questions would provide means to empirically determine whether given features are advantages or disadvantages. **Observable features of the student performance by the end of the course: PS-4-5** 1. Communication style and format a. Students use at least two different formats (e.g., oral, graphical, textual, and mathematical) to communicate technical information and ideas, including fully describing* at least two devices and the physical principles upon which the devices depend. One of the devices must depend on the photoelectric effect for its operation. Students cite the origin of the information as appropriate. 2. Connecting the DCIs and the CCCs a. When describing* how each device operates, students identify the wave behavior utilized by the device or the absorption of photons and			

	production of electrons for devices that rely on the photoelectric effect, and qualitatively describe* how the basic physics principles were utilized in the design through research and development to produce this functionality (e.g., absorbing electromagnetic energy and converting it to thermal energy to heat an object; using the photoelectric effect to produce an electric current). b. For each device, students discuss the real-world problem it solves or need it addresses, and how civilization now depends on the device. c. Students identify and communicate the cause and effect relationships that are used to produce the functionality of the device.			
Concepts: Hair Analysis, Fiber Analysis, Fingerprint Analysis, Handwriting Analysis, DNA Evidence, Matter and Chemical Analysis				
UNIT 4	**ENDURING UNDERSTANDINGS / ESSENTIAL QUESTIONS** **LEARNING OBJECTIVES, ESSENTIAL QUESTIONS, AND EVIDENCE STATEMENTS**	**CONTENT** **NGSS PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS (DCIs)**	**ASSURED EXPERIENCES & ASSESSMENTS**	**INSTRUCTIONAL STRATEGIES & PATHWAYS** **SCIENCE AND ENGINNERING PRACTICES (SEPs) & Cross Cutting Concepts (CCCs)**

Blood and Toxicology	**Learning Objectives:** • Test and identify blood samples and determine the blood type of those samples. • Design an experiment to test the affect that gravity and height has on falling blood. • Use mathematical formulas to calculate the angle at which a blood stain strikes a surface. • Compare blood stain patterns at different velocities, heights, with different weapons, and on different surfaces. • Analyze and interpret blood stains found at a crime scene. • Explain the role of a forensic toxicologist. • Classify common drugs according to schedules (as outlined by the Controlled Substances Act). • Identify the presence of an unknown drug sample through lab testing. • Describe the effects of alcohol on the human body. • Construct an argument for the definition of death and defend your position using a real life case study. **Essential Questions** • How can alcohol, drugs, and poisons be detected in the human body? • What can blood from a crime scene tell forensic scientists? • Based on your own observations of how fluids act, how can blood	**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. *Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen. Assessment is limited to chemical reactions involving main group elements and combustion reactions.* **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. **PS1.B: Chemical Reactions** • 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-PS2-1*:** Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. *Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp,*	• Blood Typing Student-Directed Research Activity • The Case of Lenny Smith- simulated blood typing lab • Blood Typing Game • Blood spatter WebQuest • Blood Splatter Analysis: Effect of Height on Blood Drops • Area of Convergence • Sam Sheppard Case Study • 3-2-1 Review • The Case of the Missing Wife- mock investigation • Passive Blood Stains- student led inquiry lab • Blood as Evidence review stations • Blood evidence Domino Review Activity • Blood Spatter Scavenger Hunt • Blood Splatter Quiz • Blood Evidence Quiz • Case Studies (Real World Applications) • Drug Schedules Color Activity • Toxicology WebQuest • Toxicology Application Lab (student led) • Alcohol's Effects on the Body- CLOSE reading passage	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • 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. **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. **Analyzing and Interpreting Data** Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid

	spatter evidence determine direction and type of object used to commit a violent crime? **Evidence Statements** **Observable features of the student performance by the end of the course: PS1-2 (partial implementation*)** 1. Articulating the explanation of phenomena a. Students construct an explanation of the outcome of the given reaction, including: iv. A discussion of how the patterns of attraction allow the prediction of the type of reaction that occurs (e.g., formation of ionic compounds, combustion of hydrocarbons). 2. Evidence a. Students identify and describe* the evidence to construct the explanation, including: iv. The patterns of reactivity (e.g., the high reactivity of alkali metals) at the macroscopic **Observable features of the student performance by the end of the course: PS-2-1 (partially implemented*)** 1. Organizing data a. Students organize data that represent the net force on a macroscopic object, its mass (which is held constant), and its acceleration	*or a moving object being pulled by a constant force.* **PS2.A: Forces and Motion** • Newton's second law accurately predicts changes in the motion of macroscopic objects. **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. *Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields. Assessment is limited to systems with two objects* **PS2.B: Types of Interactions** • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • 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-LS1-3****: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. *Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.*	• Toxicology Classroom Escape Challenge • Toxicology Quiz •	and reliable scientific claims or determine an optimal design solution. ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Theories and laws provide explanations in science. • Laws are statements or descriptions of the relationships among observable phenomena. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical representations of phenomena to describe explanations. ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Theories and laws provide explanations in science.

