Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
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Science and the Law

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The intent of this unit is to be enjoyable, creative and to enhance the thinking skills of the students by utilizing the scientific method with a myriad of hands-on-activities. This unit will also show diversity between science and other disciplines. I will introduce scientific techniques that a criminalist may use in a court of law to aid in convicting or proving a suspect innocent. A criminalist encompasses areas of the physical and natural science which are applicable to the analysis of physical evidence. In this unit, the following topics will be addressed:

1. Forensic science which is the application of science to criminal investigation in order to provide evidence that can be used in the solution of criminal cases.
2. Forensic psychology or forensic psychiatry is concerned with the area where psychology or psychiatry and the law interact.
3. Physical evidence is any and all objects that can help establish that a crime has been committed.
4. DNA (deoxyribonucleic acid) is the blueprint for life. It is a nucleic acid that carries information that controls the building of protein and is present in the blood. DNA is unique in each individual except some identical twins. DNA fingerprinting is a procedure that produces a unique genetic map or fingerprint for each individual. The validity of DNA fingerprinting has been well established by the courts. Critics, however, complain that sloppy laboratoryprocedures reduce the tests reliability.
5. Fingerprints penetrate through layers of skin. Fingerprints start to develop during the fetal stage of development and the fingerprint remains the same throughout life.

I plan to use this unit in my eighth grade Earth Science class. It can be used up to grade 10. This unit will run for three weeks. Included in this unit is a vocabulary list, a career choice, lesson plans with laboratory activities, teacher reading list, student reading list, and a bibliography. Additional resources such as speakers (Criminalist Henry Lee, police, detective, criminalist, forensic scientist, judge, lawyer) will visit the classroom,

and a trip to the court will take place. Various hands-on-activities are recommended as well as the availability of resource books, CHEMS kit fingerprinting and crime solving.

I am sure that this unit will enhance and broaden the minds of students at they correlate science and the law. This unit will give students the opportunity to do research and explore ideas. The O.J. Simpson murder trial is being used as a core for this unit.

PHILOSOPHY

It is the aim of this unit to develop literacy in science and other disciplines and to help students live interesting, responsible lives.

This unit will assist the students to further develop:

critical thinking and analytical skills independently and collectively

literacy in forensic science

technology to aid in crime solving

deal sensibly with problems that involve evidence and uncertainties

scientific methods in problem solving

interest in students that will carry over into their neighborhoods and communities

It is also important that the students be made aware of the many vocations and career possibilities involved in Forensic Science.

INTRODUCTION

My students have been following the O.J. Simpson murder trial. Their assignment has been to access all scientific data as it relates to the trial. I have seen their interest sky rocket. Many heated debates have evolved as they emulate the judge, lawyers, newscasters and witnesses.

The O.J. Simpson trial has earned the title of 'The Trial of the Century.' O.J. is a black celebrity, former professional football player, who has been accused of brutally murdering his Caucasian wife, Nicole Brown-Simpson, and an associate of her's, Ronald Goldman. The defense attorneys have raised many questions about the methods and procedures used by the LA Police Department in collecting and storing vital physical evidence.

My students will learn some of the methods and procedures of forensic scientists and involve themselves in hands-on-activities to get a feel for what the experts do and scientifically arrive at conclusions.

FORENSIC SCIENCE

History and Development of Forensic Science

Forensic science is the application of science to criminal and civil laws that are enforce by police agencies in a criminal justice system.

Forensic science began with those individuals who developed the principles and techniques necessary to identify or compare physical evidence, and with those who recognized the necessity of merging of those principles into a coherent discipline that practically applied to the criminal justice system.

Many believe that Sir Arthur Conan Doyle, through his fictional character, Sherlock Holmes, popularized scientific crime detection methods. It was Holmes who first applied the principles of serology the study of blood, fingerprinting, firearm identification, and document examination long before their value was first discovered and implemented by real life criminal investigators.

The following are some pioneers who made early contributions to formulating the disciplines that now constitute forensic science:

Alphonse Bertillion began to develop the science of anthropmetry, a systematic procedure of taking a series of body measurements as a measure of distinguishing one individual from another, in 1879. Fingerprinting replaced this procedure in the 1900's. Bertillion also earned the distinction of being the father of criminal identification.

Frances Galton undertook the first definitive study of fingerprints and developed a methodology of classifying them in 1892. His work described the basic principles that formed the present system of identification by fingerprints.

Leone Lattes discovered that blood can be grouped into different categories. Since 1915, blood types have been recognized as A, B, AB, and O. Today, his procedure is utilized often by forensic scientists.

Calvin Goddard refined the techniques to determine whether or not a particular gun has fired a bullet by utilizing the comparison microscope.

