**Forensic Science**

**Includes the following examples:**

**Forensics – “g” Vista del Lago HS**

**Forensics - “g” Folsom HS**

**Forensics - “g” Cypress Charter HS**

**Forensics – “d” Folsom HS**

**Forensic Science – “d” Beaumont HS**

**Forensic Science – “d” - Monte Vista HS**

**Forensic Science “d” – Paloma Valley HS**

**Forensic Science “d” – Los Angeles Leadership Academy HS**

**Forensics**

**Vista del Lago HS**

College Preparatory Elective “g” –

Discipline: Laboratory Science – Integrated Science

Forensics is a third year of college-prep laboratory science for students that are college bound and/or interested in the field of forensics. This class will introduce students to the fields of forensic science and provide a general overview of the forensic sciences. Students will participate in many qualitative hands-on labs and simulations that develop the practical and theoretical aspects of forensics. This class will integrate previous science courses and demonstrate to the student the relevance of science education for practical use.

Prerequisites:

2 years high school level science with C’s or better (required)

Algebra 1 with a grade of C or better (required)

o Soil Separation Lab: Students will use various physical separation methods to sort through soil to uncover evidence. o Centrifugation Lab: Students will use centrifugation as a means of separating mixtures based upon density. o Chromatography Lab: Students will employ liquid chromatography techniques to separate a mixture of chemicals as a means of identifying them based upon their mass, color and chemical affinities. o Chemical Separation Lab: Students will use solubility and pH as a means of separating and identifying substances. o Material Science Lab: Materials will be examined and identified based upon their physical and chemical properties: melting point, boiling point, freezing point, solubility, plasticity, density and flammability. o Forensic Chemistry Lab: Analysis and detection of the following chemical components will be practiced: Illicit Drugs, Toxic Compounds, Fibers, Paints, and Other Polymers, Glass and Soil, Fires and Explosions o Microscopy: microscopes will be used to examine and identify materials, tissues and fluids. o Fingerprinting: students will learn fingerprinting techniques and the means to use fingerprint patterns to identify individuals. o Impressions Lab: The techniques for taking molded impressions from tire tracks, shoe prints, toolmarks and other objects will be practiced o Document Analysis: Students will learn how to analyze and compare handwriting.and will analyze ink and paper using thin layer chromatography techniques. o Firearms lab: the physics of bullet trajectory and matching bullets to firearms will be investigated. o Anatomy and Pathology Labs: :Students will learn how autopsies are performed. A medical examiner would be invited as a guest speaker.. Students will learn techniques used to determine time of death. o Skeletal Remains Lab: Students will learn about the human skeleton .and how to distinguish between human bone from other animal bone. Students will determine approximate age of individual based upon skeletal remains. o Hair Lab: Students will differentiate between human hair and nonhuman hair. Students will use hair samples to determine age, gender, and whether the sample has been colored. o Entomology Lab: Students will explore decomposition rates and the roles of insects in the process. o Serology lab: Students will learn how to confirm a sample is blood and how to

 locate blood samples at a crime scene and how to perform A/B/O blood typing using a simulated blood product. o Blood splatter Lab: Students will analyze blood spatter and use this information to reconstruct an incident. o DNA Extraction Lab: Students will learn how to extract DNA from living tissues and crime scene samples. o Polymerase Chain Reaction (PCR) Lab: Students will learn how to process samples for PCR, a means of amplifying the amount of DNA available for analysis from small samples. o DNA Fingerprinting Lab: Students will learn how to perform DNA fingerprinting as a means of positively identifying individuals based upon their unique DNA sequences.

Textbook:
Forensics Seigle McGraw 2nd edition - primary text

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**Forensics**

**Folsom HS**

College Preparatory Elective “g”

Discipline: Laboratory Science – integrated science

Grade levels – 10th,11th

Forensic science is a laboratory-based introduction to the analysis of crime scenes by collecting and analyzing physical evidence. This course is designed to integrate the core scientific disciplines (as outlined in the California State Science Standards for grades 9-12) while giving students both theory and hands-on experience with the skills and knowledge required of a forensic crime scene investigator. This multidisciplinary approach will highlight topics in DNA, genetics, anatomy, chemistry, physics, entomology, botany, and investigative techniques with supplemental subject matter through case studies, earth science, mathematics, medicine, technology and sociology. In addition, the ethical, legal, and social concerns surrounding forensics will be discussed. Sample evidence for analysis will include, but is not limited to, fingerprints, DNA, projectiles and trajectories, hair, fibers, toxicology, blood spatter patterns, ballistics, chromatography, entomology, soil samples, flowers, and impressions. Process skills will include comparative analysis, critical thinking, deductive reasoning, interviewing, observation, organization, problem solving, research, communication, evidence collection, lab safety, and technical reading. Project-based learning through laboratory investigations and discussions/class lecture will serve as the main method of content delivery.

