

Scope and Sequence of Forensic Science

Written: July 2019

Adopted: August 21, 2020

MP1	Ch 1: Observation skills Ch 2: Crime scene investigation and Evidence Collection Ch 3: Hair Analysis Ch 4: A Study of Fibers and Textiles Ch 10: Handwriting Analysis, Forgery, and Counterfeiting
MP2	Ch 6: Fingerprints Ch 7: DNA Profiling Ch 8: Blood and Blood Spatter
MP3	Ch 9: Forensic Toxicology Ch 14: Forensic Anthropology Ch 11: Forensic Entomology Ch 12: Death: Manner, Mechanism, and Cause
MP4	Ch 15: Glass Evidence Ch 16: Casts and Impressions Ch 17: Tool Marks Ch 18: Firearms and Ballistics

Unit 1: History, Observation, Investigation, and Evidence Collection in Forensic Science	
Est. Time to complete: 4 weeks	Cengage Book Chapters: <ul style="list-style-type: none"> ● 1: Observation Skills (1.5 wks) ● 2: Crime Scene Investigation and Evidence Collections (2.5 wks)
NGSS Standards	
<ul style="list-style-type: none"> ● HS-LS3-1 <ul style="list-style-type: none"> ○ Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. 	<ul style="list-style-type: none"> ● HS-LS3-3 <ul style="list-style-type: none"> ○ Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ● HS-ETS1-2 <ul style="list-style-type: none"> ○ Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Science and Engineering Practices	
<ul style="list-style-type: none"> ● Asking Questions and Defining Problems ● Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. ● Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1) 	
Disciplinary Core Ideas	
<ul style="list-style-type: none"> ● LS1.A: Structure and Function <ul style="list-style-type: none"> ○ All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) ● LS3.A: Inheritance of Traits <ul style="list-style-type: none"> ○ Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. ○ All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural 	

functions, and some have no as-yet known function. (HS-LS3-1)

Crosscutting Concepts

- Cause and Effect
 - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1)
- Scale, Proportion, and Quantity
 - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g. linear growth vs. exponential growth). (HS-LS3-3)
- Connections to Nature of Science
 - Science is a Human Endeavor
 - Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3)
 - Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

1. Define observation, and describe what changes occur in the brain while observing.
2. Describe examples of factors influencing eyewitness accounts of events.
3. Compare the reliability of eyewitness testimony to what actually happened and relate observation skills to their use in forensic science
4. Define forensic science.
5. Practice and improve your own observation skills.
6. Summarize Locard's Principle of Exchange
7. Identify examples of trace evidence and distinguish between direct and circumstantial evidence
8. Identify the types of professionals who might be present at a crime scene
9. Summarize the seven steps of a crime scene investigation and explain the importance of securing a crime scene
10. Identify the methods by which a crime scene is documented and demonstrate proper technique in collecting and packaging trace evidence
11. Explain what it means to map a crime scene

Interdisciplinary Connections

- ELA
 - **RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- Mathematics

- ELA
 - **RST.11-12.9** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting

<ul style="list-style-type: none"> ○ MP.2 Reason abstractly and quantitatively. 	<p>information when possible.</p>
<p>21st century skills:</p> <ul style="list-style-type: none"> ● Critical thinking, Creativity, Collaboration, Communication, Media literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity, Social skills <p>Career Readiness Standards</p> <ul style="list-style-type: none"> ● 9.2.12.CAP.3: Investigate how continuing education contributes to one’s career and personal growth. ● 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans. 	
<p>Assessments</p>	
<ul style="list-style-type: none"> ● Formative <ul style="list-style-type: none"> ○ Exit tickets, check for understanding, lab activities ● Summative <ul style="list-style-type: none"> ○ Tests, quizzes, lab activities 	<ul style="list-style-type: none"> ● Alternative <ul style="list-style-type: none"> ○ Projects, labs ● Benchmark <ul style="list-style-type: none"> ○ Students should be able to record detailed observations after an event, perform the seven “S’s” of crime scene investigation, and properly store evidence. ○ New Jersey Student Learning Assessment Science (NJSLA) ○ Quarterlies ○ Unit Test ○ Performance Assessments
<p>Modifications</p>	
<ul style="list-style-type: none"> ● ELL <ul style="list-style-type: none"> ○ Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). 	<ul style="list-style-type: none"> ● Special Education and 504’s <ul style="list-style-type: none"> ○ Modified assignments (ex: fewer problems per page) ○ Response to Intervention (RTI) (www.help4teachers.com) ○ Follow all IEP modifications/504 plan ○ Oral Instructions