Education and Scientific Progress in Forensic Science

Forensic science includes specialists in pathology, psychiatry, and jurisprudence. Criminalistics is a subdivision of forensic science which involves the collection and laboratory examination of physical evidence from a crime scene or a suspicious occurrence . Items submitted to the criminalist laboratory might include a blood sample, a weapon, or bloodstained clothing from the crime scene.

There are three major subdivisions of the process of physical evidence evaluation: collection, laboratory evaluation, and court presentation of results and their significance. The crime investigator in each of the subdivisions should be well aware of which types of evidence are useful for investigative purposes, and what evidence the local, regional, or federal laboratory is capable of processing. The chosen evidence should be collected and transmitted to the laboratory in a manner so that the results of the laboratory will not be jeopardized. The crime scene should be surveyed by a trained criminalist who is responsible for the proper collection and transmission of physical evidence, unlike in the case of O. J. Simpson. Unfortunately, this

practice is almost always restricted to major crimes (suicide, homicide, bombings, hit and run, etc.) The criminalist must be well aware of what he is looking for and the accuracy, precision, and investigative significance of his measurements.

In some jurisdictions, the local criminalistics laboratory is staffed by police officers who acquired their training on the job, which is essential to the practice of forensic science. These officers may not be equipped to broaden their laboratory's capabilities in the examination of sufficiently wide range of evidence. In court on cross examination their testimony may be called into question on technical grounds, nullifying their work in the laboratory.

Local and regional laboratories should be well managed and adequately staffed by competent, scientifically trained criminalists who are given the opportunity and encouragement to update their education continually.

Entry into forensic science at the technical level requires training in mathematics, physical science, physics, biology, and particularly, chemistry. Most universities are capable of providing the basic scientific and legal courses, and the only elements needed to be added are the special coverage of forensic science topics and a field internship. Forensic science courses must be taught by professional criminalists who are both competent and enthusiastic.

A key to improving the methodology of forensic science lie in the hands of the research institutions. There is a substantial gap between the development of new technology and its application in t he field. This gap is primarily due to inadequate manpower and training and heavy workloads in the nation's criminalistics laboratories.

Forensic research must be aimed at early solutions to urgent current problems. Laboratory techniques must be rapid and reliable in order to be useful and legally admissible. They must also give reproducible data which are scientifically acceptable. The case number is increasing where testimony must be supported by statistical data which substantiate the conclusion of the witness.

Function of the Forensic Scientist

The forensic scientist must be skilled in applying the principles and techniques of the physical and natural sciences to the analysis of the many types of evidence that may be recovered during crime investigations. The scientist must also be made aware of the demands and constraints that are imposed by the judicial system. The techniques and procedures utilized in the laboratory must rest only on a solid scientific foundation and satisfy the criteria of admissibility that have been established by the courts.

Methods of Forensic Science

The analysis of fibers is one of the most important tasks of the criminalist. In the laboratory fibers play an important part in finding traces of contacts which help to clear a case. Contacts are of the highest importance because by using them it is possible to prove one or several of the following points.

1. The presence of the suspect on the crime scene.
2. The way of the perpetrator's flight or the way taken by the perpetrator of the crime to introduce himself to the scene of the crime.
3. Contact with the victim.
4. The use of definite tools (i.e.. weapons or vehicles).

5. The wearing of clothing or shoes abandoned or denied.
6. Contact of victim in an automobile hit and run accident with the car suspect.

Many factors depend on the value of these indicators. An intensive search for fibers in all zones of possible contacts and the use of an adequate technique for collecting evidence can give positive results.

White cotton is an example of collecting fibers that have no special evidential value because they are present always and everywhere. It is more fortunate when the scientist finds rare kinds of fibers or dyes with a high evidentiaryvalue.

A great part of the final success in collecting fiber evidence depends on correct sampling. Evidentiary value is especially diminished by carelessness. Faults made during this state of the operation are normally irreparable.

The first problem on the crime scene is to know where invisible fiber evidence might be located. Studying the modus operandi of the criminal is beneficial in finding all the regions he might have touched with his clothes (doors, walls, etc.). It is possible by following the visible or presumed way(s) step by step to collect evidence completely invisible to the naked eye. This procedure is done by pressing scotch tape to the surface of such hot zones. After folding the contaminated part upon a clean strip for further analysis the scotch tape with the lifted microscopic traces is not to be opened, so as to prevent any loss of evidence and prevent contamination with foreign dust.

If examination under a stereoscopic lens shows interesting details, a few of them are cut or punched out, while the remaining scotch tape is left intact for eventual controls to be examined by other experts.

It is of the highest importance to collect dust samples from zones the criminal definitely did not touch in order to get material for comparison and to know the normal composition of dust on the scene of the crime. The neutral sample makes it possible to determine in most cases immediately whether the fibers found have anything to do with the crime or not. The collecting of fibers from the clothing of the criminal himself and from his victim must be done in such a way that all possible information is preserved.