	(e.g., via tables, graphs, charts, vector drawings). 2. Identifying relationships a. Students use tools, technologies, and/or models to analyze the data and identify relationships within the datasets, including: i. A more massive object experiencing the same net force as a less massive object has a smaller acceleration, and a larger net force on a given object produces a correspondingly larger acceleration; and ii. The result of gravitation is a constant acceleration on macroscopic objects as evidenced by the fact that the ratio of net force to mass remains constant. 3. Interpreting data b. Students use the data as empirical evidence to distinguish between causal and correlational relationships linking force, mass, and acceleration. **Observable features of the student performance by the end of the course: PS-2-4 (partial implementation**)** 1. Representation a. Students clearly define the system of the interacting objects that is mathematically represented. b Using the given mathematical representations, students identify and describe* the gravitational attraction between two objects as the	**LS1.A: Structure and Function** • 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.		• Laws are statements or descriptions of the relationships among observable phenomena. **Planning and Carrying Out Investigations** Planning and carrying out 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. ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. **Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

	product of their masses divided by the separation distance squared (Fg = −G m1m2 d2), where a negative force is understood to be attractive. 2. Mathematical modeling a. Students correctly use the given mathematical formulas to predict the gravitational force between objects or predict the electrostatic force between charged objects. 3. Analysis a Based on the given mathematical models, students describe* that the ratio between gravitational and electric forces between objects with a given charge and mass is a pattern that is independent of distance. b. Students describe* that the mathematical representation of the gravitational field (Fg = −G m1m2 d2) only predicts an attractive force because mass is always positive. d. Students use the given formulas for the forces as evidence to describe* that the change in the energy of objects interacting through electric or gravitational forces depends on the distance between the objects. **Observable features of the student performance by the end of the course: HS-LS1-3 (partial implementation in this unit, further implementation in unit 5)** 1. Identifying the phenomenon under investigation a. Students describe* the phenomenon under investigation, which includes the following idea:			

	that feedback mechanisms maintain homeostasis. 2. Identifying the evidence to answer this question a. Students develop an investigation plan and describe* the data that will be collected and the evidence to be derived from the data, including: i. Changes within a chosen range in the external environment of a living system; and ii. Responses of a living system that would stabilize and maintain the system's internal conditions (homeostasis), even though external conditions change, thus establishing the positive or negative feedback mechanism.			
Concepts	Blood Typing, Blood as Evidence, Blood Splatter Trajectory, Forensic Toxicology, Famous Toxicology Cases			
UNIT 5	**ENDURING UNDERSTANDINGS / ESSENTIAL QUESTIONS** **LEARNING OBJECTIVES, ESSENTIAL QUESTIONS, AND EVIDENCE STATEMENTS**	**CONTENT** **PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS (DCIs)**	**ASSURED EXPERIENCES & ASSESSMENTS**	**INSTRUCTIONAL STRATEGIES & PATHWAYS** **SCIENCE AND ENGINNERING PRACTICES (SEPs) & Cross Cutting Concepts (CCCs)**
Death and the Human Body	**Learning Objectives** Students will… • Explain the stages of decomposition and how characteristics of the body at each stage can assist investigators in determining time of death.	**HS-LS4-1**: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. **LS4.A: Evidence of Common Ancestry and Diversity** • Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary	• Death and the Human Body Flipbook • Class Debate Activity- student led • Stages of Decomposition Comic Strip • Graphing Algor Mortis • Illustrate It! Algor, Livor and Rigor Mortis	**Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific information (e.g., about phenomena and/or the process of development and the design