<ul style="list-style-type: none">o Audio books, movies, and other digital media in lieu of print versionso Native language texts and native language to English dictionary● Gifted and Talented<ul style="list-style-type: none">o Peer Tutoringo Cooperative Learning Groupso Differentiated Instructiono Use project-based science learning to connect science with observable phenomena.o Structure the learning around explaining or solving a social or community-based issue.	<ul style="list-style-type: none">o Record lessons instead of taking noteso Outlines of lessonso Study Guides with answerso Word processor to type noteso Frequent breakso Provide students with multiple choices for how they can represent their understanding (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
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Unit 2: A Study of Hair Analysis, Fibers, Textiles, Handwriting, Forgery, and Counterfeiting

Est. Time to complete: 4 weeks

Cengage Book Chapters:

- Ch 3: Hair Analysis (1 wk)
- Ch 4: A Study of Fibers and Textiles (1wk)
- Ch 10: Handwriting Analysis, Forgery, and Counterfeiting (2 wks)

NGSS Standards

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| <ul style="list-style-type: none"> ● HS-LS1-1 <ul style="list-style-type: none"> ○ Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. ● HS-LS3-3 <ul style="list-style-type: none"> ○ Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. | <ul style="list-style-type: none"> ● HS-ETS1-2 <ul style="list-style-type: none"> ○ Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
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Science and Engineering Practices

- 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 an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-1)

Disciplinary Core Ideas

- LS1.A: Structure and Function
 - Systems of specialized cells within organisms help them perform the

essential functions of life. (HS-LS1-1)

- All cells contain genetic information in the form of DNA molecules.
- Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)

Crosscutting Concepts

- Structure and Function
 - Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)
- Scale, Proportion, and Quantity
 - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g. linear growth vs. exponential growth). (HS-LS3-3)
- Connections to Nature of Science
 - Science is a Human Endeavor
 - Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3)
 - Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

1. Identify the various parts of a hair.
2. Describe variations in the structure of the medulla, cortex, and cuticle.
3. Distinguish between human and nonhuman animal hair.
4. Determine if two examples of hair are likely to be from the same person.
5. Explain how hair can be used in a forensic investigation.
6. Calculate the medullary index for a hair.
7. Distinguish hairs from individuals belonging to broad racial categories.
8. Identify and describe common weave patterns of textile samples.
9. Compare and contrast various types of fibers through physical and computational analysis.
10. Describe principal characteristics of common fibers used in their identification.
11. Apply forensic science techniques to analyze fibers.
12. Explain how a sample of handwriting evidence is compared by oh qualitative and quantitative characteristics.
13. Identify a historical case of document fraud and explain how the fraudulent document(s) were created.
14. List and describe several ways in which businesses prevent and check forgery.
15. Compare and contrast older paper currencies with new currencies.

Interdisciplinary Connections

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| <ul style="list-style-type: none"> ● ELA <ul style="list-style-type: none"> ○ RST.11-12.1 Cite specific | <ul style="list-style-type: none"> ● World History <ul style="list-style-type: none"> ○ WHST.9-12.2 Write |
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<p>textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p>	<p>informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <ul style="list-style-type: none"> ○ WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
<p>21st century skills:</p> <ul style="list-style-type: none"> ● Critical thinking, Collaboration, Communication, Information literacy, Media literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity <p>Career Readiness Standards</p> <ul style="list-style-type: none"> ● 9.2.12.CAP.3: Investigate how continuing education contributes to one’s career and personal growth. ● 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans. 	
<p>Assessments</p>	
<ul style="list-style-type: none"> ● Formative <ul style="list-style-type: none"> ○ Exit tickets, check for understanding, lab activities ● Summative <ul style="list-style-type: none"> ○ Tests, quizzes, lab activities 	<ul style="list-style-type: none"> ● Alternative <ul style="list-style-type: none"> ○ Projects, labs ● Benchmark <ul style="list-style-type: none"> ○ Students should be able to differentiate between human and animal hair, characterize different fibers based on physical and chemical properties, match a handwriting sample from evidence to a suspect, and identify counterfeit bills. ○ New Jersey Student Learning Assessment Science (NJSLA) ○ Quarterlies ○ Unit Test ○ Performance Assessments

