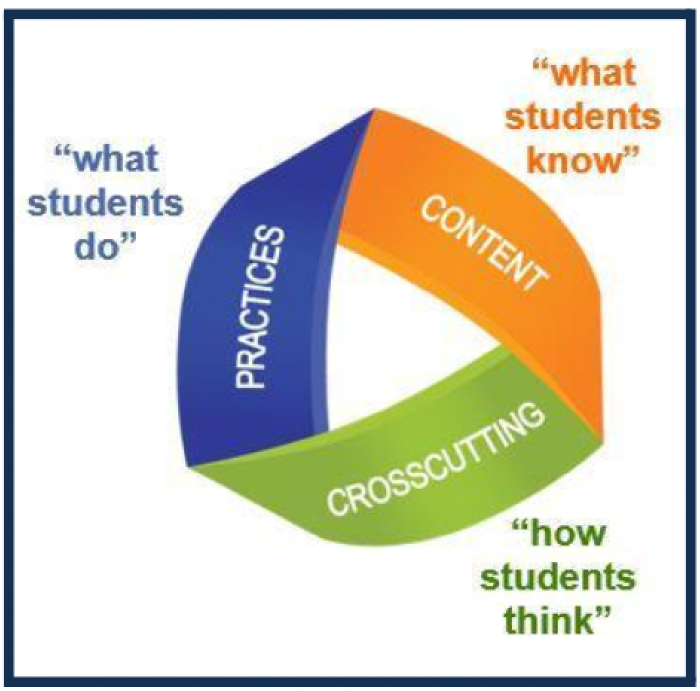
Ledyard Public Schools

Ledyard High School

NGSS Science Curriculum

Forensic Science



Approved by Instructional Council on May 10, 2023

Course Title	Forensic Science
Department and Curriculum Writing Team Members	**Science** Samantha Cregger
Course Overview	Forensic Science is the use of science in a court of law. This Forensic Science course involves a discussion and practice of the chemical, physical, and biological laboratory techniques used to interpret evidence. The focus is on scientific analysis of mock evidence, rather than crime scene procedures. Blood, DNA, and fingerprinting are examples of mock evidence to be covered. Other possibilities include bones, teeth, insects, toxins, documents, hair and other trace evidence, firearms and ballistics, and more. This course is available to students in grades 10-12.
Length of Course	☐ Full year ☑ Semester
Type of Course	☐ Humanities Required Credit ☐ STEM Required Credit ☐ Humanities Elective Credit ☑ STEM Elective Credit ☐ PE/Health Required Credit ☐ Other
Grade Level	☐ 9 ☑ 10 ☑ 11 ☑ 12
Prerequisites	None
Ledyard High School Vision of the Graduate	Ledyard High School is a learning community dedicated to the cultivation of skills essential for our students' success in a rapidly-evolving society. At Ledyard High School, we believe our graduates should demonstrate the following: ☑ Collaboration - Colonel Graduates will demonstrate an ability to work effectively with others, sharing ideas, acknowledging one another's strengths, and collaborating to produce presentations, projects, performances, or events. ☑ Communication- Colonel Graduates will demonstrate an ability to communicate information clearly and effectively through a variety of media, including written, oral, visual, musical, and/or video productions. ☑ Problem-Solving- Colonel Graduates will demonstrate an ability to solve problems of varying complexity across a variety of content areas. ☑ Critical Thinking - Colonel Graduates will demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas. ☑ Perseverance - Colonel Graduates will demonstrate perseverance in academic and extracurricular settings by working through and past obstacles in pursuit of goals. ☑ Creativity - Colonel Graduates will demonstrate creativity through their participation in fine arts courses as well as through their inventive approaches to learning activities in a variety of settings.
VOG Portfolio Component	"When Did She Die?" Activity Critical Thinking

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District Philosophy

Ledyard's vision for K-12 inquiry based science is to engage students in scientific and engineering practices as they apply crosscutting concepts to deepen their understanding of the core ideas in these fields.