One of the most important sources for fibers is the human body (fingernails, pubic hairs, etc.). So as to avoid any loss of evidence, collection of samples must be done as soon as possible, preferably before the arrest and before a victim is brought to the morgue and washed.

If the collected fibers, especially the microscopic fragments have to be brought into court as a decisive means of proof, they must be handled with the maximum of care. Operators on the crime scene and in the laboratory must be able to assume responsibility that no contamination was possible during their work. It would be a great risk to touch alternately the clothes of the victim and the clothes of the presumed author of the crime. It may be well to treat each in separate rooms so that the microscopic preparations of single fibers meet only under the comparison microscope in order to avoid mixing up microscopic traces.

The first step from evidence to proof where of fibers are concerned is the identification of the fiber types. An investigation to the whole wardrobe of the individuals is necessary to determine whether or not the questioned type of fiber is present.

To the eye of the expert, most kinds of natural fibers are so familiar that one look under the microscope is sufficient to recognize the special type involved.

In a preliminary examination for studying details of fiber structure, it is advisable to begin any analysis with a pre-selection at a low magnification before opening the scotch tape or even before using a mounting medium. It is of great importance to study first the degree of dustiness of the fibers and eventually the adhering impurities which are able to increase the evidential value. This is why samples should not be cleaned. Cleaning often destroys traces of soap, water, repellent agents, dry cleaning, residues, moth repellents, etc., which may detected by ultraviolet light.

Mountings are made in an embedding medium with an appropriate refractive index in order to give the maximum of contrast.

The study of the general aspect of fibers includes not only the form and outline, but the natural ending of the fiber. To preserve these endings and not to cut all the fibers is most important.

Cross-section studies are not so important in natural fibers as in man-made textile. There is however an exception, such as in some plant fibers (hemp and flax) and animal hairs.

FORENSIC PSYCHOLOGY/PSYCHIATRY

Forensic psychology or forensic psychiatry concerns the area where psychology and psychiatry and the law interact. In the field of forensic psychiatry of psychology, there are two matters of emphasis: first is to emphasize the psychological nature of the interaction; and second is to point out the forensic nature of the interaction in both courts and corrections, because it occasionally causes public debate.

When a psychiatrist examines a criminal case, he must first be certain that he is not trapping the patient into making damaging admissions. Most courts refuse to consider a psychiatric examination as a from of compulsory self incrimination. The doctor informs the accused that he had been asked to make an examination and the accused does not have to answer any type of the questions and if the accused submits without objection, then such testimony is admissible.

It is important that the patient’s comments be recorded verbatim. These notes will serve in supporting conclusions and maybe in the report.

All defendants must undergo a physical examination with emphasis on a neuralgic survey listed as of the commoner syndromes picked up in an examination: Alcoholism, Hearing defects, Neurosyphilis, Visual defects, Scars, Senility, Epilepsy, Endocrine defects, Drug addiction, Cerebral Arteriosclerosis, Hyperthyroidism, and Hypothyroidism.

The physical examination should precede, follow, or accompany the psychiatric interview depending on the circumstances of the case and the nature of the doctor’s relationship to the defendant. If a mental

examination is necessity, most courts today are sophisticated enough to recognize that a mental examination does require the accumulation of historical, educational, vocational, and social facts from various sources as well as dialoguing with the patient.

A psychiatric examination should be comprehensive enough to assure an answer to the following questions:

1. patients general behavior

2. state of consciousness

3. psycho motor activity

4. mood

5. orientation

6. memory

7. hallucinations

8. sense of remorse

9. delusions

10. insight

11. intelligence

12. personality

There is a personal checklist the psychiatrist should be aware prior to appearing in court and the following points should be documented for prompt answers:

1. date graduated from medical school

2. place and date of internship

3. place, nature, and date of residence

4. other specialty training

5. state licensed and when

6. hospital affiliations

7. experience with this kind of case

8. special training

9. board diplomas

10. special society membership

11. books and papers published

12. agency affiliation

PHYSICAL EVIDENCE

Physical evidence includes any and all objects that can establish that a crime has been committed or that can provide a link between a crime and its victim.

Listed are common types of physical evidence: blood, semen, and saliva (these fluids are subjected to serological biochemical analysis for determination of identity and possible origin), documents, drugs, explosives, fibers, fingerprints, paint, glass, hair, impressions, powder, residue, took marks, soil, and minerals, firearms, ammunition, serial numbers, petroleum products, organs and physiological fluids, wood, and other vegetative matter.

The search for physical evidence at a crime scene must be thorough and systematic. When and what to search for will be determined by the particular circumstances of the crime.

Collecting, Preserving Physical Evidence

The forensic scientist seldom personally supervises the collection of evidence at the crime scene. It is left to the field investigator who must be well aware of the requirements that will arise out of the future utilization of such evidence in a legal proceeding.

