Fairfield Public Schools
Science Curriculum

Draft Units

Forensics I: Never Gone Without a Trace
Forensics II: You Can't Fake the Prints

DRAFT November 2016

Forensics I and Forensics II: Description

Crime Scene Forensics, which is a laboratory-based course, will promote and cultivate the development of student's scientific inquiry and scientific method skills, which are important critical thinking skills. Crime Scene Forensics applies concepts and skills acquired in grades nine and ten to look at the criminal justice area. This course focuses on problem solving, with an emphasis on writing, using experimentation and evidence based conclusions. Students will write reports that record their results, conclusions and analyses of case studies and investigations. Students will participate in hands-on laboratory exercises that require lengthy laboratory procedures with many recently developed techniques for analyzing evidence, crime scenes, blood/body fluids, trace evidence. The course is laboratory driven and requires students to use advanced tools and equipment in addition to excellent observation skills.

Crime Lab Forensics, which is a laboratory-based course, will promote and cultivate the development of student's scientific inquiry and scientific method skills, which are important critical thinking skills. Crime Lab Forensics applies concepts and skills acquired in grades nine and ten to look at the criminal justice area. This course focuses on problem solving, with an emphasis on writing, using experimentation and evidence based conclusions. Students will write reports that record their results, conclusions and analyses of case studies and investigations. Students will participate in hands-on laboratory exercises that require lengthy laboratory procedures with many recently developed techniques for DNA extraction, DNA fingerprinting by gel electrophoresis, molecular DNA probes, protein analysis, PCR, sequencing, bioinformatics, drug and toxicology testing,impressions, handwriting and document analysis, forensic anthropology and ethics. The course is laboratory driven and requires students to use advanced tools and equipment in addition to excellent observation skills.

CROSS CUTTING CONCEPTS

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.

Forensics I and Forensics II

Course Essential Questions
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Course: Year-at-a Glance

Unit	Title		Unit Essential Questions
1	Intro to Forensics	Introduction to Forensics and the Law Evidence Crime Scene	What is the breadth of knowledge required for a career in science? How is the integrity of data/evidence preserved? How is media portrayal of forensics science incomplete, misleading or inaccurate? How is scientific knowledge created and communicated?
2	Trace Evidence	Hair Fibers Blood	How can hairs be characterized and analyzed microscopically? How can fibers be characterized and analyzed microscopically? How is blood evidence interpreted?
3	Biotechnology	DNA testing Toxicology	How can forensic science use DNA for identification purposes using DNA fingerprinting? How is toxicology used in forensic cases in terms of exposure, factors determining degree of harm and methods to test for toxic substances?
4	Human Prints and Impressions	Impressions Remains Questioned Documents	In what ways are human prints developed, stored and used in solving crimes? How is skeletal evidence used in the reconstruction of a person's life and death? What are some distinguishing characteristics of handwriting and forgery?

Unit 1

Overview

Forensics is relating the application of scientific knowledge to legal questions. Students will learn to accurately and without bias observe, interpret, and report observations as they apply to legal questions.

Unit Content Objectives

- Describe the the applications of forensics.
- Describe the relationship of science, forensics and the law.
- Explain forensic practices using specific court cases throughout the course.
- Discuss the importance of the work of various forensics pioneers.
- Discuss the careers that contribute to the field of forensics.
- Discuss the "CSI effect" on the field of forensics.
- Explain the importance of Locard's "Exchange Principle" of evidence.
- Describe the different types of evidence.(material vs. probative, testimonial vs. physical, class vs. individual)
- Contrast criminal vs civil laws.
- Explain the Federal rules of evidence including the Frye standard and the Daubert ruling.
- Describe the rules of search and seizure. (Mincey vs Arizona, search warrants, Miranda rights)
- Explain the reasons for isolation and protecting a crime scene from the outside contamination.
- Explain the importance of the "chain of evidence"
- Explain the steps for thoroughly recording the crime scene.
- Describe the proper procedures for conducting a systematic search of a crime scene for physical evidence.
- Differentiate between primary and secondary crime scene.

Unit Essential Questions

What is the breadth of knowledge required for a career in science?
How is the integrity of data/evidence preserved?
How is media portrayal of forensics science incomplete, misleading or inaccurate?
How is scientific knowledge created and communicated?

Crosscutting Concepts

- Cause and Effect
- Science is a Human Endeavor
- Influence of Science, Engineering and Technology on Society and the Natural World

NGSS Standards

HS-ETS1-1
HS ETS1-3

SCIENCE AND ENGINEERING PRACTICES (SEP):

- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Using Mathematical and Computational Thinking
- Analyzing and Interpreting Data
- Obtaining, Evaluating, and Communicating Information
- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Corresponding CT Core Standards:
Corresponding CT Core Standards:
ELA/Literacy –
RST .11-12.1, WHST .9-12.2, WHST .9-12.9, SL.11-12.4, RST .11-12.8, WHST .9-12.5
Mathematics –
MP.2 , MP.4

Unit 2

Overview

Trace evidence is a broad category and in this unit students will focus on hair, fiber and blood evidence. Students will develop an understanding of how to correctly use compound light microscopes. Students will learn how to collect and analyze hair and determine whether is it from a human or other animal. They will learn how to collect and analyze fibers, including their source. Student will learn how to test whether a substance is blood and if it is human blood or from another animal. Lastly, students will learn how blood typing is utilized and how blood spatter can give details about a crime.