• Apply the major concepts in biology, chemistry, and physics as the basis for solving crimes. • Design and conduct scientific investigations by identifying questions and concepts that guide forensic science. • Use technology and mathematics to improve investigations and communications. • Formulate and revise scientific explanations and models using logic and evidence. • Recognize and analyze alternative explanations and models. • Communicate and defend scientific argument. Students will use their newly acquired knowledge and skills to answer questions, solve problems (crimes), and communicate effectively supporting their conclusions.

Prerequisites: Biology (required)

nstructional Methods and/or Strategies • Unit pretests to determine skill level in biology, chemistry, and physics • Lab experiments and activities • Lecture w/PowerPoint • Case studies - research and report a synopsis of the crime, the case, the type of evidence examined, how the case was botched, what precedents were set, and the outcome of the trial • Online tutorials and interactive crime investigations • Internet research • Current events from journals and new sources • Structured controversy via discussion or writing assignment • Forensic Files (Court TV) and Medical Detectives (TLC); these 30 minute segments offer real-life crime reconstructions and the forensic science behind cracking the case • Unit/vocabulary study guides • Paper and performance based assessment • Assigned reading and outlining from text to supplement lecture

Fall and Spring Final Exams - Mock trial; 2 crime scenes will be set up with evidence examined in the course of the semester as well as extraneous materials. Students will be assigned specialized groups for evidence analysis, jurors, attorneys, witnesses. Each student will play the role of forensic scientist in one scenario, and courtroom participant the other. In addition to the specific assessments below, units will include most, if not all of the following: • Performance assessments • Case study analysis • Research project or opinion papers • Chemistry practice problems/calculations • Lab result assessment and proper interpretation of evidence (please see lab list in ‘Key Assignments’ section) • Unit exam focused on scientific principals, vocabulary, and data analysis/lab activities