A New Vision for Science Education

Implications of the Vision of the Framework for K-12 Science Education and the Next Generation Science Standards

SCIENCE EDUCATION WILL INVOLVE LESS:	SCIENCE EDUCATION WILL INVOLVE MORE:
Rote memorization of facts and terminology.	Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.
Learning of ideas disconnected from questions about phenomena.	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned.
Teachers providing information to the whole class.	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance.
Teachers posing questions with only one right answer.	Students discussing open-ended questions that focus on the strength of the evidence used to generate claims.
Students reading textbooks and answering questions at the end of the chapter.	Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information.
Pre-planned outcome for "cookbook" laboratories or hands-on activities.	Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas.
Worksheets.	Student writing of journals, reports, posters, and media presentations that explain and argue.
Oversimplification of activities for students who are perceived to be less able to do science and engineering	Provision of supports so that all students can engage in sophisticated science and engineering practices

Source: National Research Council. (2015). *Guide to Implementing the Next Generation Science Standards* (pp. 8-9). Washington, DC: National Academies Press. http://www.nap.edu/catalog/18802/guide-to-implementing-the-next-generation-science-standards

Three Dimensions of the *Next Generation Science Standards*: Practices of Science and Engineering:

Scientific and Engineering Practices Matrix - SEP (appendix F)

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.
Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.
Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.

Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

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Three Dimensions of the *Next Generation Science Standards*: Disciplinary Core Ideas:

Disciplinary Core Ideas Matrix - DCI (appendix E)

Physical Science	Life Science	Earth and Space Science	Engineering, Technology, and the Application of Science
PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

Three Dimensions of the *Next Generation Science Standards*: Crosscutting Concepts:

Crosscutting Concepts Matrix - CCC (appendix G)		
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. **Cause and Effect: Mechanism and Explanation** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.	**Scale, Proportion, and Quantity** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. **Systems and System Models** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.	**Energy and Matter: Flows, Cycles, and Conservation** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. **Structure and Function** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and Change** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

Connections to the Nature of Science

Nature of Science Practices	Nature of Science Crosscutting Concepts
These understandings about the nature of science are closely associated with the science and engineering practices, and are found in that section of the foundation box on a standards page. More information about the Connections to Engineering, Technology and Applications of Science can be found in Appendix H.	These understandings about the nature of science are closely associated with the crosscutting concepts, and are found in that section of the foundation box on a standards page. More information about the Connections to Engineering, Technology and Applications of Science can be found in Appendix H.
Scientific Investigations Use a Variety of Methods	Science is a Way of Knowing
Science Knowledge is Based on Empirical Evidence	Scientific Knowledge Assumes and Order and Consistency in Natural Systems
Scientific Knowledge is Open to Revision in Light of New Evidence	Science is a Human Endeavor
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena.	Science Addresses Questions About the Natural and Material World

How does Ledyard Define Inquiry?

Inquiry is defined as a way of seeking information, knowledge, or truth through questioning. Inquiry is a way for a learner to acquire new information and data and turn it into useful knowledge. Inquiry involves asking good questions and developing robust investigations from them. Inquiry also involves considering possible solutions and consequences. A third component of inquiry is separating evidence based claims from common opinion, and communicating claims with others, and acting upon these claims when appropriate. Questions lead to gathering information through research, study, experimentation, observation, or interviews. During this time, the original question may be revised, a line of research refined, or an entirely new path may be pursued. As more information is gathered, it becomes possible to make connections and allows individuals to construct their own understanding to form new knowledge. Sharing this knowledge with others develops the relevance of the learning for both the student and a greater community. Sharing is followed by reflection and potentially more questions, bringing the inquiry process full circle.

Inquiry 5 Science Teaching Model

Engagement	Object, event or question used to engage students. Connections facilitated between what students know and can do.
Exploration	Objects and phenomena are explored. Hands-on activities, with guidance.
Explanation	Students explain their understanding of concepts and processes. New concepts and skills are introduced as conceptual clarity and cohesion are sought.
Elaboration	Activities allow students to apply concepts in contexts, and build on or extend understanding and skill.
Evaluation	Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.