Modifications	
<ul style="list-style-type: none"> ● ELL <ul style="list-style-type: none"> ○ Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ○ Audio books, movies, and other digital media in lieu of print versions ○ Native language texts and native language to English dictionary ● Gifted and Talented <ul style="list-style-type: none"> ○ Peer Tutoring ○ Cooperative Learning Groups ○ Differentiated Instruction ○ Use project-based science learning to connect science with observable phenomena. ○ Structure the learning around explaining or solving a social or community-based issue. 	<ul style="list-style-type: none"> ● Special Education and 504's <ul style="list-style-type: none"> ○ Modified assignments (ex: fewer problems per page) ○ Response to Intervention (RTI) (www.help4teachers.com) ○ Follow all IEP modifications/504 plan ○ Oral Instructions ○ Record lessons instead of taking notes ○ Outlines of lessons ○ Study Guides with answers ○ Word processor to type notes ○ Frequent breaks ○ Provide students with multiple choices for how they can represent their understanding (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Unit 3: Fingerprints, DNA profiling, Blood and Blood Spatter	
Est. Time to complete: 6 weeks	Cengage Book Chapters: <ul style="list-style-type: none"> ● Ch 6: Fingerprints (1.5 wks) ● Ch 7: DNA Profiling (1.5 wks) ● Ch 8: Blood and Blood Spatter (3 wks)
NGSS Standards	
<ul style="list-style-type: none"> ● HS-LS1-1 <ul style="list-style-type: none"> ○ Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. ● HS-LS1-2 <ul style="list-style-type: none"> ○ Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. 	<ul style="list-style-type: none"> ● HS-ETS1-2 <ul style="list-style-type: none"> ○ Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Science and Engineering Practices	
<ul style="list-style-type: none"> ● Developing and Using Models <ul style="list-style-type: none"> ○ 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. (HS-LS1-2) ● Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> ○ 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 an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past 	

and will continue to do so in the future. (HS-LS1-1)

Disciplinary Core Ideas

- LS1.A: Structure and Function
 - Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
 - All cells contain genetic information in the form of DNA molecules.
 - Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)
 - Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)

Crosscutting Concepts

- Structure and Function
 - Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)
- Systems and System Models
 - Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2),

1. Outline the history of fingerprinting and describe the characteristics of fingerprinting.
2. Compare and contrast the basic types of fingerprints and describe how criminals attempt to alter their fingerprints.
3. Present and refute arguments that question fingerprint evidence reliability.
4. Summarize the proper procedure for collecting fingerprint evidence and describe the latest identification technologies.
5. Lift a latent print and prepare a ten card and analyze the ridge patterns of prints.
6. Explain how DNA can be important to criminal investigations
7. Explain how crime scene evidence is collected for DNA analysis and describe how crime scene evidence is processed to obtain DNA
8. Explain what a short tandem repeat (STR) is, and explain its importance to DNA profiling
9. Explain how law enforcement agencies compare new DNA evidence to existing DNA evidence.
10. Describe the use of DNA profiling using mDNA and Y STRs to help identify a person using the DNA of a family member
11. Compare and contrast a gene and a chromosome, and an intron and an exon
12. Describe the forensic significance of the different types of blood cells.

13. Summarize the history of the use of blood and blood spatter analysis in forensics.
14. Outline the procedure used of blood to determine blood type
15. Describe how to screen for the presence of human blood
16. Calculate the probability of a person having a specific blood type using data from population studies
17. Describe the proper procedures for handling blood evidence
18. Analyze blood spatter evidence using angle of impact, area of convergence, and area of origin.
19. Compare and contrast different types of blood spatter patterns and describe how those patterns are formed.

Interdisciplinary Connections

<ul style="list-style-type: none"> ● ELA <ul style="list-style-type: none"> ○ RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. 	<ul style="list-style-type: none"> ● World History <ul style="list-style-type: none"> ○ WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. ○ WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
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- 21st century skills:
- Critical thinking, Creativity, Collaboration, Communication, Information literacy, Media literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity, Social skills
- Career Readiness Standards
- 9.2.12.CAP.3: Investigate how continuing education contributes to one’s career and personal growth.
 - 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.