1. Introduction to Forensic Science (1-2 weeks) A. Definition and scope of forensic science: real CSI vs. ‘reel CSI’ B. History and development of forensic science C. Crime lab organizations and services: private vs. public labs, departments, state/local lab vs. federal D. Areas of forensic science: criminalist, pathologist, medical examiner, coroner, accident reconstruction, odontologist, pathologist, anthropologist, mental health profiler, document examiner, toxicologist, artist, accountant, ballistics expert, dactyloscopist, entomologist, geologist, computer examiner, linguist E. The forensic scientist: education, training, and expert testimony F. Evidence transfer and persistence: Locard’s principle and the scientific method G. Court room decisions that have impacted the admissibility of evidence II. The Crime Scene and Physical Evidence (1 week) A. Defining a crime scene: artifacts and evidence B. Review the metric system and appropriate units of measurement C. Uses for and information from physical evidence in criminal investigations D. Kinds of evidence: individual vs. class, circumstantial, conclusive, conflicting, cooborating, presumptive, Prima facia, probative, tainted E. General crime scene procedures, management, and investigative techniques F. Securing the crime scene, survey (photography and sketching), documentation, collection and preservation of evidence G. Chain of custody H. Safety: universal precautions, protective equipments, handling of hazardous materials I. Contamination of evidence J. Identity, class, and individualization of evidence K. Preliminary analysis of evidence and controls L. History of precedent-setting law cases M. Using statistics to calculate probability of evidence - inclusion or exclusion III. Fingerprints (2 weeks) A. The integumentary system B. Epithelial tissue and its general characteristics C. Skin layers: epidermis, dermis, and hypodermis D. Accessory organs: nails, sebaceous glands, sweat glands, eccrine glands, and apocrine glands E. Heat production and loss F. Healing of wounds and burns G. Fingerprints as evidence H. History of fingerprinting I. Fundamental principals in fingerprint morphology and classification J. Methods of detecting fingerprints K. Preservation of developed fingerprints: manually and via computer IV. DNA Fingerprinting (4 weeks) A. Organic compounds and components: carbohydrates, lipids, protein, and nucleic acids B. Nucleotides, DNA replication, and protein synthesis C. Genetics and Punnett square review D. Repetitive sequences of the human genome E. Genetic engineering and mutations F. The beginning of DNA fingerprinting G. Collection and preservation of biological evidence for DNA analysis H. Comparing nuclear and mitochondrial DNA and its forensic applications I. Isolating DNA J. Restriction fragment length polymorphisms, short tandem repeats, and single nucleotide polymorphisms K. Mechanics of polymerase chain reaction L. Mechanics of electrophoresis (gel and capillary) M. Electropherogram pedigree analysis N. Population genetics support via statistical data O. Challenges in court: the admissibility of DNA evidence, discovery and legal procedures, convicted offenders databases, protecting the innocent, DNA in noncriminal cases P. Probability statistics Q. The future of DNA typing V. Human Remains and Entomology (5-6 weeks) A. Levels of organization – cell, tissue, organ, organ systems B. Four types of tissues (epithelial covered in unit 3) C. Human body systems overview D. The human skeleton and anatomy of bones E. Physical anthropology and the sexual dimorphism of bones F. Importance in determining time of death and decomposition G. Taphonomy (the history of a body after death) and archaeology: human remains in water environments (diatom taxonomy) and buried remains H. Class Insecta I. Metamorphosis and the life cycle of a fly J. Collection and challenges of entomological evidence K. Performing an autopsy VI. Physical Properties: Glass and Soil (2-3 weeks) A. Errors and estimates in lab measurements - significant figures B. The chemistry of matter: subatomic particle, elements, and compounds C. Analyzing evidence using density D. Interactions of light and matter E. Applications of spectrometry F. Characteristics of glass G. Refractive index and the forensic applications of glass H. The effect of projectiles on glass and fracture match I. Soil composition and color analysis J. Climate and soil formation K. Analysis of humic fractions of soils L. Microorganisms and their effects on evidence VII. Organic & Inorganic Analysis (5 weeks) A. Elements and compounds (inorganic and organic) B. Using the periodic table C. Modern atomic theory D. Isotopes – calculating mass and their role in scientific research E. Balancing chemical equations and gram-mole conversions F. Types of reactions G. The electromagnetic spectrum H. Properties of waves and the mathematics of light I. Physical separation of solid mixtures J. Chemical separation of solid mixtures: solubility and pH K. Chromatography: separating small amounts of material L. Electrophoresis: separating very similar substances M. Spectrometry: identifying unknowns by their mass N. The emission and absorption spectrum of elements O. Neutron activation analysis P. X-ray diffraction VIII. Hair, Fibers, and Paint and the Microscope (3 weeks) A. Lenses: how objects are magnified B. Using the compound microscope, stereomicroscope, and comparison microscope C. Mechanics of a scanning electron microscope in forensics D. Human vs. animal hair comparison E. Structure, growth, color, treatment and damage or hair F. The morphology hair and its forensic implications G. DNA analysis of hair H. Polymer composition and structure I. Fiber morphology J. Analysis and interpretation of synthetic fibers K. Paint and other coating compositions L. How cars are painted M. Identification of fiber and paint trace evidence using refractive index and fluorescence IX. Drugs and Toxicology (4 weeks) A. Organic chemistry and organic compounds B. Solubility and acid-base properties C. Major classes of drugs and their effects on the human body D. Testing process E. Ethyl alcohol and measurement of blood alcohol content F. Pharmaceutical materials G. Nonmedical agents H. Metal analyses I. Analytical methods: microcrystalline test, spectroscopy chromatography J. Drug control laws K. Applications of forensic toxicology X. Arson and Explosives (2 weeks) A. Thermal equilibrium B. Balancing chemical equations for combustion C. Redox reactions D. Thermochemistry of fire E. Heat capacity and phase changes F. The mathematics of calorimetry G. Kinetic molecular theory of gases H. Mathematics of gas laws I. Deliberately set fires: arson and incendiary J. Collection and preservation of arson evidence K. The role of accelerants and types of explosives L. Collection and analysis of explosives XI. Forensic Serology (3 weeks) A. Circulatory system – structures and functions B. The nature of blood - cell types and function C. Antigens, blood types, and antibodies D. Principles of heredity for blood characteristics E. Immunoassay techniques F. Species origin determination in bloodstains G. Size, shape, and directionality of bloodstains H. Stain patterns of blood; spatter angle of impact and velocity I. Interpretation of bloodstains on clothing and footwear J. Use of luminal photography for bloodstain pattern analysis K. Identification of other biological fluids: semen, saliva, urine, feces, vomitus, and vaginal secretions XII. Trace Evidence, Impressions, Firearms, and Tool Marks (1- 2 weeks) A. Biometrics – lip prints and saliva B. Coefficient of friction – determining a cars speed and direction C. Issues surrounding gun control D. Types of modern firearms, manufacturing, and ammunition E. Collection of firearms-related evidence F. Gunpowder residues and primer residues on hands G. Types of tool marks H. Processing of tool mark evidence at the crime scene I. Original equipment tires, replacement tires, and tire construction J. Tire tread nomenclature and sidewall information K. Collecting tire track evidence L. Headlamp analysis M. Vehicular accident analysis XIII. Botany (3 weeks) A. Plant classification, morphology, and reproduction B. Collection and challenges of palynological (pollen) evidence C. Linking suspect to scene via biological evidence D. Plants – the production of controlled substances XIV. Ethical, Legal, and Social Issues (to be incorporated throughout the year) A. Law enforcement and the law B. Forensic scientists, scientific values, and the law C. Scientifically reliable methods D. The great debate – discussion of ethical issues related to forensics (see Key Assignments for unit 15) E. Mock trial – take the evidence to court (see Assessment Methods)