Course Overview
Forensic Science is the use of science in a court of law. This Forensic Science course involves a discussion and practice of the chemical, physical, and biological laboratory techniques used to interpret evidence. The focus is on scientific analysis of mock evidence, rather than crime scene procedures. Mock evidence analyzed in this course includes Blood, DNA, and fingerprinting, and may include bones, teeth, insects, toxins, documents, hair and other trace evidence, firearms and ballistics, among others

Grade Level:	10-12	Timeline: 12 classes
Unit Title: Introduction to Forensic Science		
Essential Question(s):	● How is the depiction of forensic science in popular culture misleading? ● What information can be gained from the proper processing of evidence from a crime scene? ● How can evidence be used to reconstruct a crime scene?	

Standards:

- LS1-6.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.
- 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.

Crosscutting Concepts:

- 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.
- 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.
- Cause and Effect
  - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- 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.

Science and Engineering Practices:

- Planning and Carrying Out Investigations
  - 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.
- Constructing Explanations and Designing Solutions
  - 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.
- Engaging in Argument from Evidence
  - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
  - Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

Content & Vocabulary:	● Observational skills ● Testimonial evidence and eyewitness reliability ● Facial composites ● The Innocence Project and the history of DNA evidence ● The crime scene and the steps of crime scene management (7 S's) ● Media portrayals of Forensic Science ● Types of evidence: biological, physical, trace ● Evidence collection and processing

	● Types of crimes: infractions, felonies, and misdemeanors
	● Laws and basic criminal procedures
	    ○ Warrants and warrantless searches
	    ○ Miranda warning
	    ○ Basic processing and documentation procedures
	● Expert testimony: Frye standard v. Daubert standard

Suggested Activities:	● Observational skills activity ● FaceMaker- facial composites activity ● TED talk: *How reliable is your memory? (https://www.youtube.com/watch?v=PB2OegI6wvI)* Elizabeth Loftus and reflection/discussion ● Kelly Murder Mystery activity ● Make Your Own Crime Scene Project and Gallery Walk ● Ronald Cotton Case Study- eyewitness reliability, exoneration ● Helle Crafts Case Study- evidence collection
Suggested Assessments:	● Make Your Own Crime Scene Project ● Unit 1 Test

Grade Level: 10-12	Timeline: 13 classes
Unit Title: Physical Evidence	
EssentialQuestion(s):	● Why is it important to collect evidence in a procedural manner? ● What is the difference between the identification and analysis of physical evidence? ● How can hair and fibers be used as circumstantial evidence to provide links to the victim, suspect, and crime scene? ● How can fingerprints identify a criminal with absolute certainty? ● How can forensic scientists detect forgeries or counterfeits? ● How can handwriting be used as individual evidence?

Standards:

- LS2-3.B Variation of Traits
  - In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.
  - Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.
- 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.

Crosscutting Concepts:

- 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.
- Cause and Effect
  - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- 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.
- Structure and Function
  - Investigating or designing new systems or structures requires 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.
- Science is a Human Endeavor
  - Technological advances have influenced the progress of science and science has influenced advances in technology.
  - Science and engineering are influenced by society and society is influenced by science and engineering.

Science and Engineering Practices:

- Constructing Explanations and Designing Solutions
  - 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.
- Engaging in Argument from Evidence
  - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
  - Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

● Analyzing and Interpreting Data ○ Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Using Mathematical and Computational Thinking ○ Use mathematical representations of phenomena or design solutions to support claims. ● Obtaining, Evaluating, and Communicating Information ○ Communicate scientific information (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).	
Content & Vocabulary:	● Types of evidence: physical, biological, trace ● Evidence collection and storage procedures ● Evidentiary value ● Locard's Exchange Principle ● Hair structure and characteristics ● Hair and fiber evidence ● Questioned documents ● Handwriting characteristic and analysis ● The process of fingerprinting ● Fingerprint types: latent, plastic, visible ● Fingerprint characteristics and comparative analysis ● Ballistics ● Impressions
Suggested Activities:	● Trace Evidence/Locard's Exchange Principle Lab ● Observing hair and fibers under the microscope ● Caylee Anthony Case Study ● Handwriting Analysis Lab ● Taking and analyzing fingerprints activity ● Family Fingerprint Project
Suggested Assessments:	● Trace Evidence/Locard's Exchange Principle Lab ● Handwriting Analysis Lab ● Family Fingerprint Project ● Unit 2 Test

Grade Level:	10-12	Timeline: 10 classes
Unit Title: Biological Evidence		
Essential Question(s):	● How is blood analyzed by forensic investigators? ● How can information be inferred from blood spatter patterns? ● What is the significance and value of DNA evidence to forensic investigation? ● What DNA technologies have been developed that can be used to isolate and identify evidence?	

