

Ledyard Public Schools  
Science Curriculum

# Forensic Science

1480

Instructional Council Approval May 15, 2003

# Forensic Science

## General Curriculum

Note: This curriculum is designed to be a dynamic document. The field of forensic science, a combination of many disciplines, is so vast with so many specialties that these units represent only some of the possible areas of study. While some units are required others may be chosen based on the interest and expertise of the instructor. Still other units may be developed and added to the curriculum with approval of the department chairman based on the general curriculum presented here. All units use this general format.

**Suggested Time:** 6-10 class periods per unit

**Essential question** How is evidence processed and analyzed and used in a court of law?

### **Focus Questions**

1. What is the scientific background behind this evidence?

**Learning Objectives :**The Student will

- a. examine the scientific basis and concepts relative to the type of forensic evidence under study.
- b. apply the scientific concepts to the use of this evidence.

2. What are the characteristics of this evidence in relation to actions, individuals and/or populations?

**Learning Objectives: The** Student will

- a. determine how this evidence can provide predictions of the actions that created it; and/or
- b. assess how this evidence may indicate certain individuals or populations.

3. How is evidence collected, identified and analyzed?

**Learning Objectives :**The Student will

- a. list, identify or explain the procedures for the collection of this type of evidence.
- b. classify and analyze the variations in this type of evidence.

4. What is the controversy surrounding the use of this type of evidence?

**Learning Objectives :**The Student will

- a. evaluate the issues regarding the use of this type of evidence
- b. assess the validity of the basis, collection and use of this evidence

### **Required Units**

Blood

DNA

Fingerprinting

### **Additional Units – The instructor should choose at least 1**

Anthropology

Pathology/Entomology

Toxicology & Forensic Chemistry

# Blood

**Suggested Time:** Approximately 9-10 class periods

**Essential Question**

How is blood evidence analyzed and used in a court of law?

**Focus Questions**

1. What are the characteristics of Blood?

**Learning Objectives – The Student will be able to:**

- a. classify blood according to antigens.
- b. use antibodies (antiserum) to determine blood type of an unknown sample.
- c. determine whether an individual is Rh positive or Rh negative.

2. What are the characteristics of Blood evidence?

**Learning Objectives – The Student will be able to:**

- a. determine the percent of the human population with a particular blood type.
- b. determine the relationship between height and the diameter of a blood drop.
- c. determine the relationship between angle of incidence and width to length ratio of a blood drop.
- d. distinguish between low and high velocity blood spatter.
- e. explore examples of types of events that could lead to specific blood stain patterns.

3. How is Blood Evidence collected, identified and analyzed?

**Learning Objectives – The Student will be able to:**

- a. explore the characteristics of blood spatters.
- b. determine if a substance is blood.
- c. determine if blood is human.

4. What is the Controversy regarding the use of blood evidence?

**Learning Objectives – The Student will be able to:**

- a. discuss the use of blood evidence in the courtroom.

### Assessment:

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

### Required Activities

The following **types** of laboratory activities are required. Titles in parentheses are suggested and lab procedures for these activities are available.

Blood Typing (Mock blood typing)

Blood Spatters (Mock blood spatter interpretation)\*\*\*\*\*

\*\*\*This activity will address the Ledyard Academic Expectation for problem-solving

### Resources

**Student:** LHS Forensic Science Textbook (Montgomery/Schneider)

**Teacher:** LHS Forensic Science Textbook (Montgomery/Schneider)  
**Blood Dynamics** , A. Y. Wonder 2001, Academic Press  
**Forensic Laboratory Science and Detective Mystery Writing**  
Gary Schiltz, 1994 , Flinn Scientific, Inc.  
Sam Shepherd video *The Killer's Trail*

### **Curriculum Alignment with State of Connecticut Science Standards** **All areas address State Standards for Scientific Inquiry, Literacy and Numeracy**

| Focus Questions             | Content Standard | Supportive Concepts         |
|-----------------------------|------------------|-----------------------------|
| 1. Characteristics of Blood | B5               | B(47, 53, 54)               |
| 2. Blood Evidence           | SILN, P1, P2     | DINQ8, P(2, 3, 4, 5, 7, 12) |
| 3. Analyzing Blood Evidence | SILN             | DINQ6                       |
| 4. Blood Evidence use       | SILN             | DINQ2                       |

# DNA

**Suggested Time:** Approximately 6-8 class periods

**Essential Question**

How is DNA evidence analyzed and used in a court of law?