Unit 1: Introduction to Forensic Science • Research the location of local and state crime labs: how are they organized, what services do they offer, how many cases are handled each year, what types of cases are most common? • Read Newsweek article The CSI Effect • Forensic Roles Group Research; divide the 18 specialty careers in forensics amongst 4 group members and describe the specialty area, responsibilities or job opportunities, and the education required • Activity - Leads vs. Needs; test your investigative techniques

http://www.crimelibrary.com/criminal\_mind/forensics/buddhist\_temple/index.html • Case Study - Jascalevich Murder Trial; offers an example of the legal and scientific issues involved in assessing the admissibility and value of scientific evidence Unit 2 - The Crime Scene and Physical Evidence • Activity: Probability and Class Evidence; students make a list of characteristics to describe students in their school. Using probability calculations, determine how many of such characteristics would be needed to narrow a suspect down to 1-2 students • Lab: Can This Evidence be Individualized? Students examine 13 types of evidence with stereomicroscopes to determine if it is 1) individual evidence, class evidence, or has probative value • Activity: Eye Witness demonstration; students unknowingly witness a crime and must give details regarding the event and identify the perpetrator in a line-up • Lab: Crime Scene Investigation; isolate, record, and search for evidence at a mock crime scene using proper forensic procedures • Case Study - Crafts Murder Trial; offers an example of how a conviction can be made even if a dead body is never found • Case Study - the Wayne Williams trial; circumstantial fiber evidence and probability determination Unit 3 - Fingerprints • Lab: Observing and Taking Fingerprints • Lab: Developing Latent Fingerprints • Research: Investigate the use of retinal scans as a means of identification. Is this a valid method of identification? What are advantages and disadvantages over the use of fingerprints? What about other biometric measurements? Unit 4 - DNA Fingerprinting • Lab: DNA Extraction from Bovine Thymus (lab) • Computer simulation - PCR and electrophoresis

http://nobelprize.org/educational\_games/chemistry/pcr/ • Activity: Using a micropipette and gel box • Lab: DNA Fingerprinting (using rented equipment from the Santa Clara County Biotechnology Education Partnership) • Lab: PCR of the Alu gene with data entry to worldwide database online (using rented equipment from the Santa Clara County Biotechnology Education Partnership) \*Note - this lab may be completed in the future with another unit where the subject matter is not as lab intensive. • Activity: Creating Pedigrees from Electropherograms; students use electropherogram results to create a family pedigree • Activity: Identifying the Remains of the Romanovs