Standards:

- LS1-6.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.
- LS2-3.B Variation of Traits
  - In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.
  - Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.
- 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.

Crosscutting Concepts:

- 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.
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- 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.
- Structure and Function
  - Investigating or designing new systems or structures requires 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.
- Science is a Human Endeavor
  - Technological advances have influenced the progress of science and science has influenced advances in technology.
  - Science and engineering are influenced by society and society is influenced by science and engineering.

Science and Engineering Practices:

- Constructing Explanations and Designing Solutions
  - 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.
- Engaging in Argument from Evidence

○ Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ○ Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. ● Analyzing and Interpreting Data ○ Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Using Mathematical and Computational Thinking ○ Use mathematical representations of phenomena or design solutions to support claims. ● Obtaining, Evaluating, and Communicating Information ○ Communicate scientific information (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).	
Content & Vocabulary:	● Blood evidence ● Blood types and inheritance (antigens & antibodies, agglutination) ● Blood spatter patterns and analysis ● DNA structure and function ○ Nuclear DNA versus mitochondrial DNA ● DNA evidence ● The Innocence Project
Suggested Activities:	● Virtual Blood Typing Lab ● Blood Spatter Analysis Lab ● OJ Simpson Case Study ● DNA Extraction Lab
Suggested Assessments:	● Virtual Blood Typing Lab ● Blood Spatter Analysis lab ● Unit 3 Test

Grade Level: 10-12	Timeline: 11 days
Unit Title: Death and Decomposition	
Essential Question(s):	• How is toxicity determined? • How can an autopsy help solve a crime? • Why is time of death important?

Standards:

- ESS2.A: Earth Materials and Systems
  - Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
- 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.

Crosscutting Concepts:

- Energy and Matter
  - Energy drives the cycling of matter within and between systems.
- 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.
- Structure and Function
  - Investigating or designing new systems or structures requires 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.
- Science is a Human Endeavor
  - Technological advances have influenced the progress of science and science has influenced advances in technology.
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- Analyzing and Interpreting Data
  - Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
- Using Mathematical and Computational Thinking
  - Use mathematical representations of phenomena or design solutions to support claims.
- Obtaining, Evaluating, and Communicating Information
  - Communicate scientific information (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).

Content & Vocabulary:	• Toxicology

	○ Lethal dose/LD50 ○ Analysis techniques ○ Cause of death ○ Poisoning ● Death: Manner of Death versus Cause of Death versus Mechanism of Death ○ Determining death ○ Time of death calculations ● Decomposition ○ Lividity ○ Livor mortis ○ Rigor mortis ○ Algor mortis ○ Stages of decomposition ○ Stomach contents ● Autopsy- process and information that can be gathered ● Body farms and research ● Forensic entomology (succession) ● Cold Cases
Suggested Activities:	● Southeastern CT Opioid Crisis data analysis ● Celebrity Death by Drugs Project ● Mystery Powders Lab ● Lethal Dose activity ● Banana Autopsy Lab ● “Secrets of the Body Farm” video ● VOG: “When Did She Die?” Activity ● Final Project: Cold Case Investigation
Suggested Assessments:	● VOG: “When Did She Die?” Activity ● Unit 4 Test ● Final Project: Cold Case Investigation

Suggested Timeline and Pacing *Subject to further reviews. Units should be intended to be completed in each quarter but are not required.*	
Unit 1: Introduction to Forensic Science	**12 classes**
Unit 2: Physical Evidence	**13 classes**
Unit 3: Biological Evidence	**10 classes**
Unit 4: Death and Decomposition	**11 classes**