Program Features

Frey's Inquiry Investigations™ Module Forensic Science engages your students in an exciting world of investigation and inquiry. This unique curriculum program allows flexibility to explore aspects of various forensic science disciplines. The program module contains five units containing both skill-based and case applications that allow students to experience the wonders of science through direct, hands-on environment. A sixth unit provides a case scenario that allows students to function as actual crime scene investigators.

Each Unit includes

> Comprehensive background literature and information guides with planning and preparation tips, step-by-step instructions, case analyses, cross-curriculum integration, and assessment strategies.

> Student Inquiry Activities:

- Learning by Doing

  Activities that will give students needed forensic analysis skills.

- Detective's Casebook

  Scenarios in which students perform actual case forensic investigations using learned lab skills.

- Going Further

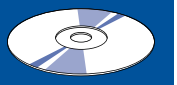
  Additional open-ended activity suggestions for students.

> A reproducible Student Guide for each unit with complete background information, step-by-step procedures, data tables, analysis questions, and space for writing reports to various public officials that explain student results. Also included are related websites and *Read More About It* resources for students to obtain additional information.

> Enough high-quality science materials for a class of up to forty students working in groups.

> A handy Storage Center to neatly store all materials.

Also included with the Inquiry Investigations™ Module Forensic Science is the Curriculum Resource CD-ROM* which includes…



Content Tutorials:

- Content featuring detailed illustrations that cover key forensic science concepts.
- Hyper-linked glossary of key concepts and terms.

Assessment Monitoring:

- Test questions which can be accessed in either Practice or Test Mode that allow students to demonstrate content knowledge.
- Create customized tests and worksheets with five questions types (essay, multiple choice, concept map, matching, and labeling), as well as dynamic web-deliverable multi-media tutorials and presentations.

Correlation to National and Selected State Science Standards:

- Key concepts correlated to the National Science Education Standards (NSES) and a link to the Frey Scientific website for selected State standards.

Teacher resources:

- Explore the image gallery for printable illustrations and images relating to forensic science topic area.
- View dynamic animations that reinforce key forensic science concepts.
- Case analysis results section provides in-depth evidence analysis for skill and case scenario activities as well as useful teacher tips. Where applicable, graphs, tables, and images are provided to enhance the understanding each skill activity or case investigation.

Virtual Laboratory – ABO - Rh Blood Typing

- Explore the object-based virtual lab environment. The virtual lab allows students to interactively perform every step of a lab activity by manipulating lab equipment on their virtual workbench.
- An electronic notebook to record and analyze results.

**System Requirements: Windows 2000 or higher, VISTA-compatible, Mac 9.2 or higher (including OSX), 128 MB RAM.*

The Curriculum Guide contains the following sections – Teacher Guide, Student Resources, Appendix, and a Curriculum Resource CD-ROM. Each section has the same general format, let's take a closer look –

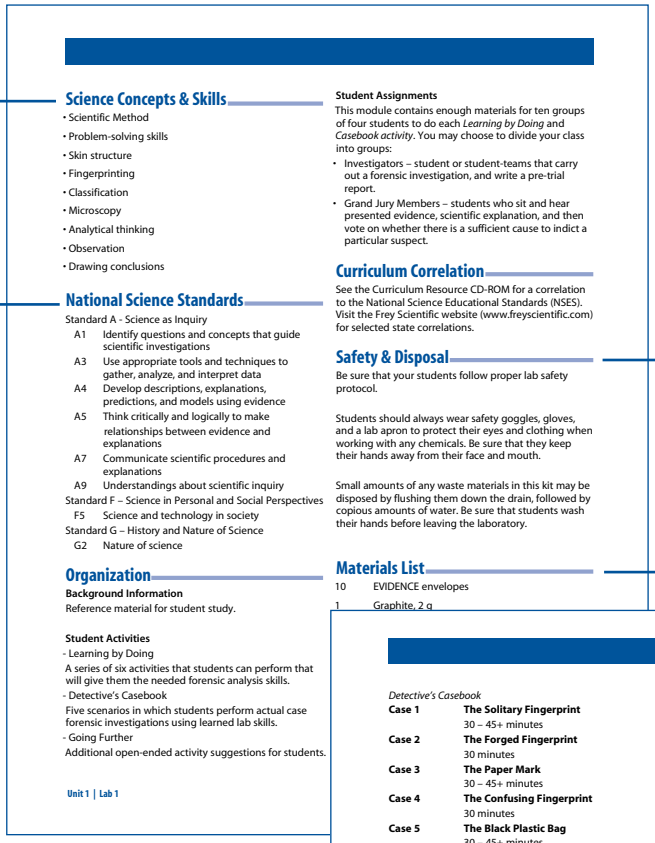
A Closer Look at the Teacher Guide…

Science Concepts

> Overview of key concepts and skills presented in each unit

Science Standards

> A list of the National Science Education Standards covered by the material in each unit



Science Concepts & Skills

- Scientific Method
- Problem-solving skills
- Skin structure
- Fingerprinting
- Classification
- Microscopy
- Analytical thinking
- Observation
- Drawing conclusions

National Science Standards

Standard A - Science as Inquiry
- A1 Identify questions and concepts that guide scientific investigations
- A3 Use appropriate tools and techniques to gather, analyze, and interpret data
- A4 Develop descriptions, explanations, predictions, and models using evidence
- A5 Think critically and logically to make relationships between evidence and explanations
- A7 Communicate scientific procedures and explanations
- A9 Understandings about scientific inquiry

Standard F – Science in Personal and Social Perspectives
- F5 Science and technology in society

Standard G – History and Nature of Science
- G2 Nature of science

Organization

Background Information
Reference material for student study.