**Focus Questions**

1. What are the characteristics of DNA?

**Learning Objectives:** The Student will be able to:

- a. characterize the structure of DNA.
- b. discuss what makes each person's DNA unique.
- c. discuss how and why DNA controls our traits.

2. What are the characteristics of DNA evidence?

**Learning Objectives:** The Student will be able to:

- a. discuss various uses of DNA evidence in forensic science.
- b. demonstrate the general process for extracting, slicing and separating fragments of DNA
- c. discover how the target frequency of an allele is determined.
- d. determine combined error frequencies of various DNA loci.
- e. differentiate between nuclear and mitochondrial DNA.

3. How is DNA evidence collected, identified and analyzed?

**Learning Objectives:** The Student will be able to:

- a. determine where to look for DNA at a crime scene.
- b. demonstrate the protocol to collect DNA at a crime scene.
- c. differentiate between PCR and RFLP methods of analyzing DNA in forensic science.
- d. determine the importance of mitochondrial DNA.

4. What is the controversy surrounding the use of DNA evidence in the courtroom?

**Learning Objectives:** The Student will be able to:

- a. determine the degree of accuracy that DNA can be attributed to one individual.
- b. determine the validity issues surrounding the use of DNA testimony.
- c. explore the importance of CODIS in cases related to DNA.
- d. discuss the validity issues and controversy surrounding the use of DNA in courtroom testimony.

### **Assessment:**

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

### **Required Activities**

The following types of laboratory activities are required. Titles in parentheses are suggested and lab procedures for these activities are available.

DNA electrophoresis using dyes or *DNA Detectives* computer lab  
Interpreting autorads in relation to various types of cases

### **Resources**

**Student:** LHS Forensic Science Textbook (Montgomery/Schneider)  
**DNA Detectives** computer lab (Class Set of 12)

**Teacher:** LHS Forensic Science Textbook (Montgomery/Schneider)  
**DNA in the Courtroom**, Howard Coleman and Eric Swenson, 1994, GeneLex  
**Forensics- Searching for Clues**, James Sutton, 1997, Kemtec

### **Curriculum Alignment with State of Connecticut Science Standards** **All areas address State Standards for Scientific Inquiry, Literacy and Numeracy**

| Focus Questions           | Content Standard | Supportive Concepts       |
|---------------------------|------------------|---------------------------|
| 1. Characteristics of DNA | B2A, B, C, D     | B(13, 14, 21, 24, 26, 28) |
| 2. DNA Evidence           | SILN, B2A        | DINQ8, B(13)              |
| 3. Analyzing DNA Evidence | SILN             | DINQ6                     |
| 4. DNA Evidence use       | SILN             | DINQ2                     |

# Fingerprinting

**Suggested Time:** Approximately 7-9 class periods

**Essential Question**

How are fingerprints analyzed to allow them to be used in a court of law?

**Focus Questions**

1. What are the characteristics of Fingerprints?

**Learning Objectives:** The Student will be able to:

- a. explore the history of the use of fingerprints in forensic science.
- b. discuss the identification of individuals before fingerprint evidence.
- c. determine how fingerprints are formed.

2. What are the characteristics of Fingerprint evidence?

**Learning Objectives:** The Student will be able to:

- a. discuss the principles that make fingerprints useful for identifying individuals.
- b. classify fingerprints according to pattern.
- c. determine ridge counts of loop fingerprints.
- d. determine primary classification of individuals when all prints are known.

3. How are Fingerprints collected, identified and analyzed?

**Learning Objectives:** The Student will be able to:

- a. demonstrate techniques for treating latent prints and lifting prints.
- b. demonstrate how invisible prints are made visible.
- c. assess the importance of AFIS to forensic scientists.
- d. determine how fingerprints are found at a crime scene.
- e. determine how detectives know which fingerprints are related to the crime.

4. What is the controversy surrounding the use of Fingerprint evidence in the courtroom?

**Learning Objectives:** The Student will be able to:

- a. discuss the use of the fingerprint evidence in the courtroom.
- b. evaluate the controversy surrounding the validity of fingerprint evidence.

### **Assessments:**

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

### **Required Activities**

The following types of laboratory activities are required. Titles in parentheses are suggested and lab procedures for these activities are available.