Physical evidence should be handled in a manner as to prevent any change from taking place between the time it is received in the crime laboratory.

Some instruments may be used at the crime scene to retrieve smallitems and place them in appropriate containers, such as unbreakable plastic pill bottles with pressure lids for collecting hair fibers and glass. Also, envelopes of various shapes and sizes make versatile evidence containers. Bloodstain materials are recommended to be wrapped in paper or paper bags.

The discovery of each item must be accompanied by a detailed description and location of each item, also by whom and when it was discovered. The description must also include how the evidence was packaged, marked and transported to the laboratory.

Methods Used in the Laboratory

1.) Quick test in celluloid films

The hair is placed on a thick transparent celluloid film and a drop of acetone is added to flow along the hair, it dries, leaving a clear impression on the surface of the celluloid. After the hair is removed, it can be studied in transmitted or incident light.

2.) Test in the Gelatin Layer of Photographic Plates of Films

Unexposed negative material is fixed and washed. As the gelatin dries a hair is embedded by pressing gently with a slide. After a few minutes the slide and the hair can be removed.

3.) Semi-embedding of Hairs

The lower half of the fiber placed on a slide is embedded in a mounting medium with identical refractive index to the fiber. The scale can be studied directly in the freeze zone. This procedure requires more skill and yields excellent results.

Forensic Bloodstains

The goal of forensic serology is to individualize blood stains by identifying genetic markers whose population frequencies have been established. This includes a series of analyses utilizing several components of the blood from which a profile of genetic markers can be established. The markers in the blood are inherited independent of one another and their frequencies within a given population are known. The profile obtained will permit a mathematical probability or uniqueness to be calculated.

Blood is a multi-component system made up of red and white blood cells, platelets and plasma. They each contain a vast array of biochemical constituents. The forensic serologist has chosen three classes of the blood constituents for their genetic information and use in individualization endeavor. These constituent classes are: 1) the blood grouping and typing antigens, 2) the polymorphic enzymes and 3) the polymorphic protein.

Since Landsteiner discovered the ABO system of typing antigens around the 1900's, over 246 published antigens have been found. However only three of these antigens, the ABO, MN, and Rh, have received crime laboratory acceptance.

The ABO, MN, and Rh system have useful population frequencies. Four groups belonging to the ABO system occur approximately the following percentage of frequency: O 44%, A 44%, B 8%, and AB 3%. The MN has three groupings with the following frequencies: M 30%, MN 50%, and N 20%. The Rh system has basically a five component antigen system giving rise to eight gene complexes or agglutinogenes. Phenotyping use Rh's is quite useful in obtaining individualizing information.

A procedure for obtaining blood group antigens information for ABO involves about 45 minutes. This includes a ten minute preparation period and the collection of threads, a ten minute antibody incubation, a three minute wait, a ten minute solution and a ten minute rotation and examination period. An advantage to this technique is that it permits more samples to be processed in a given time and only three bloodstained threads are used from the questioned source.

The second class of blood constituents used as genetic markers is the polymorhic enzymes. These enzymes of interest are within the red blood cells are commonly referred to as isoenzymes. These are described as those enzymatically active proteins which catalyze the same biochemical reactions and occur in the same species but differ in certain of their physiochemical properties. Many of the forensic serologists are not privileged to use electrophorensic and isoenzyme determination, is the technical capabilities shared by only a few

laboratories.

Many isoenzymes have been identified from various human tissue sources but six erythrocytic systems have received routine crime laboratory status. These are phosphoglucomutase (PGM), adenylate kinase (AK), adenosine deaminase (ADA), glucose-6-phosphate dehydrogenase (G-6-PD), 6-phosphatase (EAP).

The third class of constituents used as genetic markers in the blood are polymorphic proteins. Hemoglobin and the haptoglobins are the most important members of this classification. The haptoglobins are Alpha 2 globinlins which are responsible for binding free homoglobin released into the plasma after the destruction of red blood cells. Genetically they exist in three forms: Hp1, Hp2, and Hp2-1, with the following population distribution: hp1 14%, Hp2 32%, and Hp2-1 53%. These frequencies are useful in screening blood differences.

Blood Typing

Serology is use to describe a broad scope of laboratory tests that utilize specific antigen and serum antibody reactions. The most widespread application of serology is the typing of whole blood for its A, B, O identification. In determining the A, B, O blood type, only two antiserums are needed: anti-A and anti-B.

The identification of natural antibodies present in blood offer another route to the determination of blood type.

Techniques for Grouping Dried Blood

Blood of recent origin, whether in the form of a powder or flake, should be dissolved in a small quantity of distilled water and grouped.

Blood stains associated with non-absorbed substrata such as knives or bottles should be scraped off or dissolved off with distilled water and tested.