Assessments

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| <ul style="list-style-type: none"> ● Formative | <ul style="list-style-type: none"> ● Alternative |
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<ul style="list-style-type: none"> ○ Exit tickets, check for understanding, lab activities ● Summative <ul style="list-style-type: none"> ○ Tests, quizzes, lab activities 	<ul style="list-style-type: none"> ○ Projects, labs ● Benchmark <ul style="list-style-type: none"> ○ Students should be able to identify unique characteristics of fingerprints, use gel electrophoresis to narrow down suspects, analyze blood splatter evidence to reconstruct a crime scene. ○ New Jersey Student Learning Assessment Science (NJSLA) ○ Quarterlies ○ Unit Test ○ Performance Assessments
<p>Modifications</p>	
<ul style="list-style-type: none"> ● ELL <ul style="list-style-type: none"> ○ Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ○ Audio books, movies, and other digital media in lieu of print versions ○ Native language texts and native language to English dictionary ● Gifted and Talented <ul style="list-style-type: none"> ○ Peer Tutoring ○ Cooperative Learning Groups ○ Differentiated Instruction ○ Use project-based science learning to connect science with observable phenomena. ○ Structure the learning around explaining or solving a social or community-based issue. 	<ul style="list-style-type: none"> ● Special Education and 504's <ul style="list-style-type: none"> ○ Modified assignments (ex: fewer problems per page) ○ Response to Intervention (RTI) (www.help4teachers.com) ○ Follow all IEP modifications/504 plan ○ Oral Instructions ○ Record lessons instead of taking notes ○ Outlines of lessons ○ Study Guides with answers ○ Word processor to type notes ○ Frequent breaks ○ Provide students with multiple choices for how they can represent their understanding (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Unit 4: Toxicology	
Est. Time to complete: 2 weeks	Cengage Book Chapters: <ul style="list-style-type: none"> Ch 9: Forensic Toxicology (2 wks)
NGSS Standards	
<ul style="list-style-type: none"> HS-ETS1-2 <ul style="list-style-type: none"> Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 	
Science and Engineering Practices	
<ul style="list-style-type: none"> Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> 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 trade-off considerations. (HS-ETS1-2) 	
Disciplinary Core Ideas	
<ul style="list-style-type: none"> ETS1.C: Optimizing the Design Solution <ul style="list-style-type: none"> Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2) 	
Crosscutting Concepts	
<ul style="list-style-type: none"> Systems and System Models <ul style="list-style-type: none"> Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-2) 	
<ol style="list-style-type: none"> Provide examples of drugs, poisons, and toxins. List factors that affect drug toxicity. Describe the role of a toxicologist in analyzing substance evidence. Compare and contrast presumptive testing and confirmatory testing. 	

<ol style="list-style-type: none"> 5. Describe how people get exposed to environmental toxins (e.g., pesticides, carbon monoxide), and describe their effects on the body. 6. Distinguish among the terms tolerance, addiction, dependence, and withdrawal. 7. Relate the signs and symptoms of overdose with a specific substance or combination of substances. 8. Show the relationships between the law, crime, and the use of drugs. 	
Interdisciplinary Connections	
<ul style="list-style-type: none"> ● ELA <ul style="list-style-type: none"> ○ RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. 	
<p>21st century skills:</p> <ul style="list-style-type: none"> ● Critical thinking, Creativity, Communication, Information literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity, Social skills <p>Career Readiness Standards</p> <ul style="list-style-type: none"> ● 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. ● 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans. 	
Assessments	
<ul style="list-style-type: none"> ● Formative <ul style="list-style-type: none"> ○ Exit tickets, check for understanding, lab activities ● Summative <ul style="list-style-type: none"> ○ Tests, quizzes, lab activities 	<ul style="list-style-type: none"> ● Alternative <ul style="list-style-type: none"> ○ Projects, labs ● Benchmark <ul style="list-style-type: none"> ○ Students should be able to test for the presence or absence of a drug. ○ New Jersey Student Learning