Classification of various fingerprints according to pattern  
Treating latent prints using various techniques

### **Resources**

**Students:** LHS Forensic Science Textbook (Montgomery/Schneider)  
Police fingerprint cards

**Teacher:** LHS Forensic Science Textbook (Montgomery/Schneider)  
CT State Police Handbook on Fingerprint Training

### **Curriculum Alignment with State of Connecticut Science Standards** **All areas address State Standards for Scientific Inquiry, Literacy and Numeracy**

| Focus Questions             | Content Standard | Supportive Concepts    |
|-----------------------------|------------------|------------------------|
| 1. Fingerprinting           | SILN             | DINQ.2, DINQ.10        |
| 2. Fingerprint Evidence     | SILN             | DINQ8, DINQ.2, DINQ.10 |
| 3. Analyzing the Evidence   | SILN             | DINQ6, DINQ.2, DINQ.10 |
| 4. Fingerprint Evidence use | SILN             | DINQ.2, DINQ.10        |



# Anthropology

**Suggested time:** Approximately 7-9 class periods

## **Essential Questions**

1. How can bones help determine the identity of an individual?
2. How can skull and facial reconstructions help determine the identity of an individual?

## **Focus Questions**

1. What are the characteristics of Bones as applied to Forensic Anthropology?

**Learning Objectives:** The Student will be able to:

- a. distinguish human and nonhuman bones using the epiphyses of long bones and cortex and osteons of bones.
- b. distinguish male and female skeletons based on sexual dimorphism in the pelvis, long bones and skulls.
- c. distinguish general ages of skeletons based on differences in epiphyseal fusion, presence of cartilage, dentition, skulls, joints and ribs.
- d. distinguish among the three general races of skeletons based on differences in skulls, hair and femurs.
- e. determine the height of an individual using long bones and algebraic equations
- f. determine the general weight, physique and possible occupation of an individual based on skeletal characteristics.
- g. determine the handedness of an individual based on skeletal characteristics.

2. What are the characteristics of bone trauma?

**Learning Objectives:** The Student will be able to:

- a. distinguish between peri, ante and postmortem trauma to bones
- b. determine general PMI based on general characteristics of a skeleton

3. How is Anthropological evidence collected, identified and analyzed?

**Learning Objectives:** The Student will be able to:

- a. outline the general procedure for collecting bone evidence.
- b. explore how facial reconstructions are done using a skeleton.
- c. construct 2-dimensional drawings of an individual
- d. determine basic racial, gender and age characteristics of a skull.
- e. determine age progressions.

4. What is the controversy surrounding the use of Anthropological evidence in the courtroom?

**Learning Objectives:** The Student will be able to:

- a. explore cases where forensic anthropologists are used
- b. discuss the use of Anthropological evidence in the courtroom.
- c. discuss the importance of Bill Bass's Body Farm to forensic anthropologists.

### **Assessment:**

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

### **Required Activities**

The following types of laboratory activities are required. Titles in parentheses are suggested and lab procedures for these activities are available.

Determining heights of individuals using long bones and algebraic equations  
Observing post-traumatic trauma to bones  
Practicing composite drawings of suspects

### **Resources**

**Students:** LHS Forensic Science Textbook (Montgomery/Schneider)

**Teacher:** LHS Forensic Science Textbook (Montgomery/Schneider)

#### **Curriculum Alignment with State of Connecticut Science Standards** **All areas address State Standards for Scientific Inquiry, Literacy and Numeracy**

| Focus Questions            | Content Standard | Supportive Concepts         |
|----------------------------|------------------|-----------------------------|
| 1. Characteristics of Bone | B5               | 47                          |
| 2. Bone Evidence           | SILN, P1, P2     | DINQ8, P(2, 3, 4, 5, 7, 12) |
| 3. Analyzing the Evidence  | SILN             | DINQ6, DINQ.2, DINQ.10      |
| 4. Bone Evidence use       | SILN             | DINQ.2, DINQ.10             |

# Pathology / Entomology

**Suggested Time:** Approximately 8-11 class periods

## **Essential Question**

What information can insects provide that can be used in a court of law?

## **Focus Questions**

1. What is Forensic Pathology?

**Learning Objectives:** The Student will be able to:

- a. explain the function of a forensic pathologist and entomologist.
- b. determine when and why autopsies are performed.

2. What information can a Forensic Pathologist provide?

**Learning Objectives:** The Student will be able to:

- a. determine the basic classification and life cycle of insects.
- b. discuss some examples of how cause of death is determined.
- c. estimate PMI using body temperature and rigor mortis.
- d. determine what causes and factors that affect the rate of rigor mortis.
- e. discuss stages of decay in a body and what happens physiologically after death.
- f. distinguish among three types of death: necrobiosis, necrosis and somatic death.
- g. observe and discuss the factors that affect the decomposition rate of a corpse.