Blood associated with absorbent substrata includes many different types of substratum. Blood stained material should be placed in a small quantity of distilled water and left to soak for up to an hour to allow proper extraction. A little water may be applied to the stain and in a few seconds it is possible to scrape it off with a scalpel. These methods can be applied to cloth and paper. Fragments of bloodstained materials is very effective and can easily be made to stick in the wells of cavity slides by the standard method. Fingernail fragments have been grouped successfully utilizing this method.

Tube Technique

1.) Place small fragments of blood stain in the bottom of three 5 cm x 0.5 cm test tubes.
2.) Dispense small amounts of 0.5% v/v A1, B, and O suspensions into the test tubes. The amount of cell suspension used is the smallest volume commensurate with being able to recover a sufficient amount for recordings to be made.
3.) Leave cells and blood stain in contact for two hours then remove the cell suspension gently with a pipette and spread carefully ontoa microscope slide.

Cavity Slide Technique

The cavity slide technique has not been too effective in dealing with small quantities of test material in the well of a three cavity 3 in. x 1 in. slide.
1.) Place fragments of bloodstain material in the well of a three cavity 3 in. x 1 in. slide.
2.) Dispense one drop of a 0.01% v/v indicator cell suspension of the appropriate type to each well (A, B, and O) using a very fine borepipette. The test material should be covered by the cell suspension.
3.) Place the slide in a moist chamber to prevent evaporation.
4.) The results are read with a low-power microscope. Pipetting is not required. A reaction may be evident within a few minutes or up to two to three hours.

DNA (Deoxyribonucleic Acid)

Human beings normally have 46 chromosomes, twenty-three (23) pairs in all but sex cells. Chromosomes are located in the nucleus of a cell. Chromosomes have thousands of genes which carry information for specific traits or inherited characteristics.

A gene is constructed of a segment of DNA (deoxyribonucleic acid) formed like a twisted ladder, known as the double helix. Each upright in the ladder consist of a chain of alternate sugar and phosphate units. The sugar is called deoxyribose.

Attached to each sugar unit is a chain of biochemical compound of a base. There are only four bases: adenine (A) , thimine (T), guanine (G), and cytosine (C). An individual gene may have from a thousand to several hundred thousand bases. The bases protrude from the sugar phosphate chains to form the rungs of the double helix ladder. The sequence of bases along the sugar phosphate chains is called the genetic code and the genetic code dictates to the other chemicals what to do.

When the DNA ladder breaks apart and the exposed bases read off in groups of three triplets to form a carrier substance, the process is known as messenger RNA (ribonucleicacid).

DNA in the nucleus of cells makes up the cells' chromosomes. These are divided into genes which determine physical characteristics. Genes provide the blueprint for constructing a person. Genes are composed of DNA located in the nucleus.

DNA Fingerprinting

Most genes are identical or very similar from human to human. However, there are areas on or between the genome that are highly variable and unique for each individual. It is because of these differences the

technique called ‘DNA fingerprinting‘ could be developed. The DNA fingerprinting technique produces a unique genetic map or ‘fingerprint‘ for each individual. Genetic fingerprinting is based on the unique DNA profile of an individual and has nothing at all to do with fingerprints.

DNA fingerprinting was developed and refined in the 1980’s and can prove valuable for linking criminals to a crime and for freeing innocent persons.

The procedure in making a genetic fingerprint is as follows. The researchers must isolate the target area of DNA and treat it with a combination of proteins called restriction enzymes. Since the target DNA is different from site to site, it may not split at all. The result is a combination of fragments of lengths. The fragments are eventually separated by lengths on a special piece of paper. They form a pattern which looks like the bar code used for identification of products in the supermarket. Crime lab technician can isolate DNA evidence to produce a genetic fingerprint to be compared with that obtained from a suspect. A very small amount of DNA, equal to that in a single hair, can be used to create the necessary fingerprint. A small amount of DNA can be converted into larger amounts through a process known as polymerase chain reaction, or PCR.

FINGERPRINTS

Fingerprints can tie a suspect to a crime scene. Dusting for fingerprints is a technique criminalists may use at a crime scene.

