

Curriculum Development
In the Fairfield Public Schools

Fairfield Public Schools
FAIRFIELD, CONNECTICUT

CRIME LAB FORENSICS

BOE Approved 05/12/2009

CRIME LAB FORENSICS

Statement of Purpose

Science education promotes essential understandings of the natural world and nurtures students' abilities to apply scientific knowledge as seen through a lens from both a personal and societal perspective. As such, this education requires that the fundamental approach to science be a creative and logical process for investigating, reasoning, critiquing and communicating about ideas, not just a static body of facts to be memorized. Understanding the interconnections between science and technology and their shared impact on the environment and societal issues is essential for all students.

Audience

Grade 11 or 12 students

Prerequisites

Successful completion of 4 credits of science including Biology

Design and Description

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, handwriting and document analysis, arson investigation and ethics. The course is laboratory driven and requires students to use advanced tools and equipment in addition to excellent observation skills.

Course Objectives

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 applications of Polymerase Chain Reaction (PCR) technology in forensics.
- analyze the use of molecular DNA probes in DNA fingerprinting.
- explain the purpose of DNA databases and identify whose DNA is collected.
- describe the nature of death and decomposition.
- explain how determining time of death relates to decomposition.
- discuss the role of insects in determining the time of death.
- explain how to determine the cause of an injury and death.

- identify the parts of a skeleton that can help determine age, gender, and race.
- describe the nature of an autopsy.
- describe the role of a Forensic Anthropologist.
- identify and give examples of 5 classes of controlled substances.
- identify types of toxins and their sources of exposure.
- describe the factors that determine the degree to which a substance is poisonous.
- describe the types of screening tests for drugs and alcohol.
- explain the equipment and tests used by forensic scientists in identifying toxins.
- describe how to determine a fire's point of origin.
- summarize the techniques used to determine how the fire started.
- explain how samples from a crime scene are collected.
- describe how samples are analyzed to identify the presence and type of accelerants.
- classify different types of explosives.
- describe bomb scene protocol and evidence collection.
- classify various types of document evidence.
- identify examples of 12 points of handwriting analysis.
- identify ways for businesses to prevent check forgery.
- describe methods use to detect art forgery.

Skill Objectives

Students will:

- isolate and extract DNA from cells.
- use lab equipment associated with gel electrophoresis.
- compare and analyze DNA samples using gel electrophoresis.
- calculate probabilities of identity using short tandem repeats (STR).
- analyze a DNA fingerprint to determine family relationships and match unknowns.
- apply methods of identification using a skeleton: teeth, gender, age, and race and the limits of such determination.
- estimate the height of a victim.
- perform paper chromatography.
- perform drug and alcohol screening tests.
- find point of origin.
- use techniques to determine how a fire started.
- collect evidence at crime scene.
- identify methods for accelerants/explosives.
- characterize his/her own handwriting using 12 points of analysis.
- detect deliberately disguised handwriting by examining documents.
- identify the safeguards against counterfeiting of US currency.

Core Standards

Scientific Inquiry

Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.

Students will use appropriate tools and techniques to make observations and gather data.

Chemical Structures and Properties - Science and Technology in Society

Chemical technologies present both risks and benefits to the health and well-being of humans, plants and animals.

The products of chemical technologies include synthetic fibers, pharmaceuticals, plastics, and fuels.

Cell Chemistry and Biotechnology – Science and Technology in Society

Microorganisms have an essential role in life processes and cycles on Earth.

Students will describe the similarities and differences between bacteria and viruses.

Biology Enrichment Standards

Genetics

The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation and transformation) is used to construct recombinant DNA molecules.

Ecology

Stability in an ecosystem is a balance between competing effects.

A vital part of an ecosystem is the stability of its producers and decomposers.

Physiology

As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.

The nervous system mediates communication between different parts of the body and the body's interactions with the environment.

Chemistry Enrichment Standards

Atomic and Molecular Structure

The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure

The electronic configuration of elements and their reactivity can be identified based on their position in the periodic table.

Information and Technology Standards (to be added)

Essential Questions

- What processes are responsible for life's unity and diversity?
- How do materials cycle through the Earth's systems?
- How do science and technology affect the quality of our lives?
- How are organisms structured to ensure efficiency and survival?
- How does the structure of matter affect the properties and uses of materials?
- How is scientific knowledge created and communicated?

Focus Questions

- How is DNA analyzed and when is each method of DNA analysis used?
- Why are molecular probes used to develop a DNA fingerprint?
- How is a small sample of DNA used to produce billions of identical copies?
- How is skeletal evidence used in the reconstruction of a person's life and death?
- How do we detect and identify poisons and toxins in humans?
- How do we determine if a fire is caused by arson?
- How are explosives identified before and after a blast?
- What are some distinguishing characteristics of handwriting and forgery?
- What kind of precautions are in place to prevent document fraud?

UNITS OF STUDY

Unit 1: DNA Evidence

Biology Enrichment Standards

Genetics

The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation and transformation) is used to construct recombinant DNA molecules.

Essential Question

What processes are responsible for life's unity and diversity?

Focus Questions

- How is DNA analyzed and when is each method of DNA analysis used?
- Why are molecular probes used to develop a DNA fingerprint?
- How is a small sample of DNA used to produce billions of identical copies?