Student Activities
- Learning by Doing
A series of six activities that students can perform that will give them the needed forensic analysis skills.
- Detective's Casebook
Five scenarios in which students perform actual case forensic investigations using learned lab skills.
- Going Further
Additional open-ended activity suggestions for students.

Unit 1 | Lab 1

Student Assignments
This module contains enough materials for ten groups of four students to do each *Learning by Doing* and *Casebook activity*. You may choose to divide your class into groups:
- Investigators – student or student-teams that carry out a forensic investigation, and write a pre-trial report.
- Grand Jury Members – students who sit and hear presented evidence, scientific explanation, and then vote on whether there is a sufficient cause to indict a particular suspect.

Curriculum Correlation

See the Curriculum Resource CD-ROM for a correlation to the National Science Educational Standards (NSES). Visit the Frey Scientific website (www.freyscientific.com) for selected state correlations.

Safety & Disposal

Be sure that your students follow proper lab safety protocol.

Students should always wear safety goggles, gloves, and a lab apron to protect their eyes and clothing when working with any chemicals. Be sure that they keep their hands away from their face and mouth.

Small amounts of any waste materials in this kit may be disposed by flushing them down the drain, followed by copious amounts of water. Be sure that students wash their hands before leaving the laboratory.

Materials List

10 EVIDENCE envelopes
1 Graphite, 2 g

Safety & Disposal

> Tips for safe disposal of waste materials and student safety

Materials

> Comprehensive list of the materials contained in the module

Pre-lab Preparation

> Overview of any necessary pre-lab preparation

Evidence Preparation

> Step-by-step instructions on how to safely prepare the materials for each activity and case scenario

Detective's Casebook

Case 1	**The Solitary Fingerprint**	30 – 45+ minutes
Case 2	**The Forged Fingerprint**	30 minutes
Case 3	**The Paper Mark**	30 – 45+ minutes
Case 4	**The Confusing Fingerprint**	30 minutes
Case 5	**The Black Plastic Bag**	30 – 45+ minutes

Pre-lab Preparation

Learning by Doing

Activity 1
Taking a Direct Fingerprint

Materials
- 40 Blank index cards, white
- 40 Inkless fingerprinting cards
- 10 Pencils
- COPYMASTER 1 - Teacher Information sheet
- COPYMASTER 2 - Thumbprint Record sheet

Preparing Evidence
1. Make a direct thumbprint of your own right thumb. Place a developed fingerprint label on the *Thumbprint Record sheet* and record your name (or other identifier) and corresponding record number on the *Teacher Information Sheet*--Fingerprint Record.

Note: *To safeguard individual student identities, you may choose to have them provide a pseudonym instead of their name.*

2. Hand out materials:
Per Group
- 4 Blank index card, white
- 4 Inkless fingerprinting cards
- 1 Pencil

Per Class
- COPYMASTER 1 - Teacher Information sheet
- COPYMASTER 2 - Thumbprint Record sheet

Activity 2
Identifying Fingerprint Ridge Details

Materials
- COPYMASTER 3 - Activity 2 Analysis sheet

Preparing Evidence
1. Hand out materials:
Per Student
- COPYMASTER 3 - Activity 2 Analysis sheet

Activity 3
Practicing Fingerprint Identification Skills

Materials
- 40 Index cards with direct fingerprints
- 40 Pencils
- 40 Magnifying glasses
- COPYMASTER 4 - Activity 3 Analysis sheet
- Completed Teacher Information sheet
- Completed Thumbprint Record sheets

Preparing Materials
1. You will need to make up to forty photocopies of the completed *Thumbprint Record sheet*. When copying, try to make sure that the contrast levels provide for clear fingerprint images. Students will use this sheet as their main thumbprint database for the population of class thumbprints for future analyses.

2. Make forty photocopies of the COPYMASTER 4 - Activity 3 Analysis sheet.

3. Hand the following materials:
Per Student
- Copied Thumbprint Record sheet
- Index card with direct fingerprint
- Magnifying glass
- Pencil
- COPYMASTER 4 - Activity 3 Analysis sheet

Per Class
- COPYMASTER 2 - Teacher Information sheet
- Access to a photocopier
- Clear acetate sheets for photocopying (optional)
- Computer microscope (optional)