There are three principles that relate to fingerprinting. The first principle is that fingerprints are an individual characteristic. No two fingers have yet been found to have identical ridge characteristics. The acceptance of fingerprint evidence by the courts has always been predicated on the assumption that no two individuals have identical fingerprints. The individuality of a fingerprint is determined by a careful study of its ridge characteristics (minutiae) and not by its general shape or pattern. Second, fingerprints will remain the same during an individuals lifetime. Fingerprints are a reproduction of friction skin ridges on the palm side of the fingers and thumbs. These skin surfaces have been designed by nature to provide our bodies with a firmer grasp and a resistance to slippage. Skin is composed of layers of cells. The outer portion of skin is the epidermis, the inner skin is the dermis. Between the epidermis and dermis is the papillae, which is a boundary of cells separating the two. Each skin ridge is populated with a single row of pores for ducts leading from the sweat glands. Once the finger touches a surface, perspiration along with oils that may have been picked up by touching the hairy portions of the body which are then transferred onto that surface. The result is an impression of the finger’s ridge pattern. Prints deposited in this manner iare referred to as hidden fingerprints because they are invisible to the naked eye. Lastly, fingerprints can be systematically classified according to their general ridge patterns. All fingerprints are divided into three classes on the basis of their general pattern: loops, whorls, and arches. Sixty to sixty-five (60-65%) percent of the population has loops, 30-35% have whorls, and about 5% have arches. The above three classes form the basis for all the ten-finger classification systems presently in use.

A loop consists of one or more ridges entering from one side of the print, re-curving and exiting from the same side. When the loop opens toward the little finger, it is called an ulnar loop; if it opens toward the thumb, it is referred to as a radial loop. The pattern area of the loop is surrounded by two diverging ridges known as type-line divergence in known as the delta. The core is the approximate center of the pattern.

There are four distinct groups of whorls: plain whorl, central pocket loop, double loop and accidental whorl. All whorl patterns must have type lines and a minimum of two deltas. A plain whorl and the central pocket loop have at least one ridge that makes a complete circuit. This particular ridge may be in the form of a spiral oval or any variant of a circle.

Arches are the least common and are divided into two distinct groups: plain arches and tented arches. The plain arch is the simplest of all fingerprint patterns. It is formed by ridges entering from the side of the print and exiting on the opposite side. Generally, these ridges tend to rise in the center of the pattern, forming a wave-like pattern. There is a similarity between the tented arch and the plain arch. The exception is that the plain arch rises smoothly at the center. There is a sharp up thrust or the ridges meet an angle that is less that 90%. Arches do not have type lines, deltas or cores.

There are three kinds of crime scene prints: visible prints made by fingers touching a surface after the ridges have been in contact with colored material such as blood; plastic prints, which are ridge impressions left on a soft material such as soap or dust; and invisible prints or true latents made by impressions caused by the transfer of body perspiration or oil present on ridges to the surface of an object.

CONCLUSION

Forensic science pays a major role in the court room where scientific evidence is admissible. This is especially true in the OJ Simpson murder trail where DNA is considered to be a major piece of evidence. Criminalist are called to testify in court concerning the evidence collected at a crime scene.

DNA fingerprints taken from blood samples at the crime scene can link a suspect to the crime. However, how well a criminalist carries out his/her job is of major importance to the prosecution. In the OJ Simpson murder trial, the defense has pointed out instances of sloppy work both in the collecting and storing of physical evidence at the crime scene and in the crime lab.

Making accurate investigations and utilizing the scientific method in arriving at conclusions enhances critical and analytical thinking skills.

VOCABULARY

1. FORENSIC SCIENCE

2. FIBER

3. PERPETRATOR

4. VICTIM

5. PHYSICAL EVIDENCE

6. SAMPLING

7. CRIME SCENE

8. CONTAMINATION

9. CRIMINALIST

10. EVALUATION

11. PRELIMINARY EXAMINATION

12. AUTHROPOMETRY

13. DNA

14. DNA FINGERPRINTING

15. FINGERPRINT

16. JUDICIAL

17. ADMISSIBLE

18. MOUNTING

19. MEDIUM

20. HALLUCINATION2

1. DELUSIONS

22. TRANSPARENT

23. CELLULOID FILM

24. SEROLOGIST

25. POLYMORPHIC

26. ERYTHROCYTIC

27. PIPETTE

28. SUSPENSION

29. CHROMOSOMES

30. HOMICIDE

31. DEOXIRIBOSE

2. GENE

33. DOUBLE HELIX

CAREER CHOICE—(Criminalist or Forensic Scientist)

* a degree is needed in criminalistics, chemistry or a related field

* One may work in a local police department analyzing physical evidence or at the state or governmental level

LESSON PLAN I—(Forensic Science)

I. Objective:

The students will be able to:

1. define forensic science.

2. list some early pioneers of forensic science and their contributions.

3. discuss the three major subdivisions of physical evidence evaluation.

II. Vocabulary

1. forensic science

2. fiber

3. perpetrator

4. victim

5. evidence

6. anthropometry

7. sampling

8. crime scene

9. preliminary examination

10. criminalist

11. evaluation

12. contamination

III. Question:

Who was Sherlock Holmes and what was he famous for?

Answer:

Accept any reasonable answer as it relates to forensic science

Definition: Forensic science is the application of science to criminal and civil laws that are enforced by police agencies in a criminal justice system.