http://www.shodor.org/workshops/forensic/cases/romanov.html • Activity: Statistics Sampling Lab; students calculate the probability that one of their class mates committed a crime • Case study - The OJ Simpson Trial; how irrefutable evidence sets new precedents Unit 5 - Human Remains and Entomology • Lab: Fetal Pig Dissection - modeling an autopsy and investigate the various organ systems • Online Tutorial: http://www.nlm.nih.gov/visibleproofs/education/anthropological/index.html • Lab: Estimating Age, Gender and Height from Bones at a Crime Scene • Field trip to medical examiner (future?) or the San Jose Technology Museum (2007) for the Body Worlds exhibit. Worksheet to accompany. • Activity: Spontaneous Generation? Maggots on meat. • Lab: Entomology In Action and Calculating Accumulated Degree Hour (time of death) • Interactive Crime Scene Entomology Collection http://www.pbs.org/wnet/nature/fun/crimescene\_flash.html • Video: Insect Clues (Nature) • Lab: Diatom Taxonomy in a Drowned Victim • Read - Body Farm article and complete questions Unit 6 - Physical Properties, Glass and Soil • Demo: Disappearance of Becke lines • Lab: Collecting and Analysis of Minerals and Soil • Lab: Observation and Characterization of Different Types of Glass • Lab: Determining Refractive Index • Calculations: Solving chemistry problems in forensics • Case Study - The Coors Kidnapping and Murder; conviction of Walter Osbourne from layers of soil trapped in wheels Unit 7 - Organic & Inorganic Analysis • Lab: Qualitative Analysis by Thin-Layer Chromatography • Lab: The Quantitative Analysis of Aspirin by Spectrophotometry • Lab: Flame Tests to Determine the Unknown • Lab: Analysis of White Powders; students will use forensic investigation methods introduced in this unit to identify unknown powders • Read: FDA’s Forensic Center: Speedy, Sophisticated Sleuthing http://www.fda.gov/fdac/features/695\_forensic.html; describe their uses of spectrometry, electrophoresis, and chromatography • Calculations: Solving chemistry problems in forensics • Case Study - The Assassination of President Kennedy; the use of neutron activation analysis Unit 8 - Hair, Fibers, and Paint and the Microscope • Lab: Microscopic Observation of Hair, Fibers, Fabric and Paint • Activity: Test Your Skills as a Forensic Hair Examiner http://dsc.discovery.com/fansites/onthecase/hair/photo.html • Lab: Thermal Decomposition and Burn Tests on Fabric • Lab: Distinguishing Fiber Type by Refractive Index and Fluorescence • Case study - Microscopic Trace Evidence; wood evidence in the Lindbergh kidnapping • Research - Investigate the legal aspects of taking hair samples from a suspect, similar to issues around fingerprinting. Is this a violation of the Fifth Amendment? • Activity: Sampling and Statistics; what are the chances that the fibers found at a crime scene belong to a student in the class? Unit 9 - Drugs and Toxicology • Lab: Presumptive Color Tests for Drugs • Demo: Alcohol Breath Analyzer

http://chem.lapeer.org/Chem1Docs/Breathalyzer.html • Lab: The Quantitative Analysis of Aspirin by Spectrophotometry • Lab: Detecting Lead • Lab: Analysis of Drugs and Poisons • Research - prepare a one-page report on a toxin or poison of your choice including description, source, toxicity, symptoms, detection, cure, lasting effects, history, examples, and social impact, if any. (This is one of five topics to choose from. Other are Napoleon’s death, Beethoven’s death, Lincoln and Newton’s supposed mercury poisoning, and the stillborn foal epidemic in Kentucky, 2001) • Opinion paper - Write a paper analyzing the arguments about the legalization of drugs in the United States. Unit 10 - Arson and Explosives • Demo: Using Isopropyl Alcohol to Demonstrate Volatility and Flash Point • Demo: Touch Explosives using Ammonia and Iodine Crystals • Lab: Case of the Fallen Walkway; three parts investigate oxidation/reduction, the source and cause of corrosion, and identifying sacrificial metals • Case Study - The Crash of TWA Flight 800 • Calculations: Solving chemistry problems in forensics • Nova video: Hunt for the Serial Arsonist Unit 11 - Forensic Serology • Lab: Blood Typing Simulation • Activity: Detection of Blood Using Hemastix and Hydrogen Peroxide • Lab: Prepared Slides of Human and Animal Blood • Blood spatter tutorial http://www.bloodspatter.com/BPATutorial.htm • Lab: Where’s the Shooter? Where’s the Victim? Calculating bullet trajectories • Case Study - Sam Sheppard’s Case Reopened: What the Blood Told • Case Study – What the FBI Said vs. the Black Panthers; using trajectory evidence to reconstruct the crime Unit 12 - Trace Evidence, Impressions, Firearms, and Tool Marks • Lab: Analyzing Lipstick with Thin-Layer Chromatography • Lab: Identification of Metals • Lab: Vehicular Accident Analysis; students will determine how fast a car was going by the skid marks and coefficient of friction in addition to identifying other trace evidence • Activity: Bullet Comparison and Firing Pin Impressions • Complete the firearm tutorial

http://library.med.utah.edu/WebPath/TUTORIAL/GUNS/GUNINTRO.html Unit 13 Botany • Lab: Pollen Under the Microscope • Lab: Flowers for Freddy – plant morphology and taxonomy helps identify a suspect Unit 14 - Ethical, Legal, and Social Issues Debate the following: • Should DNA be taken from all people accused of a crime? • Should capital punishment be abolished? • Death sentence vs. life imprisonment? • Is there a “mean” gene? • Should teenagers be tried as adults? • Should prisoners be rehabilitated? • What measures can be done to make our campus a safer environment? • Do sports, movies, and music influence criminal behavior? • Should sexual offenders be sterilized?