	<p>Assessment Science (NJSLA)</p> <ul style="list-style-type: none"> ○ Quarterlies ○ Unit Test ○ Performance Assessments
<p>Modifications</p>	
<ul style="list-style-type: none"> ● ELL <ul style="list-style-type: none"> ○ Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ○ Audio books, movies, and other digital media in lieu of print versions ○ Native language texts and native language to English dictionary ● Gifted and Talented <ul style="list-style-type: none"> ○ Peer Tutoring ○ Cooperative Learning Groups ○ Differentiated Instruction ○ Use project-based science learning to connect science with observable phenomena. ○ Structure the learning around explaining or solving a social or community-based issue. 	<ul style="list-style-type: none"> ● Special Education and 504's <ul style="list-style-type: none"> ○ Modified assignments (ex: fewer problems per page) ○ Response to Intervention (RTI) (www.help4teachers.com) ○ Follow all IEP modifications/504 plan ○ Oral Instructions ○ Record lessons instead of taking notes ○ Outlines of lessons ○ Study Guides with answers ○ Word processor to type notes ○ Frequent breaks ○ Provide students with multiple choices for how they can represent their understanding (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Unit 5: Forensic Anthropology, Entomology, and the Manner, Mechanism, and Cause of Death

Est. Time to complete: 6 weeks

Cengage Book Chapters:

- Ch 14: Forensic Anthropology (2 wks)
- Ch 11: Forensic Entomology (1.5 wks)
- Ch 12: Death: Manner, Mechanism and Cause (2.5 wks)

NGSS Standards

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| <ul style="list-style-type: none"> ● HS-LS1-1 <ul style="list-style-type: none"> ○ Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. ● HS-LS1-2 <ul style="list-style-type: none"> ○ Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ● HS-LS1-4 <ul style="list-style-type: none"> ○ Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. | <ul style="list-style-type: none"> ● HS-ETS1-2 <ul style="list-style-type: none"> ○ Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● HS-PS1-5 <ul style="list-style-type: none"> ○ Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. ● HS-PS3-4 <ul style="list-style-type: none"> ○ Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system. |
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Science and Engineering Practices

- 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 trade-off considerations. (HS-ETS1-2)
- 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. (HS-LS1-2)
 - Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4)

Disciplinary Core Ideas

- ETS1.C: Optimizing the Design Solution
 - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)
- LS1.A: Structure and Function
 - Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
 - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)
 - Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- LS1.B: Growth and Development of Organisms
 - In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

Crosscutting Concepts

- Systems and System Models
 - Models (e.g., physical, mathematical, computer models) can be used to

simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-2)

- Systems and System Models
 - Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2),
- Structure and Function
 - Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

1. Summarize the information a forensic anthropologist derives from skeletal remains to construct a biological profile.
2. Distinguish among growth plates, bone caps, bone shafts and sutures, and explain their significance for forensic anthropology
3. Compare and contrast an adult's skeleton and a child's skeleton in terms of composition, number of bones, suture marks, and growth plates.
4. Apply knowledge of bone growth (ossification) to estimate the age of the deceased person at the time of death based on skeletal remains
5. Apply appropriate formulas to estimate the height of a person based on individual bone length
6. Distinguish between male and female skeletal remains based on the structure, the size and shape of the skull, pelvis, and the long bones
7. Provide examples of different types of skeletal trauma due to disease, injuries, occupation, or environmental factors that can provide clues to the identification of skeletal remains.
8. Discuss the significance of isotopes in determining where someone lived
9. Describe the methods used to analyze skeletal remains, including radiology, computer imaging, DNA technology, video or photographic superimposition, and craniofacial reconstruction.
10. Describe several examples of the ways that forensic entomology is used to help solve crimes.
11. Compare and contrast the four stages of blowfly metamorphosis, and describe the significance of blowflies in forensic entomology.
12. Describe the function of each of the following organs on blow flies and explain the significance of each structure to forensic entomology : spiracles, mouth hooks, crop.
13. Describe the effect of different environmental factors on insect development
14. Describe the five stages of decomposition
15. Explain how forensic entomologists interpret evidence and environmental conditions to estimate a postmortem interval

16. Relate the process of insect succession to the changing environment that occurs during the stages of decomposition
17. Explain how insect evidence is analyzed to provide evidence of the deceased person's identity or drug poison, or toxic exposure.
18. Summarize the procedure for documenting and collecting insect evidence from a crime scene.
19. Distinguish between cellular death and death of an organism
20. Distinguish among the four manners of death: natural, accidental, suicidal, and homicidal.
21. Distinguish among cause, manner and mechanism of death
22. Outline the sequence of events that occurs in the first few minutes after death.
23. Explain how algor, rigor, livor, and rigor mortis develop following death and describe how their development is affected by environmental factors.
24. Sequence and describe the chemical and physical changes during decomposition, including autolysis, putrefaction, marbling, and adipocere formation.
25. Analyze the evidence from algor, livor, and rigor mortis, stomach contents, and decomposition, along with environmental factors to estimate a postmortem interval
26. Compare and contrast the roles of medical examiners and coroners.
27. Describe the procedures of an autopsy, and give examples of how an autopsy helps establish the cause of death, manner of death, and postmortem interval
28. Support the claim that it is often difficult to pinpoint the post mortem interval.