IV. Question:

Name pioneers who contributed to the discipline of forensic science.

1. Sir Arthur Conan Doyle ‘Sherlock Holmes‘

2. Alphonse Bertillion anthropometry

3. Frances Galton fingerprinting

4. Leone Lattes grouped blood

5. Calvin Goddard ballistics

V. Three Major Subdivisions of Physical Evidence Evaluation

1. collecting

2. laboratory evaluation

3. court presentation

VI. Lab Activity: Fingerprinting

A. Material

1. The teacher will pass along the group with the ink blotter and allow each student to press his/her thumb on the blotter and press it on the paper. Afterwards, wipe off the excess ink from the thumb with the wet paper towel. Have the students write in their notebooks their description of their fingerprint and compare it with their partner. One person from the group will share the findings with the class.

B. Optional: Fingerprint Art

1. Use the ink pad to make several fingerprints then dress them up to look like people by putting in eyes, hats, hair, noses and mouths. One may be as creative as one wishes.

C. Optional

2. Students will solve crimes by using fingerprints: They must make up their own scenario mysteries.

LESSON PLAN II(Physical Evidence)

I. Objective:

The students will be able to:

1. define physical evidence.

2. discuss four common types of physical evidence.

3. discuss the manner in which physical evidence should be handled and why.

II. Vocabulary

1. fiber

2. physical evidence

3. contamination4. admissable

Definition: Physical evidence is any and all objects that can establish that a crime has been committed or can provide a linkbetween a crime and its victim(s).

III. Common Types of Physical Evidence

blood, semen, saliva, documents, drugs, explosives, fibers, fingerprints, paint, glass, hair, impressions, powder, residue, soil and minerals, firearms, ammunition, serial numbers, petroleum products, etc.

IV. Manner in Which Physical Evidence Should be Handled to Prevent Contamination

A. Instruments for retrieving
1. plastic pill bottles with pressure lids

2. envelopes of various sizes

3. paper bags

B. Documentation
1. description and location of items

2. by whom it was discovered

3. how evidence packaged and marked

4. how evidence transported to lab

V. Lab Activity

A. Materials

1. Hair
    a. microscope
    b. slide
    c. cover glassd. five (5) hair samplese. notebook
2. Fiber
    a. microscope
    b. slide
    c. cover glassd. five (5) thread samplese. notebook

B. Procedures

1. Students will investigate all hair and fiber samples underthe microscope. They will also draw the hair and threadsamples in their notebooks.

C. Questions (to be answered in complete sentences)

1. What are the similarities in the hair (thread samplings)?

2. Describe the differences between the hair and thread.

3. How do you think these samplings may be used in a crimelab?

LESSON PLAN III—(DNA-Deoxyribonucleic Acid)

I. Objective:

Students will be able to:

1. define DNA and tell where it is located.
2. explain what the double helix looks like and name the chemical on it.
3. explain where the chromosomes and genes are located in the cell and their function.
4. know the difference between genetic fingerprinting and fingerprints.

II. Vocabulary

1. DNA

2. chromosomes

3. deoxiribose

4. fingerprint

5. genetics fingerprinting

6. genes

7. double helix

8. DNA fingerprinting

III. Chromosomes

A. Human beings have 46 chromosomes 23 pairs

B. located in the nucleus of a cell

C. genes are located on the chromosomes

1. inherited characteristics

2. constructed of DNA segments

IV. DNA looks like a twisted ladder (double helix)

A. Each rung is an alternating step of a sugar and a phosphate
    1. sugar—-deoxyribose
    2. phosphate—-base (A-adenine, T-thimine, C-cytosine and g-guanine)

V. DNA Fingerprinting

A. A unique genetic map
B. Looks like a bar code used in supermarkets
C. PCR (polymerase chain reaction) process used to convert small amounts of DNA into large amounts

VI. Optional:

A. Review cell structure and point out the location of the chromosomes in the nucleus

VII. Laboratory Activity
A. DNA Fingerprinting
B. UPJOHN The Secret of Life
1. Optional: Video The Unity of LifeDiscusses how DNA binds together all forms of life
2. The Secret of Life Videocassettes:The WGBH CollectionP.O. Box 2053Princeton, NJ 08543(800) 828-WGBHFax (609) 275-3767

LESSON PLAN IV(Fingerprinting)

I. Objective:

Students will be able to:

1. list and discuss the three principles of fingerprinting as it relates to the court.
2. list and discuss the three types of fingerprint patterns.
3. List the three kinds of crime scene prints.

II. Vocabulary

1. fingerprint

2. crime scene

3. criminalist

4. epidermis

III. The Three Principles of Fingerprinting

A. Fingerprints are an individual characteristic.
B. Fingerprints will remain the same during an individual's lifetime.
C. Fingerprints can be systematically classified according to their general ridge pattern.