Cells and Microbiology • Bacteria: Students will culture harmless bacteria in the lab and will demonstrate the ability to prepare the proper nutrient broth, streak the plate and transform the bacteria using sterile technique. • Cell Structure & Function: Students will analyze various slides obtained from a wide variety of histology groups and will consist of healthy and unhealthy tissue. Based on their analysis they will be able to identify conditions that may have contributed to the cause of death. Students will also prepare some of their own slides for examination and are responsible for the staining and proper mounting of the specimens • Microscopy: Students will have the opportunity to use advance microscopy techniques to view slides at 1000X power. They will also have samples viewed under an electron microscope. Students will label and draw detailed diagrams of all organisms viewed under the microscope. Genetics • ABO/Rh: Using stimulated blood samples, students will determine ABO and Rh Factor typing for mock paternity and crime scene investigations. Students will test the unknown blood samples along with controls and based on antigen-antibody complex formation will record the blood type. Genetic crosses, Monohybrid and dihybrid Punett squares, will then be used in conjunction with the blood typing to exclude and include suspects based on blood type inheritance • Pedigrees: Using Ted Bundy as an example, students will construct a pedigree based on phenotypical analysis and extrapolate potential genotypes based on the patterns of inheritance. Students will determine if there is a genetic link to behavior based on the analysis of the Bundy family. • DNA Isolation: Students will be responsible for DNA extraction, solution preparation, gel preparation and analysis for all molecular labs. • DNA Fingerprinting (PCR/Gel Electrophoresis): • Students will perform restriction enzyme digests on DNA samples and perform gel electrophoresis to separate the fragments. Students will then stain the gels with methylene blue (or ethidium bromide dependant on the sensitivity required) and will analyze their results. Restriction enzyme maps will be constructed and the DNA evidence will be interpreted. Band size will also be determined using graphs. • Students will isolate their own DNA and perform PCR to amplify a region of DNA known as D1S80 consisting of VNTRs. • Students will isolate their own DNA and perform PCR to amplify the 13 STR regions identified in CODIS to create their individual unique DNA profile. • Apply their knowledge of PCR, DNA and gel electrophoresis to analyze results found at a crime scene. • DNA stability over time: Students will evaluate the stability of DNA over time and based on various conditions of their choice. PCR and gel electrophoresis will be utilized • Karyotypes: Students will assemble normal and abnormal karyotypes from a wide variety of conditions. Based on the structural and numerical abnormalities, students will be able to positively identify the syndrome and sex of the individual. Ecology • Botany: Investigate how seeds, pollen and fungal spore evidence can be used to determine location and time of death in crime scene investigations based on the organisms’ life cycle • Entomology: • Students will diagram and describe the life cycle of a blowfly in a laboratory setting. Based on time, if given an unknown specimen, students should be able to approximate the time of death. Environmental factors, such as temperature, that effect the time of death will be analyzed. • Describe the order and function of various insects arriving to a corpse and how they contribute to the decomposition of a body. • Students will go out into different areas of the campus every month and document the various types of insects found. Based on their data they can identify the habitat and environmental factors that effect insects and how time of death can be calculated. • Solvent extraction and TLC (think layer chromatography) will be used to determine how blowflies can provide toxicological clues which can lead to a potential cause of death • Decomposition: Using meat, students will conduct experiments on the rates and stages of decomposition in various environments and will be able to describe how water, nitrogen, phosphorus, sulfur and other minerals are returned to their cycle and environment. • Food Chains: Based on chemical analysis students will be able to describe how various environmental pollutants can impact the food chain. • Soil Analysis: Students will analyze various types of soil for their physical and chemical properties. Based on their results they will be able to describe how these soils are unique to the areas from which they are found based on the environment. Human Physiology • Fingerprinting: Using fingerprint ink, students will roll their prints and analyze the basic and minutiae patterns. Calculate their ratio using Henry’s Classification System. Roll another person’s fingerprints and calculate their ratio using Henry’s Classification System. Identify dust/develop and lift prints using proper technique on various surfaces such as glass, wood, paper, tile, plastic, aluminum using ninhydrin, cyanoacrylate fuming, magnetic and original fingerprint powders, silver nitrate and fluorescent powder. Students will need to match these prints to various suspects in crime scene scenarios Identify a set of identical twins and analyze their fingerprints to understand the basics of inheritance. Participate in a mock crime scene where fingerprint evidence must be utilized to determine who committed the crime • Trace Evidence: Students will analyze their own hair structure microscopically and identify the following characteristics: surface pattern, cortex, medulla, root structure, tip structure and pigmentation from different types of hair locations. They will compare their findings by analyzing real hair samples from other individuals in the class of different ethnic backgrounds. Based on their findings they will be able to identify various types of information that can be gained from hair left at a crime scene such as: hair pulled or fell out, cut or color treated. Students will analyze hair samples from various types of animals microscopically and identify the following characteristics: surface pattern, cortex, medulla, root, tip and pigmentation. Based on their findings they will be able to identify unknown samples. Students will also analyze various types of other microscopic trace evidence throughout the year such as paint, ash, skin flasks, dust, pollen, fingernail fragments in various crime scene investigations. • Blood Splatter Patterns: Using their knowledge of the physical properties of blood, velocity and trajectories, students will determine the sequence of events that occur at a mock crime scene using blood splatter patterns and will relate these events to the type and degree of injury the victim sustained. They will also string the room to approximate points of impact. • Blood Detection: Students will conduct various presumptive tests such as the use of Luminol, Hemastix, Kastle-Meyer and analyze the results to locate blood evidence • Urinalysis: Students will perform mock urinalysis on samples of stimulated urine as well as a number of presumptive tests for the presence of protein, glucose and HGH (pregnancy test) and interpret their results based on the data. • Autopsy: Students will perform a mock autopsy on a fetal pig and will name, identify. draw and explain the function for the following systems: Nervous (Central and Peripheral), Excretory, Reproductive, Circulatory, Respiratory, Endocrine and Digestive. Proper protocol for examination, incision making, extracting, weighing, measuring and evaluating the organs for a potential cause of death. Students will document their findings using the proper format recognized by the Coroner’s office • Stomach Contents: Use indicators (Benedict’s, Iodine, Biuret) to detect the presence of common macromolecules • Forensic Ondontology: Using casts from various types of teeth, students will identify and match bite marks in terms of radius, tooth length and unique dental features. They will also cast their own bite marks found on evidence at a crime scene. • Wound Pattern Analysis: Using photographs, students will identify and describe the presence of wounds (including defensive wounds) made by various types of weapons found a crime scenes (knives, shotguns, bullets, ligatures) and how these weapons damage the dermis and underlying tissue. Based on these patterns, students will be able to identify the cause of death in mock crime scene investigations. • Lividity: Using photographs, students will identify and describe how lividity can be used to determine time of death. Students will discover how the relocation of a corpse will change the patterns of lividity • Forensic Anthropology: Students will view and measure replica bones from male and female skeletons as well as skull from European, Asian and African subjects to determine the various differences between sex and race. Bone structure will also be analyzed using pictures that show various types of wear and tear that can provide clues about the age, health, medical history and body size of the individual. • Core Body Temperature: Students will calculate and predict approximate time of death by researching and graphing how the body’s muscle mass cools as a function of time and ambient air temperature. They will also predict how heating systems and air conditioning could effect their calculations