Lab 1 | Pre-Lab Preparation

Fingerprint Evidence 23

A Closer Look at the Teacher Guide…

Objective

> Overview of the activity

Safety

> Important safety information specifically related to each activity

Materials

>Specific materials used in each activity

Assessment Strategies

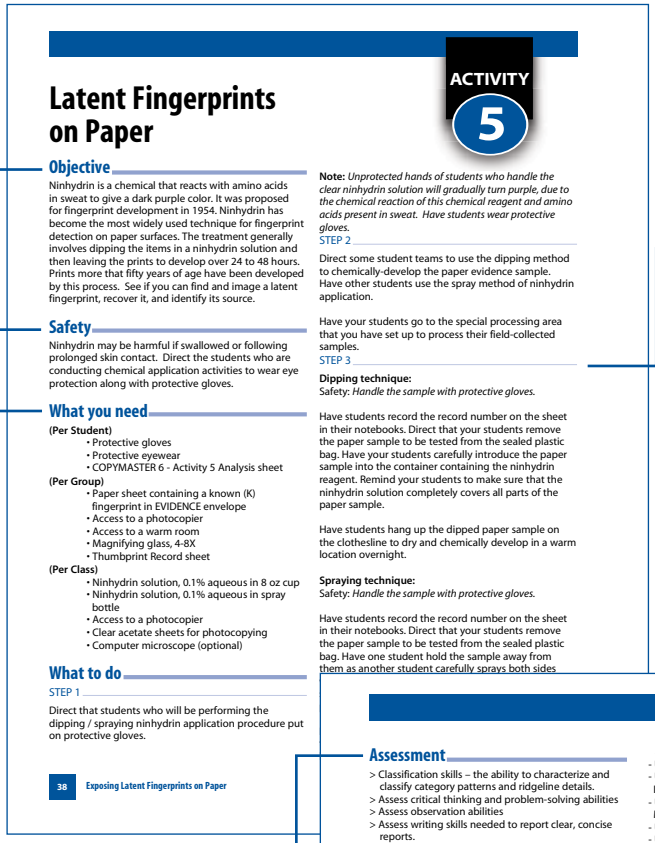
> Additional activity suggestions to reinforce the key concepts

Cross-Curricular Integration

> Suggestions of how to relate the key concepts of the activity to other disciplines

What to do

> Teacher friendly step-by-step procedures for each activity



ACTIVITY 5

Latent Fingerprints on Paper

Objective

Ninhydrin is a chemical that reacts with amino acids in sweat to give a dark purple color. It was proposed for fingerprint development in 1954. Ninhydrin has become the most widely used technique for fingerprint detection on paper surfaces. The treatment generally involves dipping the items in a ninhydrin solution and then leaving the prints to develop over 24 to 48 hours. Prints more that fifty years of age have been developed by this process. See if you can find and image a latent fingerprint, recover it, and identify its source.

Safety

Ninhydrin may be harmful if swallowed or following prolonged skin contact. Direct the students who are conducting chemical application activities to wear eye protection along with protective gloves.

What you need

(Per Student)
- Protective gloves
- Protective eyewear
- COPYMASTER 6 - Activity 5 Analysis sheet

(Per Group)
- Paper sheet containing a known (K) fingerprint in EVIDENCE envelope
- Access to a photocopier
- Access to a warm room
- Magnifying glass, 4-8X
- Thumbprint Record sheet

(Per Class)
- Ninhydrin solution, 0.1% aqueous in 8 oz cup
- Ninhydrin solution, 0.1% aqueous in spray bottle
- Access to a photocopier
- Clear acetate sheets for photocopying
- Computer microscope (optional)

What to do

STEP 1

Direct that students who will be performing the dipping / spraying ninhydrin application procedure put on protective gloves.

Note: *Unprotected hands of students who handle the clear ninhydrin solution will gradually turn purple, due to the chemical reaction of this chemical reagent and amino acids present in sweat. Have students wear protective gloves.*

STEP 2

Direct some student teams to use the dipping method to chemically-develop the paper evidence sample. Have other students use the spray method of ninhydrin application.

Have your students go to the special processing area that you have set up to process their field-collected samples.

STEP 3

Dipping technique:
Safety: *Handle the sample with protective gloves.*

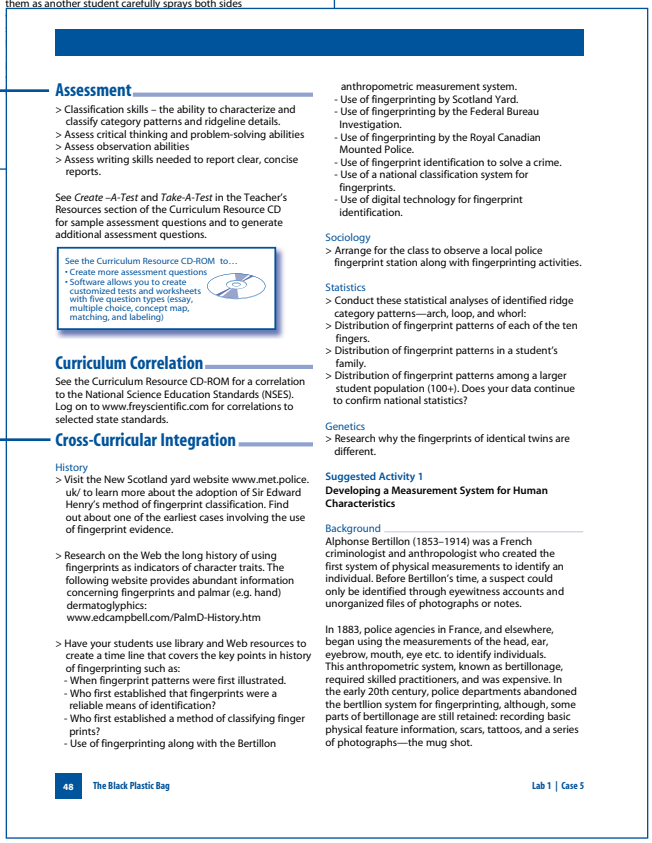
Have students record the record number on the sheet in their notebooks. Direct that your students remove the paper sample to be tested from the sealed plastic bag. Have your students carefully introduce the paper sample into the container containing the ninhydrin reagent. Remind your students to make sure that the ninhydrin solution completely covers all parts of the paper sample.