	• Calculate approximate time of death, given information about livor, rigor and algor mortis.. • Illustrate the blowfly life cycle and explain how each stage of a blowfly's life cycle can assist forensic investigators in determining post mortem interval. • Design and construct an experiment that studies blowflies at their different life stages. • Explain how features of the skull can be used to identify an unknown individual whose skeletal remains are found. • Identify parts of the pelvic bone that can be used to determine biological sex. • Calculate the height of an unknown individual whose skeletal remains are found. • Explain how advancements in technology are able to help forensic anthropologist determine the identity of unidentified skeletal remains. **Essential Questions:** • If you were a forensic scientist and needed to catch a murderer, would you prefer a body and no crime scene, or a crime scene and no body? • What evidence is available to the forensic investigator when examining a corpse?	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 and from anatomical and embryological evidence. **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. *Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen. Assessment is limited to chemical reactions involving main group elements and combustion reactions.* **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. **PS1.B: Chemical Reactions** • 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.	• Time of Death Task Cards • Time of Death Review Maze • Death Investigation Quiz • Blowfly Life Cycle Doodle Notes • Differentiated Entomology Review Stations • Entomology Double Puzzle • Death and the Human Body Digital Escape Room • Forensic Entomology Quiz • Anthropometry Activity • Dertermining the Age of a Skull • Bones: Male or Female? • Estimation of Body Size from Individual Bones • What the Bones Tell US • Calculating Height from Bone activity • Forensic Anthropology Mad Libs Puzzle • The Secret's in the Bones- student led investigation • Height and Body Proportions • Forensic Anthropology crossword puzzle • Forensics Anthropology Scavenger Hunt	and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). *Connections to Nature of Science* Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. **Developing and Using Models** 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 and use a model based on evidence to illustrate the relationships between systems or between components of a system. • Use a model based on evidence to illustrate the relationships between systems or between components of a system. **Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to

	Evidence Statements **Observable features of the student performance by the end of the course: LS4-1** 1.Communication style and format a. Students use at least two different formats (e.g., oral, graphical, textual and mathematical), to communicate scientific information, including that common ancestry and biological evolution are supported by multiple lines of empirical evidence. Students cite the origin of the information as appropriate. 2 Connecting the DCIs and the CCCs a. Students identify and communicate evidence for common ancestry and biological evolution, including: i. Information derived from DNA sequences, which vary among species but have many similarities between species; ii. Similarities of the patterns of amino acid sequences, even when DNA sequences are slightly different, including the fact that multiple patterns of DNA sequences can code for **Observable features of the student performance by the end of the course: HS-PS1-2**	**HS-LS1-2**: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. *An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.* **LS1.A: Structure and Function** • 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-LS1-3**: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. *Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.* **LS1.A: Structure and Function** • 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.	• Forensic Anthropology Quiz • Unit 3 Review Tournament • Quizizz Review Game • Unit 3 Exam • Cereal Box Serial Killer Research	simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. Energy and Matter • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes the universe is a vast single system in which basic laws are consistent. • 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. • **Planning and Carrying Out Investigations** Planning and carrying out 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.,

	1. Articulating the explanation of phenomena a. Students construct an explanation of the outcome of the given reaction, including: i. The idea that the total number of atoms of each element in the reactant and products is the same; ii. The numbers and types of bonds (i.e., ionic, covalent) that each atom forms, as determined by the outermost (valence) electron states and the electronegativity; iii. The outermost (valence) electron state of the atoms that make up both the reactants and the products of the reaction is based on their position in the periodic table; and iv. A discussion of how the patterns of attraction allow the prediction of the type of reaction that occurs (e.g., formation of ionic compounds, combustion of hydrocarbons). 2. Evidence a. Students identify and describe* the evidence to construct the explanation, including: i. Identification of the products and reactants, including their chemical formulas and the arrangement of their	**HS-LS1-7**: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. **LS1.C: Organization for Matter and Energy Flow in Organisms** • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • 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-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. **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		number of trials, cost, risk, time), and refine the design accordingly. - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. Stability and Change • Feedback (negative or positive) can stabilize or destabilize a system. Energy and Matter • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. Patterns

	outermost (valence) electrons; ii. Identification that the number and types of atoms are the same both before and after a reaction; iii. Identification of the numbers and types of bonds (i.e., ionic, covalent) in both the reactants and the products; iv. The patterns of reactivity (e.g., the high reactivity of alkali metals) at the macroscopic level as determined by using the periodic table; and v. The outermost (valence) electron configuration and the relative electronegativity of the atoms that make up both the reactants and the products of the reaction based on their position in the periodic table. 3. Reasoning a. Students describe* their reasoning that connects the evidence, along with the assumption that theories and laws that describe their natural world operate today as they did in the past and will continue to do so in the future, to construct an explanation for how the patterns of outermost electrons and the electronegativity of elements can be used to predict the number and types of bonds each element forms.	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-PS3-1**: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. **PS3.A: Definitions of Energy** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. **PS3.B: Conservation of Energy and Energy Transfer** • Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Mathematical expressions, which quantify how the stored energy in a system depends on its		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. **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create a computational model or simulation of a phenomenon, designed device, process, or system.