Textbook

Forensic Science: An Antro Richard Soferstein

Pearson Prentice Hall 1st edition primary text

**Forensics**

***Cypress Charter High School***

*College Preparatory Elective “g” 10th,11th*

*Forensic science is a laboratory-based introduction to the analysis of crime scenes by collecting and analyzing physical evidence. This course is designed to integrate the core scientific disciplines (as outlined in the California State Science Standards for grades 9-12) while giving students both theory and hands-on experience with the skills and knowledge required of a forensic crime scene investigator. This multidisciplinary approach will highlight topics in DNA, genetics, anatomy, chemistry, physics, entomology, botany, and investigative techniques with supplemental subject matter through case studies, earth science, mathematics, medicine, technology and sociology. In addition, the ethical, legal, and social concerns surrounding forensics will be discussed. Sample evidence for analysis will include, but is not limited to, fingerprints, DNA, projectiles and trajectories, hair, fibers, toxicology, blood spatter patterns, ballistics, chromatography, entomology, soil samples, flowers, and impressions. Process skills will include comparative analysis, critical thinking, deductive reasoning, interviewing, observation, organization, problem solving, research, communication, evidence collection, lab safety, and technical reading. Project-based learning through laboratory investigations and discussions/class lecture will serve as the main method of content delivery.