Have students hang up the dipped paper sample on the clothesline to dry and chemically develop in a warm location overnight.

Spraying technique:
Safety: *Handle the sample with protective gloves.*

Have students record the record number on the sheet in their notebooks. Direct that your students remove the paper sample to be tested from the sealed plastic bag. Have one student hold the sample away from them as another student carefully sprays both sides

38 Exposing Latent Fingerprints on Paper



Assessment

> Classification skills – the ability to characterize and classify category patterns and ridgeline details.
> Assess critical thinking and problem-solving abilities
> Assess observation abilities
> Assess writing skills needed to report clear, concise reports.

See *Create –A-Test* and *Take-A-Test* in the Teacher's Resources section of the Curriculum Resource CD for sample assessment questions and to generate additional assessment questions.

See the Curriculum Resource CD-ROM to…
- Create more assessment questions
- Software allows you to create customized tests and worksheets with five question types (essay, multiple choice, concept map, matching, and labeling)

Curriculum Correlation

See the Curriculum Resource CD-ROM for a correlation to the National Science Education Standards (NSES). Log on to www.freyscientific.com for correlations to selected state standards.

Cross-Curricular Integration

History
> Visit the New Scotland yard website www.met.police.uk/ to learn more about the adoption of Sir Edward Henry's method of fingerprint classification. Find out about one of the earliest cases involving the use of fingerprint evidence.

> Research on the Web the long history of using fingerprints as indicators of character traits. The following website provides abundant information concerning fingerprints and palmar (e.g. hand) dermatoglyphics: www.edcampbell.com/PalmD-History.htm

> Have your students use library and Web resources to create a time line that covers the key points in history of fingerprinting such as:
- When fingerprint patterns were first illustrated.
- Who first established that fingerprints were a reliable means of identification?
- Who first established a method of classifying finger prints?
- Use of fingerprinting along with the Bertillon anthropometric measurement system.
- Use of fingerprinting by Scotland Yard.
- Use of fingerprinting by the Federal Bureau Investigation.
- Use of fingerprinting by the Royal Canadian Mounted Police.
- Use of fingerprint identification to solve a crime.
- Use of a national classification system for fingerprints.
- Use of digital technology for fingerprint identification.

Sociology
> Arrange for the class to observe a local police fingerprint station along with fingerprinting activities.

Statistics
> Conduct these statistical analyses of identified ridge category patterns—arch, loop, and whorl:
> Distribution of fingerprint patterns of each of the ten fingers.
> Distribution of fingerprint patterns in a student's family.
> Distribution of fingerprint patterns among a larger student population (100+). Does your data continue to confirm national statistics?

Genetics
> Research why the fingerprints of identical twins are different.

Suggested Activity 1
Developing a Measurement System for Human Characteristics

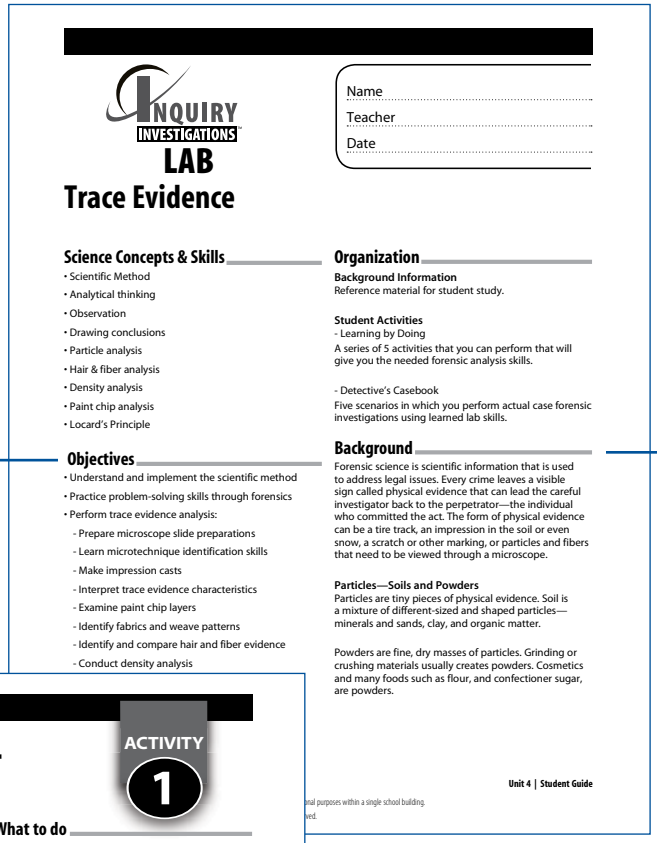
Background

Alphonse Bertillon (1853–1914) was a French criminologist and anthropologist who created the first system of physical measurements to identify an individual. Before Bertillon's time, a suspect could only be identified through eyewitness accounts and unorganized files of photographs or notes.

In 1883, police agencies in France, and elsewhere, began using the measurements of the head, ear, eyebrow, mouth, eye etc. to identify individuals. This anthropometric system, known as bertillonage, required skilled practitioners, and was expensive. In the early 20th century, police departments abandoned the bertillion system for fingerprinting, although, some parts of bertillonage are still retained: recording basic physical feature information, scars, tattoos, and a series of photographs—the mug shot.