Unit Content Objectives

Students will be able to:

- **identify the different types of trace evidence.**
- **describe the parts of a hair.**
- **determine whether hair is from a human or other animal.**
- **explain the lack of evidentiary value in hair comparisons.**
- **evaluate the basic types of fibers in use today.**
- **contrast natural and synthetic fibers.**
- **describe the various components of blood, and the evidence each part contains.**
- **outline methods used to identify an unknown substance as blood.**
- **outline methods used to identify blood as human or another animal.**
- **describe different blood stain patterns based on source, direction, and angle of trajectory.**

Unit Essential Questions

- How does the structure of matter affect the properties and uses of materials?
- How do science and technology affect the quality of our lives?
- What chemical and physical tests are used in analyzing trace evidence?
- How are organisms structured to ensure efficiency and survival?
- In what ways does serological evidence aid in solving crime?

Crosscutting Concepts

- Systems and System Models

- Structure and Function

NGSS Unit Standards

HS-LS1-2
HS-LS3-3

DISCIPLINARY CORE IDEAS (DCI):

- Structure and Function
- Inheritance of Traits

SCIENCE AND ENGINEERING PRACTICES (SEP):

- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Planning and Carrying out Investigations
- Using Mathematics and Computational Thinking
- Engaging in Argument from Evidence
- Asking Questions and Defining Problems
- Analyzing and Interpreting Data
- Obtaining, Evaluating and Communicating Information

Corresponding CT Core Standards:

ELA/Literacy –

RST .11-12.1, RST .11-12.9, WHST .9-12.2, WHST .9-12.7, WHST .9-12.1, WHST .11-12.8, WHST .9-12.9, SL.11-12.5, WHST.9-12.5.

Mathematics –

MP.2, MP.4 , HSF-IF.C.7, HSF-BF.A.1

Unit 3

Overview

DNA is an essential element of forensic science. Students will learn where a DNA sample can be obtained from a person and how to extract the DNA from cells. Students will learn about processes used to amplify small samples of DNA. Students will learn about how DNA fingerprints are made and be able to make matches between DNA samples from the same individual. Toxicology is used by forensic scientists to identify exposure of drugs and/or poisons. Students will investigate the different ways in which someone can be exposed to a toxic substance, factors that determine how harmful the substance will be and methods used to test for the toxic substance.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- identify where within a body DNA can be found.
- distinguish between the forensic usefulness of nuclear DNA vs. mitochondrial DNA.
- explain the importance of various DNA markers to criminal investigations.
- describe the methods of DNA collection, amplification, and analysis.
- describe the function and purpose of a restriction enzyme.
- explain the purpose of DNA databases and identify whose DNA is collected.
- extract DNA from cells and carry create and interpret DNA fingerprints.
- identify types of toxins and their sources of exposure.
- describe the factors that determine the degree to which a substance is poisonous.
- describe the several types of screening and confirmatory tests for drugs and alcohol.
- explain several examples of the equipment and tests used by forensic scientists in identifying toxins.

Unit Essential Questions

- How can forensic science use DNA for identification purposes using DNA fingerprinting?
- How is toxicology used in forensic cases in terms of exposure, factors determining degree of harm and methods to test for toxic substances?

Crosscutting Concepts

- Systems and System Models
- Structure and Function
- Cause and Effect

- Scale, Proportion, and Quantity

NGSS Unit Standards

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.)

LS3.A : Inheritance of Traits

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA . The instructions for forming species' characteristics are carried in DNA . A ll cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)

LS3.B: Variation of Traits

- 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. (HS-LS3-2)
- Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)

LS4.A : Evidence of Common Ancestry and Diversity

- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

DISCIPLINARY CORE IDEAS (DCI):
SCIENCE AND ENGINEERING PRACTICES (SEP):

- Engaging in Argument from Evidence
- Analyzing and Interpreting Data
- Asking Questions and Defining Problems

Corresponding CT Core Standards:
ELA/Literacy –
RST .11-12.1, RST .11-12.9, WHST .9-12.1
Mathematics –
MP.2

Unit 4

Overview

Human prints and impressions are valuable pieces of evidence analyzed and observed in the field of forensic science. Students will be able to analyse remains in order to determine time and cause of death. Student will also identify remains left behind and the determine origin which they are derived from: gender, age, and race. Students will also be analyzing various print impressions to identify the origin by identifying and categorizing the characteristics and traits of the impressions being analyzed.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- Identify skin anatomy, physiology, and development as related to fingerprints.
- Collect fingerprint evidence, compare fingerprints to determine match and identify own fingerprints.
- discuss the different types of prints that can be used to identify an individual: finger, lip, foot
- describe the types of fingerprints found: latent, plastic, visible.
- describe the nature of an autopsy, death, and decomposition.
- explain how determining time of death relates to decomposition.
- explain how to determine the cause of an injury and death.
- distinguish between gender, race, and age based on skeletal structure.
- describe how bones contain record of disease and injury.
- Identify technology used in handwriting analysis and technologies to prevent forgery and counterfeiting
- identify examples of 12 points of handwriting analysis.
- Analyze handwriting samples to determine a match.

Unit Essential Questions

- In what ways are human prints developed, stored and used in solving crimes?
- How is skeletal evidence used in the reconstruction of a person's life and death?
- What are some distinguishing characteristics of handwriting and forgery?

Crosscutting Concepts

- Stability and Change
- Structure and Function
- Systems and System Models
- Cause and Effect
- Scale, Proportion, and Quantity

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

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)

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.

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.

SCIENCE AND ENGINEERING PRACTICES (SEP):

- Engaging in Argument from Evidence
- Constructing Explanations and Designing Solutions
- Scientific Knowledge is Open to Revision in Light of New Evidence
- Using Mathematical and Computational Thinking
- Developing and Using Models

Corresponding CT Core Standards:

ELA/Literacy –
RST.11-12.7 , RST.11-12.8, RST.11-12.9

Mathematics –
MP.2, MP.4, HSN-Q.A.1, HSN-Q-A.3