Interdisciplinary Connections

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| <ul style="list-style-type: none"> ● ELA <ul style="list-style-type: none"> ○ RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. ● Mathematics <ul style="list-style-type: none"> ○ MP.4 Model with mathematics. ○ HSF.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ○ HSF.IF.C.8 Write a function that describes a relationship | <ul style="list-style-type: none"> ● World History <ul style="list-style-type: none"> ○ WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. ○ WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. ○ WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize |
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<p>between two quantities.</p>	<p>multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>
<p>21st century skills:</p> <ul style="list-style-type: none"> ● Critical thinking, Creativity, Collaboration, Communication, Information literacy, Media literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity, Social skills <p>Career Readiness Standards</p> <ul style="list-style-type: none"> ● 9.2.12.CAP.3: Investigate how continuing education contributes to one’s career and personal growth. ● 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans. 	
<p>Assessments</p>	
<ul style="list-style-type: none"> ● Formative <ul style="list-style-type: none"> ○ Exit tickets, check for understanding, lab activities ● Summative <ul style="list-style-type: none"> ○ Tests, quizzes, lab activities 	<ul style="list-style-type: none"> ● Alternative <ul style="list-style-type: none"> ○ Projects, labs ● Benchmark <ul style="list-style-type: none"> ○ Students should be able to identify the five stages of death, distinguish between male and female skeletal remains, and estimate time of death based upon insect morphology. ○ New Jersey Student Learning Assessment Science (NJSLA) ○ Quarterlies ○ Unit Test ○ Performance Assessments
<p>Modifications</p>	
<ul style="list-style-type: none"> ● ELL <ul style="list-style-type: none"> ○ Provide opportunities for students to connect with people of similar 	<ul style="list-style-type: none"> ● Special Education and 504’s <ul style="list-style-type: none"> ○ Modified assignments (ex: fewer problems per page)

<p>backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).</p> <ul style="list-style-type: none"> o Audio books, movies, and other digital media in lieu of print versions o Native language texts and native language to English dictionary <ul style="list-style-type: none"> ● Gifted and Talented <ul style="list-style-type: none"> o Peer Tutoring o Cooperative Learning Groups o Differentiated Instruction o Use project-based science learning to connect science with observable phenomena. o Structure the learning around explaining or solving a social or community-based issue. 	<ul style="list-style-type: none"> o Response to Intervention (RTI) (www.help4teachers.com) o Follow all IEP modifications/504 plan o Oral Instructions o Record lessons instead of taking notes o Outlines of lessons o Study Guides with answers o Word processor to type notes o Frequent breaks o Provide students with multiple choices for how they can represent their understanding (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
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<p>Unit 6: Evidence</p>	
<p>Est. Time to complete: 8 weeks</p>	<p>Cengage Book Chapters:</p> <ul style="list-style-type: none"> ● Ch 15: Glass Evidence (1.5 wks) ● Ch 16: Casts and Impressions (2.5 wks) ● Ch 17: Tool Marks (1.5 wks) ● Ch 18: Firearms and Ballistics (2.5 wks)
<p>NGSS Standards</p>	
<ul style="list-style-type: none"> ● HS-LS1-1 <ul style="list-style-type: none"> o Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. ● HS-PS1-2 <ul style="list-style-type: none"> o Construct and revise an 	<ul style="list-style-type: none"> ● HS-ETS1-2 <ul style="list-style-type: none"> o Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

explanation for the outcome of a simple chemical reaction based in the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Science and Engineering Practices

- 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 trade-off considerations. (HS-ETS1-2)
- 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. (HS-PS1-2)

Disciplinary Core Ideas

- ETS1.C: Optimizing the Design Solution
 - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)
- LS1.A: Structure and Function
 - Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
 - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)
- PS1.A: Structure and Properties of Matter
 - The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2)