48 The Black Plastic Bag Lab 1 | Case 5

A Closer Look at the Student Resources…



INQUIRY INVESTIGATIONS
LAB
Trace Evidence

Name
Teacher
Date

Science Concepts & Skills
- Scientific Method
- Analytical thinking
- Observation
- Drawing conclusions
- Particle analysis
- Hair & fiber analysis
- Density analysis
- Paint chip analysis
- Locard's Principle

Objectives
- Understand and implement the scientific method
- Practice problem-solving skills through forensics
- Perform trace evidence analysis:
  - Prepare microscope slide preparations
  - Learn microtechnique identification skills
  - Make impression casts
  - Interpret trace evidence characteristics
  - Examine paint chip layers
  - Identify fabrics and weave patterns
  - Identify and compare hair and fiber evidence
  - Conduct density analysis

Organization

Background Information
Reference material for student study.

Student Activities
- Learning by Doing
A series of 5 activities that you can perform that will give you the needed forensic analysis skills.

- Detective's Casebook
Five scenarios in which you perform actual case forensic investigations using learned lab skills.

Background
Forensic science is scientific information that is used to address legal issues. Every crime leaves a visible sign called physical evidence that can lead the careful investigator back to the perpetrator—the individual who committed the act. The form of physical evidence can be a tire track, an impression in the soil or even snow, a scratch or other marking, or particles and fibers that need to be viewed through a microscope.

Particles—Soils and Powders
Particles are tiny pieces of physical evidence. Soil is a mixture of different-sized and shaped particles—minerals and sands, clay, and organic matter.

Powders are fine, dry masses of particles. Grinding or crushing materials usually creates powders. Cosmetics and many foods such as flour, and confectioner sugar, are powders.

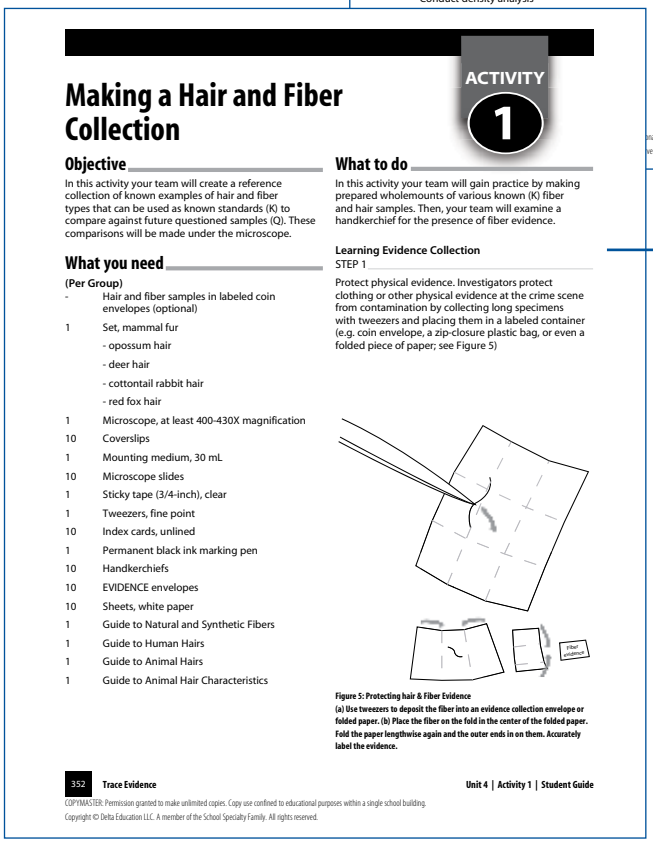
Unit 4 | Student Guide

Objectives

> Key concepts and student goals

Background Information

> Science information related to the unit topic



ACTIVITY 1

Making a Hair and Fiber Collection

Objective
In this activity your team will create a reference collection of known examples of hair and fiber types that can be used as known standards (K) to compare against future questioned samples (Q). These comparisons will be made under the microscope.

What you need
(Per Group)

-	Hair and fiber samples in labeled coin envelopes (optional)
1	Set, mammal fur - opossum hair - deer hair - cottontail rabbit hair - red fox hair
1	Microscope, at least 400-430X magnification
10	Coverslips
1	Mounting medium, 30 mL
10	Microscope slides
1	Sticky tape (3/4-inch), clear
1	Tweezers, fine point
10	Index cards, unlined
1	Permanent black ink marking pen
10	Handkerchiefs
10	EVIDENCE envelopes
10	Sheets, white paper
1	Guide to Natural and Synthetic Fibers
1	Guide to Human Hairs
1	Guide to Animal Hairs
1	Guide to Animal Hair Characteristics

What to do
In this activity your team will gain practice by making prepared wholemounts of various known (K) fiber and hair samples. Then, your team will examine a handkerchief for the presence of fiber evidence.

Learning Evidence Collection
STEP 1
Protect physical evidence. Investigators protect clothing or other physical evidence at the crime scene from contamination by collecting long specimens with tweezers and placing them in a labeled container (e.g. coin envelope, a zip-closure plastic bag, or even a folded piece of paper; see Figure 5)

Figure 5: Protecting hair & Fiber Evidence
(a) Use tweezers to deposit the fiber into an evidence collection envelope or folded paper. (b) Place the fiber on the fold in the center of the folded paper. Fold the paper lengthwise again and the outer ends in on them. Accurately label the evidence.