IV. Three Types of Fingerprint Patterns

A. Loops
B. Whorls
    1. Plain Whorls
    2. Central Pocket Loop
    3. Double Loop
    4. Accidental Whorl
C. Arches
    1. Plain
    2. Tented

V. Three Kinds of Crime Scene Prints

A. Visible Prints

B. Plastic Prints

C. Invisible Prints

VI. Lab Activity (Taking Fingerprints from a Glass)

A. Materials:
1. Glass
2. Feather
3. Spoon
4. Adhesive Tape
5. Paper Towel
6. Cornstarch
7. Black Paper
8. Notebook

B. Procedures
1. Use groups of 2 or 4
2. Using a paper towel, wipe off the glass thoroughly and apply the print of a group member's finger
3. sprinkle cornstarch over the print
4. Use a feather and slightly dust the powder residue
5. Stick adhesive tape to the area and un-stick the adhesive tape
6. Apply the adhesive tape onto the black paper
7. Write up your observations to be shared in class

C. Optional
1. Scenario

A student purchased a soda from the store on the way to school. He left the soda on his desk and went to the restroom. Upon returning, he discovered his soda had been half consumed. Let's FIND OUT WHO DID IT BY USING THE PROCEDURE ABOVE . . . .

2. Teacher: Choose one culprit, or the student may have drank it himself and forgot about it.
3. Activity (Using LHS CHES)

a. Solve the crime, page 23 Follow instructions given

FINGERPRINTS

(Use the ink pad and make a sample of your fingerprint. After students have made a sample of their fingerprints, have the class fill out the chart with their names underneath.)

(figure available in print form)

MATERIALS

Ink Pad, Magnifying Glass, Paper

TEACHER READING LIST

Curry, A.S. 'Methods of Forensic Science,' Vol. IV. Interscience Publishers, New York: 1965, pp. 273-283 (methods of forensic science).

Davidson, Henry AMD. 'Forensic Psychiatry.' The Ronald Press Company: New York: 1965 (a psychiatric legal guide).

Davies, Geoffrey. 'Forensic Science,' American Chemical Society, Washington, DC: 1975, pp. 142-149) (A symposium co-sponsored by the Division of Analytical Chemistry and the Division of Chemical Education).

Fersch, Ellsworth A., Ph.D. and Wiley A. 'Psychology and Psychiatry in Courts and Corrections,' Interscience Publications John Wiley and Sons: NY 1980 (a series of addresses on behavioral science in the nature of human personality).

Safferstein, Richard. Criminalistics an Introduction to Forensic Science, Prentice Hall, Inc., Englewood Cliffs, NJ: 1977 (techniques, skills and limitations of the modern crime laboratories).

STUDENT READING LIST

Bobick, James E. and Peffre, Margery. 'Science and Technology Desk Reference,' Soli Research Inc., Detroit: pp. 816, 1018 (1,500 answers to frequently asked or difficult to answer questions).

Clements, W.W. The Study of Latent Fingerprints, Grolier Electronic Publishing, Inc., 1987.

Collins, C.G. 'Fingerprint Science 2nd ed,' Grolier Electronic , Inc.1989.

Crime Lab Chemistry, Great Explorations in Math and Science, Lawrence Hall of Science, University of California Berkley, 1985. (Crime Labs / Fingerprinting Labs)

The New Book of Popular Science, Vol 3., Grolier International, Inc. Philippines 1994. (Reference)

BIBLIOGRAPHY

Bobick, James E. and Peffre, Margery. 'Science and Technology Desk Reference,' Soli Research Inc., Detroit: pp. 816, 1018 (1,500 answers to frequently asked or difficult to answer questions).

Clements, W.W. The Study of Latent Fingerprints, Grolier Electronic Publishing, Inc., 1987.

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Curry, A.S. 'Methods of Forensic Science,' Vol. IV. Interscience Publishers, New York: 1965, pp. 273-283 (methods of forensic science).

Davidson, Henry AMD. 'Forensic Psychiatry.' The Ronald Press Company: New York: 1965 (a psychiatric legal guide).

Davies, Geoffrey. 'Forensic Science,' American Chemical Society, Washington, DC: 1975, pp. 142-149) (A symposium co-sponsored by the Division of Analytical Chemistry and the Division of Chemical Education).

Fersch, Ellsworth A., Ph.D. and Wiley A. 'Psychology and Psychiatry in Courts and Corrections,' Interscience Publications John Wiley and Sons: NY 1980 (a series of addresses on behavioral science in the nature of human personality).

Safferstein, Richard. Criminalistics an Introduction to Forensic Science, Prentice Hall, Inc., Englewood Cliffs, NJ: 1977 (techniques, skills and limitations of the modern crime laboratories).

The New Book of Popular Science, Vol 3., Grolier International, Inc. Philippines 1994.