Crosscutting Concepts

- Systems and System Models
 - Models (e.g., physical, mathematical, computer models) can be used to

simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.
(HS-ETS1-2)

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

Objective

1. Describe the 3 major components of glass.
2. Compare and contrast different types of glass and the information that can be gained from each..(soda glass, lead glass (crystal), heat-resistant glass, laminated glass, tempered glass, and bullet-resistant glass)
3. Calculate the density and estimate the refractive index of glass samples.
4. Distinguish between radial and concentric fractures.
5. Summarize and describe the information that can be gained by analyzing bullet holes in fractured glass.
6. Summarize the ways to determine whether 2 glass fragments are consistent.
7. Provide examples of how impression evidence provides clues about the crime scene, people at the scene, and events.
8. Provide well-supported arguments that evidence such as foot, shoe, and dental impressions can be considered class evidence.
9. Distinguish among latent, patent, and plastic impressions.
10. Summarize the significance of foot and shoe impression evidence, and outline procedures for collecting impression evidence from different surfaces.
11. Describe the features of tire impressions and skid marks and the information that they can provide.
12. Compare and contrast skid marks.
13. Summarize the methods used to produce an impression or cast.
14. Analyze impression evidence to determine if it is consistent with evidence from a crime scene.
15. Describe variations in tool surfaces that could be used to identify specific tools.
16. Compare and contrast the 3 major types of tool marks and provide examples of tools that produce those types of marks.
17. Provide examples fo foreign materials found on tool marks.
18. Analyze and process a crime scene at which tools were used to commit the crime.
19. Justify the claim that tool-mark evidence is usually considered circumstantial evidence.
20. Discuss the role of technology in analysis of tools and tool marks.
21. Compare and contrast the different types of firearms, including handguns, rifles, and shotguns.
22. Put in order the sequence of events that result in a firearm discharging.
23. Estimate the trajectory of a projectile.

- 24. Discuss the composition and formation of gunshot residue and its reliability as a form of evidence.
- 25. Compare and contrast entrance and exit wounds.
- 26. Distinguish among the various forms of firearms evidence. (rifling, tool marks, gunshot residue)
- 27. Discuss how technology has improved the ability to obtain, compare, analyze, store, and retrieve firearms and ballistics evidence.
- 28. Process a crime scene for firearm or ballistics evidence.

Interdisciplinary Connections

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21st century skills:

- Critical thinking, Creativity, Collaboration, Communication, Information literacy, Media literacy, Technology literacy, Flexibility, Initiative, Productivity

Career Readiness Standards

- 9.2.12.CAP.3: Investigate how continuing education contributes to one’s career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.

Assessments

- | | |
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| <ul style="list-style-type: none"> ● Formative <ul style="list-style-type: none"> ○ Exit tickets, check for understanding, lab activities ● Summative <ul style="list-style-type: none"> ○ Tests, quizzes, lab activities | <ul style="list-style-type: none"> ● Alternative <ul style="list-style-type: none"> ○ Projects, labs ● Benchmark <ul style="list-style-type: none"> ○ Students should be able to use fracture patterns to |
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	<p>identify the direction from which a bullet entered glass, match tool marks to their tools, and make a cast of a plastic impression.</p> <ul style="list-style-type: none"> ○ New Jersey Student Learning Assessment Science (NJSLA) ○ Quarterlies ○ Unit Test ○ Performance Assessments
<p>Modifications</p>	
<ul style="list-style-type: none"> ● ELL <ul style="list-style-type: none"> ○ Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ○ Audio books, movies, and other digital media in lieu of print versions ○ Native language texts and native language to English dictionary ● Gifted and Talented <ul style="list-style-type: none"> ○ Peer Tutoring ○ Cooperative Learning Groups ○ Differentiated Instruction ○ Use project-based science learning to connect science with observable phenomena. ○ Structure the learning around explaining or solving a social or community-based issue. 	<ul style="list-style-type: none"> ● Special Education and 504's <ul style="list-style-type: none"> ○ Modified assignments (ex: fewer problems per page) ○ Response to Intervention (RTI) (www.help4teachers.com) ○ Follow all IEP modifications/504 plan ○ Oral Instructions ○ Record lessons instead of taking notes ○ Outlines of lessons ○ Study Guides with answers ○ Word processor to type notes ○ Frequent breaks ○ Provide students with multiple choices for how they can represent their understanding (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).