352 Trace Evidence Unit 4 | Activity 1 | Student Guide

What to do

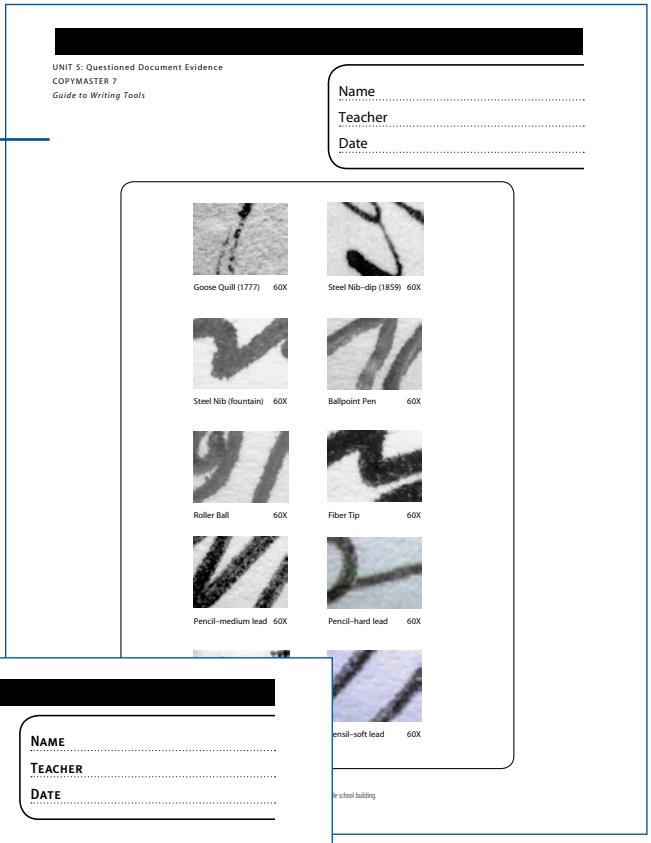
> Step-by-step procedures for each activity

A Closer Look at the Student Resources…

Guides

> Various Guides are provided for students with each focusing on a different skill.

Note: *Full color versions are provided on the Curriculum Resource CD-ROM*



UNIT 5: Questioned Document Evidence
COPYMASTER 7
Guide to Writing Tools

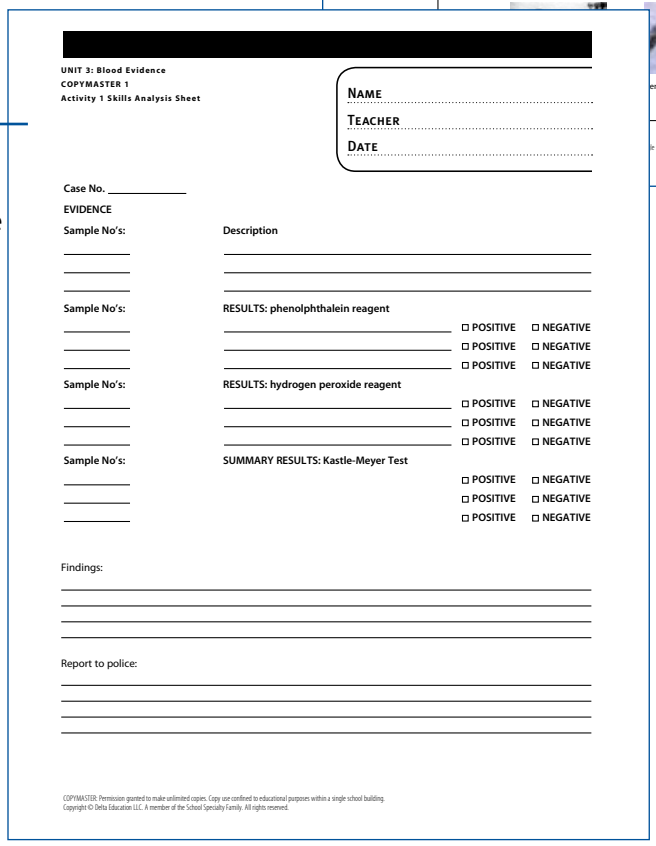
Name
Teacher
Date

Goose Quill (1777) 60X
Steel Nib–dip (1859) 60X
Steel Nib (fountain) 60X
Ballpoint Pen 60X
Roller Ball 60X
Fiber Tip 60X
Pencil–medium lead 60X
Pencil–hard lead 60X
ensil–soft lead 60X

Copymasters

> Student copymaster sheets are provided to help students record and analyze the data collected.

Note: *All copymasters are provided in a digital format on the Curriculum Resource CD-ROM*



UNIT 3: Blood Evidence
COPYMASTER 1
Activity 1 Skills Analysis Sheet

NAME
TEACHER
DATE

Case No. _____
EVIDENCE
Sample No's: Description
Sample No's: RESULTS: phenolphthalein reagent
□ POSITIVE □ NEGATIVE
Sample No's: RESULTS: hydrogen peroxide reagent
□ POSITIVE □ NEGATIVE
Sample No's: SUMMARY RESULTS: Kastle-Meyer Test
□ POSITIVE □ NEGATIVE
Findings:
Report to police:

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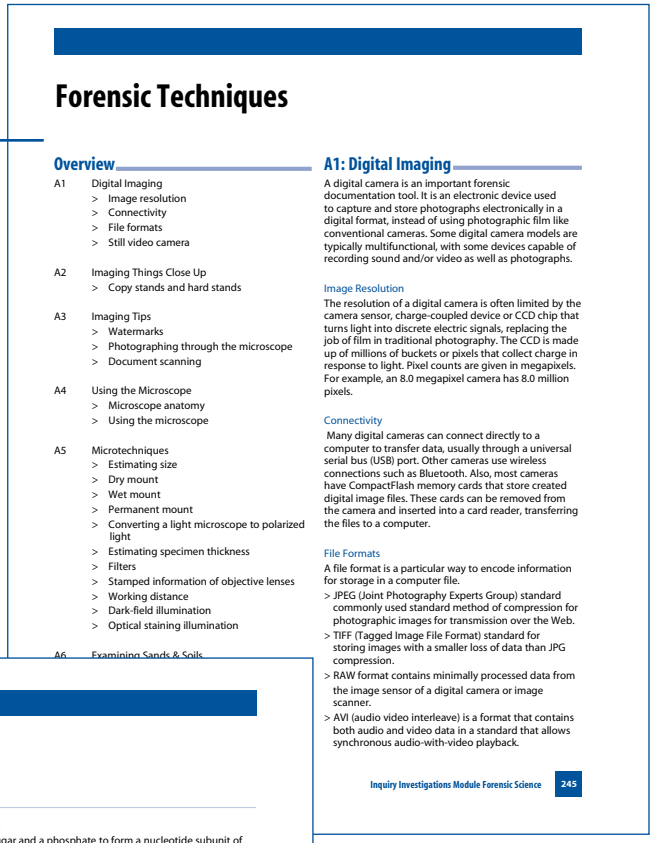
A Closer Look at the Appendix…

Forensic Techniques

> In-depth information on how to perform various forensic science techniques



Forensic Techniques

Overview

A1: Digital Imaging

A digital camera is an important forensic documentation tool. It is an electronic device used to capture and store photographs electronically in a digital format, instead of using photographic film like conventional cameras. Some digital camera models are typically multifunctional, with some devices capable of recording sound and/or video as well as photographs.

Image Resolution

The resolution of a digital camera is often limited by the camera sensor, charge-coupled device or CCD chip that turns light into discrete electric signals, replacing the job of film in traditional photography. The CCD is made up of millions of buckets or pixels that collect charge in response to light. Pixel counts are given in megapixels. For example, an 8.0 megapixel camera has 8.0 million pixels.

Connectivity

Many digital cameras can connect directly to a computer to transfer data, usually through a universal serial bus (USB) port. Other cameras use wireless connections such as Bluetooth. Also, most cameras have CompactFlash memory cards that store created digital image files. These cards can be removed from the camera and inserted into a card reader, transferring the files to a computer.

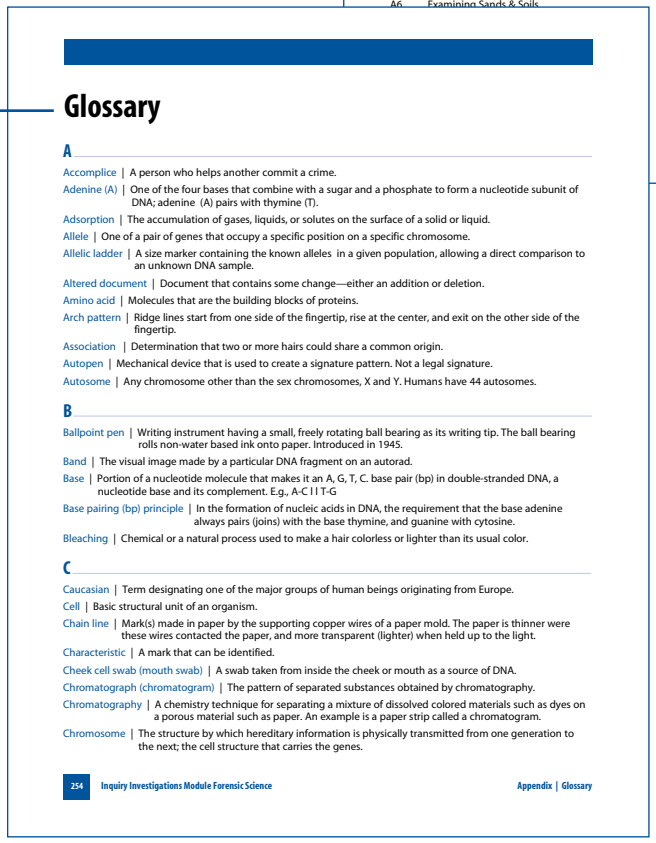
File Formats

A file format is a particular way to encode information for storage in a computer file.

> JPEG (Joint Photography Experts Group) standard commonly used standard method of compression for photographic images for transmission over the Web.
> TIFF (Tagged Image File Format) standard for storing images with a smaller loss of data than JPG compression.
> RAW format contains minimally processed data from the image sensor of a digital camera or image scanner.
> AVI (audio video interleave) is a format that contains both audio and video data in a standard that allows synchronous audio-with-video playback.

Glossary

> Comprehensive glossary of key terms



Glossary

A

Accomplice | A person who helps another commit a crime.
Adenine (A) | One of the four bases that combine with a sugar and a phosphate to form a nucleotide subunit of DNA; adenine (A) pairs with thymine (T).
Adsorption | The accumulation of gases, liquids, or solutes on the surface of a solid or liquid.
Allele | One of a pair of genes that occupy a specific position on a specific chromosome.
Allelic ladder | A size marker containing the known alleles in a given population, allowing a direct comparison to an unknown DNA sample.
Altered document | Document that contains some change—either an addition or deletion.
Amino acid | Molecules that are the building blocks of proteins.
Arch pattern | Ridge lines start from one side of the fingertip, rise at the center, and exit on the other side of the fingertip.
Association | Determination that two or more hairs could share a common origin.
Autopen | Mechanical device that is used to create a signature pattern. Not a legal signature.
Autosome | Any chromosome other than the sex chromosomes, X and Y. Humans have 44 autosomes.