3. How is pathological evidence collected and analyzed?

**Learning Objectives:** The Student will be able to:

- a. outline the basic steps of an internal and external exam during an autopsy.
- b. determine PMI (postmortem interval) using insects found on or near a body.
- c. discuss how the life cycle and succession of insects on a body are used to determine PMI.
- d. observe and collect insects from decaying corpses.
- e. discuss how DNA and toxicological screens of victims can be performed using insects that have fed on the body.
- f. determine signs of abuse and neglect provided by insects.
- g. determine how insects can cause traffic accidents and sudden death.

4. What is the controversy surrounding the use of Pathological evidence in the courtroom

**Learning Objectives:** The Student will be able to:

- a. determine how the site of a crime or evidence has been moved using insects.
- b. determine how sites of trauma can be determined using insect infestation on a body.
- c. discuss the contribution of insects of DNA and toxicological evidence to a crime.
- d. discuss the involvement of insects in cases of sudden death and traffic accidents.
- e. discuss the use of insects in cases of neglect and abuse.
- f. discuss how insects sometimes confuse investigators.

### **Assessments:**

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

### **Required Activities**

The following types of laboratory activities are required. Titles in parentheses are suggested and lab procedures for these activities are available.

Observation of the decay of fish corpses in various environments

### **Resources**

**Students:** LHS Forensic Science Textbook (Montgomery/Schneider)

**Teacher:** LHS Forensic Science Textbook (Montgomery/Schneider)

#### **Curriculum Alignment with State of Connecticut Science Standards** **All areas address State Standards for Scientific Inquiry, Literacy and Numeracy**

| Focus Questions           | Content Standard | Supportive Concepts         |
|---------------------------|------------------|-----------------------------|
| 1. Pathology              | B5               | 47                          |
| 2. Pathology Evidence     | SILN, P1, P2     | DINQ8, P(2, 3, 4, 5, 7, 12) |
| 3. Analyzing the Evidence | SILN             | DINQ6, DINQ.2, DINQ.10      |
| 4. Pathology Evidence use | SILN             | DINQ.2, DINQ.10             |

# Toxicology / Forensic Chemistry

**Suggested Time:** Approximately 8-11 class periods

## **Essential Question**

What information can toxicology screens provide that can be used in a court of law?

## **Focus Questions**

1. What is Forensic Pathology?

**Learning Objectives:** The Student will be able to:

- a. explain the function of a forensic toxicologist or chemist.
- b. determine when and why toxicology screens are performed.

2. What information can a Forensic toxicologist or Forensic Chemist provide?

**Learning Objectives:** The Student will be able to:

- a. determine the common Toxicological screens performed by Forensic toxicologists.
- b. discuss examples of how substances lead to or cause death.
- c. evaluate the reliability of toxicological data within the framework of crime situations

3. How is toxicological evidence collected and analyzed?

**Learning Objectives:** The Student will be able to:

- a. explain how toxicological evidence is collected at a crime scene.
- b. discuss the methods of analysis of toxicological evidence
- c. research and present "famous" environmental poisoning events that require toxicological analysis
- d. research and present "famous" deaths due to poisoning that have come to light years after death (i.e. Napoleon, Beethoven)

4. What is the controversy surrounding the use of toxicological evidence in the courtroom

**Learning Objectives:** The Student will be able to:

- a. discuss the possibilities and limitations of toxicological evidence in the courtroom..
- b. discuss the involvement of drugs in cases of sudden death and traffic accidents.
- c. research and evaluate current controversies in drug testing of athletes and in the workplace

### **Assessments:**

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

### **Required Activities**

The following types of laboratory activities are required. Titles in parentheses are suggested and lab procedures for these activities are available.

Observation of the decay of fish corpses in various environments

### **Resources**

**Students:** LHS Forensic Science Textbook (Montgomery/Schneider)

**Teacher:** LHS Forensic Science Textbook (Montgomery/Schneider)

#### **Curriculum Alignment with State of Connecticut Science Standards** **All areas address State Standards for Scientific Inquiry, Literacy and Numeracy**

| Focus Questions           | Content Standard | Supportive Concepts         |
|---------------------------|------------------|-----------------------------|
| 1. Pathology              | B5               | 47                          |
| 2. Pathology Evidence     | SILN, P1, P2     | DINQ8, P(2, 3, 4, 5, 7, 12) |
| 3. Analyzing the Evidence | SILN             | DINQ6, DINQ.2, DINQ.10      |
| 4. Pathology Evidence use | SILN             | DINQ.2, DINQ.10             |