Core Topics

- DNA structure and function
- Nuclear DNA vs. mitochondrial DNA
- DNA separation techniques
- PCR
- DNA Databases - CODIS

Unit Objectives

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 applications of Polymerase Chain Reaction (PCR) technology in forensics.
- analyze the use of molecular DNA probes in DNA fingerprinting.
- explain the purpose of DNA databases and identify whose DNA is collected.

Skill Objectives

Students will:

- isolate and extract DNA from cells.
- use lab equipment associated with gel electrophoresis.
- compare and analyze DNA samples using gel electrophoresis.

- calculate probabilities of identity using short tandem repeats (STR).
- analyze a DNA fingerprint to determine family relationships and match unknowns.

Sample Assessments

- Romanov Family Mystery - DNA
- DNAi.org
- Gel electrophoresis

Pacing

4 weeks

Unit 2: Forensic Pathology

Core Standards

Cell Chemistry and Biotechnology – Science and Technology in Society

Microorganisms have an essential role in life processes and cycles on Earth.

Students will describe the similarities and differences between bacteria and viruses.

Biology Enrichment Standards

Ecology

Stability in an ecosystem is a balance between competing effects.

A vital part of an ecosystem is the stability of its producers and decomposers.

Essential Questions

- How do materials cycle through the Earth's systems?
- How do science and technology affect the quality of our lives?

Focus Question

How is skeletal evidence used in the reconstruction of a person's life and death?

Core Topics

- Time of death determination methods
- Skeletal identification by age, gender, and race

Unit Objectives

Students will be able to:

- describe the nature of death and decomposition.
- explain how determining time of death relates to decomposition.
- discuss the role of insects in determining the time of death.
- explain how to determine the cause of an injury and death.
- identify the parts of a skeleton that can help determine age, gender, and race.
- describe the nature of an autopsy.
- describe the role of a Forensic Anthropologist.

Skill Objectives

Students will:

- apply methods of identification using a skeleton: teeth, gender, age, and race and the limits of such determination.
- estimate the height of a victim.

Sample Assessments

- Autopsy of Fetal Pig
- Romanov Family Mystery – bones
- Sherlock Bones

Pacing
3.5 weeks

Unit 3: Toxicology

Core Standards

Chemical Structures and Properties - Science and Technology in Society

Chemical technologies present both risks and benefits to the health and well-being of humans, plants and animals.

The products of chemical technologies include synthetic fibers, pharmaceuticals, plastics, and fuels.

Biology Enrichment Standards

Physiology

As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.

The nervous system mediates communication between different parts of the body and the body's interactions with the environment.

Essential Questions

- How are organisms structured to ensure efficiency and survival?
- How do science and technology affect the quality of our lives?

Focus Question

How do we detect and identify poisons and toxins in humans?

Core Topics

- Classes of controlled substances
- Organic and inorganic toxins
- Factors affecting toxicity
- Methods for chemical identification

Unit Objectives

Students will be able to:

- identify and give examples of 5 classes of controlled substances.
- identify types of toxins and their sources of exposure.
- describe the factors that determine the degree to which a substance is poisonous.
- describe the types of screening tests for drugs and alcohol.
- explain the equipment and tests used by forensic scientists in identifying toxins.

Skill Objectives

Students will:

- perform paper chromatography.
- perform drug and alcohol screening tests.

Sample Assessments

- Analysis of Drugs and Poisons Lab
- Poisoning Project

Pacing
3 weeks

Unit 4: Arson and Explosives Investigation

Chemistry Enrichment Standards

Atomic and Molecular Structure

The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure

The electronic configuration of elements and their reactivity can be identified based on their position in the periodic table.

Essential Question

How does the structure of matter affect the properties and uses of materials?

Focus Questions

- How do we determine if a fire is caused by arson?
- How are explosives identified before and after a blast?

Core Topics

- Explosive types
- Bomb scene protocol
- Fire/explosives
- Accelerant/explosives

Unit Objectives

Students will be able to:

- describe how to determine a fire's point of origin.
- summarize the techniques used to determine how the fire started.
- explain how samples from a crime scene are collected.
- describe how samples are analyzed to identify the presence and type of accelerants.
- classify different types of explosives.
- describe bomb scene protocol and evidence collection.

Skill Objectives

Students will:

- find point of origin.
- use techniques to determine how a fire started.
- collect evidence at crime scene.
- identify methods for accelerants/explosives.

Sample Assessment

Flight 103 Investigation

Pacing

2 weeks

Unit 5: Handwriting and Document Analysis

Core Standards

Scientific Inquiry

Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.

Students will use appropriate tools and techniques to make observations and gather data.

Essential Question

How is scientific knowledge created and communicated?

Focus Questions

- What are some distinguishing characteristics of handwriting and forgery?
- What kind of precautions are in place to prevent document fraud?

Core Topics

- Types of document evidence
- Handwriting examination and comparison
- Counterfeiting
- Non-handwriting document examination

Unit Objectives

Students will be able to:

- classify various types of document evidence.
- identify examples of 12 points of handwriting analysis.
- identify ways for businesses to prevent check forgery.
- describe methods use to detect art forgery.

Skill Objectives

Students will:

- characterize his/her own handwriting using 12 points of analysis.
- detect deliberately disguised handwriting by examining documents.
- identify the safeguards against counterfeiting of US currency.

Sample Assessments

- Examination of US currency - Is it real?
- Detection of art forgery

Pacing

3 weeks