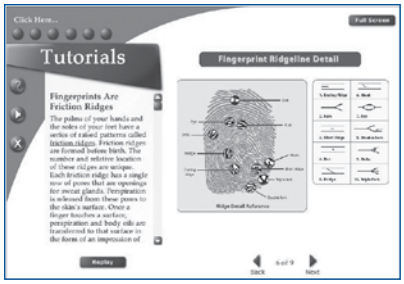
B

Ballpoint pen | Writing instrument having a small, freely rotating ball bearing as its writing tip. The ball bearing rolls non-water based ink onto paper. Introduced in 1945.
Band | The visual image made by a particular DNA fragment on an autorad.
Base | Portion of a nucleotide molecule that makes it an A, G, T, C. base pair (bp) in double-stranded DNA, a nucleotide base and its complement. E.g., A-C I I T-G
Base pairing (bp) principle | In the formation of nucleic acids in DNA, the requirement that the base adenine always pairs (joins) with the base thymine, and guanine with cytosine.
Bleaching | Chemical or a natural process used to make a hair colorless or lighter than its usual color.

C

Caucasian | Term designating one of the major groups of human beings originating from Europe.
Cell | Basic structural unit of an organism.
Chain line | Mark(s) made in paper by the supporting copper wires of a paper mold. The paper is thinner were these wires contacted the paper, and more transparent (lighter) when held up to the light.
Characteristic | A mark that can be identified.
Cheek cell swab (mouth swab) | A swab taken from inside the cheek or mouth as a source of DNA.
Chromatograph (chromatogram) | The pattern of separated substances obtained by chromatography.
Chromatography | A chemistry technique for separating a mixture of dissolved colored materials such as dyes on a porous material such as paper. An example is a paper strip called a chromatogram.
Chromosome | The structure by which hereditary information is physically transmitted from one generation to the next; the cell structure that carries the genes.

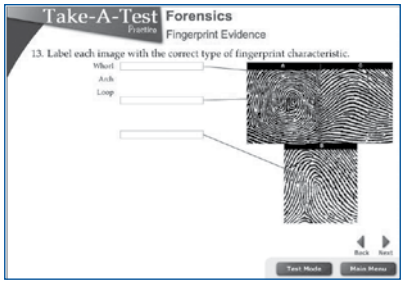
A Closer Look at the Curriculum Resource CD-ROM*…



Content Tutorials

> Comprehensivetutorials offering self-paced, individualized lessons via illuminating illustrations and animations

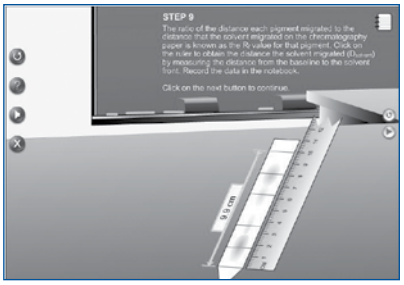
> Hyper-linkedglossary of key concepts and terms



Assessment Monitoring

> Accesstest questions in either Practice or Test Mode to allow students practice exams

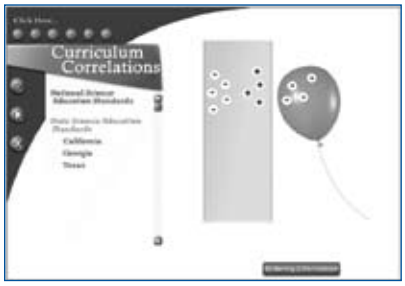
> Createcustomized tests and worksheets with various question types, as well as dynamic multimedia tutorials and presentations – saving them on a disk or in web ready format for easy Internet access



Virtual Laboratory

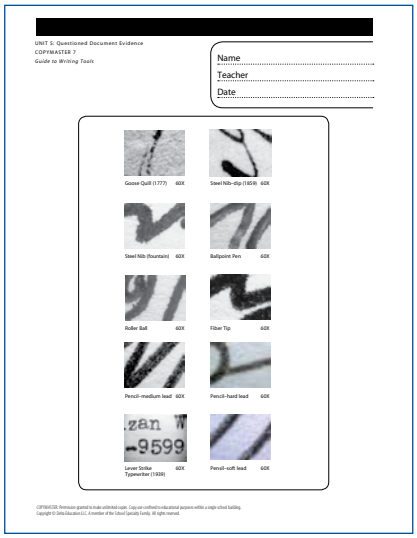
> Explorethe object-based virtual lab environment. The virtual lab allows students to interactively perform every stop of a lab activity by manipulating lab equipment on their virtual lab workbench

> Electronicnotebook allows students to record and analyze data



Correlations to National and selected State Standards

> Keyconcepts correlated to the National Science Education Standards and 25 selected State standards linked to the Frey Scientific website



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> Graphs,tables, and images are provided to enhance each activity

*CD-ROM System Requirements: Windows 2000 or higher, VISTA-compatible, Mac 9.2 or higher (including OSX), 128 MB Ram