	b. In the explanation, students describe* the causal relationship between the observable macroscopic patterns of reactivity of elements in the periodic table and the patterns of outermost electrons for each atom and its relative electronegativity. 4. Revising the explanation a. Given new evidence or context, students construct a revised or expanded explanation about the outcome of a chemical reaction and justify the revision. **Observable features of the student performance by the end of the course: HS-LS1-2** 1. Components of the model a. Students develop a model in which they identify and describe* the relevant parts (e.g., organ system, organs, and their component tissues) and processes (e.g., transport of fluids, motion) of body systems in multicellular organisms. 2. Relationships a. In the model, students describe* the relationships between components, including: i. The functions of at least two major body systems in terms of contributions to overall function of an organism; ii. Ways the functions of two different systems affect one another; and iii. A system's function and how that relates both to the	configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • The availability of energy limits what can occur in any system.		

	system's parts and to the overall function of the organism. 3. Connections a. Students use the model to illustrate how the interaction between systems provides specific functions in multicellular organisms. b. Students make a distinction between the accuracy of the model and actual body systems and functions it represents. **Observable features of the student performance by the end of the course: HS-LS1-3** 1. Identifying the phenomenon under investigation a. Students describe* the phenomenon under investigation, which includes the following idea: that feedback mechanisms maintain homeostasis. 2. Identifying the evidence to answer this question a. Students develop an investigation plan and describe* the data that will be collected and the evidence to be derived from the data, including: i. Changes within a chosen range in the external environment of a living system; and ii. Responses of a living system that would stabilize and maintain the system's internal conditions (homeostasis), even though external conditions change,			

	thus establishing the positive or negative feedback mechanism. b. Students describe* why the data will provide information relevant to the purpose of the investigation. 3. Planning for the investigation a. In the investigation plan, students describe*: i. How the change in the external environment is to be measured or identified; ii. How the response of the living system will be measured or identified; iii. How the stabilization or destabilization of the system's internal conditions will be measured or determined; iv. The experimental procedure, the minimum number of different systems (and the factors that affect them) that would allow generalization of results, the evidence derived from the data, and identification of limitations on the precision of data to include types and amounts; and v. Whether the investigation will be conducted individually or collaboratively. 4. Collecting the data a. Students collect and record changes in the external environment			

	and organism responses as a function of time. 5. Refining the design a. Students evaluate their investigation, including: i. Assessment of the accuracy and precision of the data, as well as limitations (e.g., cost, risk, time) of the investigation, and make suggestions for refinement; and ii. Assessment of the ability of the data to provide the evidence required. b. If necessary, students refine the investigation plan to produce more generalizable data. **Observable features of the student performance by the end of the course: HS-LS1-7** 1. Components of the model a. From a given model, students identify and describe* the components of the model relevant for their illustration of cellular respiration, including: i. Matter in the form of food molecules, oxygen, and the products of their reaction (e.g., water and CO_2); ii. The breaking and formation of chemical bonds; and iii. Energy from the chemical reactions. 2. Relationships			

	a. From the given model, students describe* the relationships between components, including: i. Carbon dioxide and water are produced from sugar and oxygen by the process of cellular respiration; and ii. The process of cellular respiration releases energy because the energy released when the bonds that are formed in CO_2 and water is greater than the energy required to break the bonds of sugar and oxygen. 3. Connections a. Students use the given model to illustrate that: i. The chemical reaction of oxygen and food molecules releases energy as the matter is rearranged, existing chemical bonds are broken, and new chemical bonds are formed, but matter and energy are neither created nor destroyed. ii. Food molecules and oxygen transfer energy to the cell to sustain life's processes, including the maintenance of body temperature despite ongoing energy transfer to the surrounding environment. **Observable features of the student performance by the end of the course: HS-PS3-1 (partial implementation**)**			

	1. Representation a. Students identify and describe* the components to be computationally modeled, including: i. The boundaries of the system and that the reference level for potential energy = 0 (the potential energy of the initial or final state does not have to be zero); ii. The initial energies of the system's components (e.g., energy in fields, thermal energy, kinetic energy, energy stored in springs — all expressed as a total amount of Joules in each component), including a quantification in an algebraic description to calculate the total initial energy of the system; iii. The energy flows in or out of the system, including a quantification in an algebraic description with flow into the system defined as positive; and iv. The final energies of the system components, including a quantification in an algebraic description to calculate the total final energy of the system. 3. Analysis a. Students use the computational model to predict the maximum possible change in the energy of one			

	component of the system for a given set of energy flows. b. Students identify and describe* the limitations of the computational model, based on the assumptions that were made in creating the algebraic descriptions of energy changes and flows in the system.			
Concepts: Decomposition, Cellular Respiration, Stages of Death, Forensic Anthropology, Forensic Entomology, Time of Death				