• Apply the major concepts in biology, chemistry, and physics as the basis for solving crimes. • Design and conduct scientific investigations by identifying questions and concepts that guide forensic science. • Use technology and mathematics to improve investigations and communications. • Formulate and revise scientific explanations and models using logic and evidence. • Recognize and analyze alternative explanations and models. • Communicate and defend scientific argument. Students will use their newly acquired knowledge and skills to answer questions, solve problems (crimes), and communicate effectively supporting their conclusions.*

Prerequisites: Biology (required)

Instructional Methods and/or Strategies • Unit pretests to determine skill level in biology, chemistry, and physics • Lab experiments and activities • Lecture w/PowerPoint • Case studies - research and report a synopsis of the crime, the case, the type of evidence examined, how the case was botched, what precedents were set, and the outcome of the trial • Online tutorials and interactive crime investigations • Internet research • Current events from journals and new sources • Structured controversy via discussion or writing assignment • Forensic Files (Court TV) and Medical Detectives (TLC); these 30 minute segments offer real-life crime reconstructions and the forensic science behind cracking the case • Unit/vocabulary study guides • Paper and performance based assessment • Assigned reading and outlining from text to supplement lecture

Fall and Spring Final Exams - Mock trial; 2 crime scenes will be set up with evidence examined in the course of the semester as well as extraneous materials. Students will be assigned specialized groups for evidence analysis, jurors, attorneys, witnesses. Each student will play the role of forensic scientist in one scenario, and courtroom participant the other. In addition to the specific assessments below, units will include most, if not all of the following: • Performance assessments • Case study analysis • Research project or opinion papers • Chemistry practice problems/calculations • Lab result assessment and proper interpretation of evidence (please see lab list in ‘Key Assignments’ section) • Unit exam focused on scientific principals, vocabulary, and data analysis/lab activities

1. Introduction to Forensic Science (1-2 weeks) A. Definition and scope of forensic science: real CSI vs. ‘reel CSI’ B. History and development of forensic science C. Crime lab organizations and services: private vs. public labs, departments, state/local lab vs. federal D. Areas of forensic science: criminalist, pathologist, medical examiner, coroner, accident reconstruction, odontologist, pathologist, anthropologist, mental health profiler, document examiner, toxicologist, artist, accountant, ballistics expert, dactyloscopist, entomologist, geologist, computer examiner, linguist E. The forensic scientist: education, training, and expert testimony F. Evidence transfer and persistence: Locard’s principle and the scientific method G. Court room decisions that have impacted the admissibility of evidence II. The Crime Scene and Physical Evidence (1 week) A. Defining a crime scene: artifacts and evidence B. Review the metric system and appropriate units of measurement C. Uses for and information from physical evidence in criminal investigations D. Kinds of evidence: individual vs. class, circumstantial, conclusive, conflicting, cooborating, presumptive, Prima facia, probative, tainted E. General crime scene procedures, management, and investigative techniques F. Securing the crime scene, survey (photography and sketching), documentation, collection and preservation of evidence G. Chain of custody H. Safety: universal precautions, protective equipments, handling of hazardous materials I. Contamination of evidence J. Identity, class, and individualization of evidence K. Preliminary analysis of evidence and controls L. History of precedent-setting law cases M. Using statistics to calculate probability of evidence - inclusion or exclusion III. Fingerprints (2 weeks) A. The integumentary system B. Epithelial tissue and its general characteristics C. Skin layers: epidermis, dermis, and hypodermis D. Accessory organs: nails, sebaceous glands, sweat glands, eccrine glands, and apocrine glands E. Heat production and loss F. Healing of wounds and burns G. Fingerprints as evidence H. History of fingerprinting I. Fundamental principals in fingerprint morphology and classification J. Methods of detecting fingerprints K. Preservation of developed fingerprints: manually and via computer IV. DNA Fingerprinting (4 weeks) A. Organic compounds and components: carbohydrates, lipids, protein, and nucleic acids B. Nucleotides, DNA replication, and protein synthesis C. Genetics and Punnett square review D. Repetitive sequences of the human genome E. Genetic engineering and mutations F. The beginning of DNA fingerprinting G. Collection and preservation of biological evidence for DNA analysis H. Comparing nuclear and mitochondrial DNA and its forensic applications I. Isolating DNA J. Restriction fragment length polymorphisms, short tandem repeats, and single nucleotide polymorphisms K. Mechanics of polymerase chain reaction L. Mechanics of electrophoresis (gel and capillary) M. Electropherogram pedigree analysis N. Population genetics support via statistical data O. Challenges in court: the admissibility of DNA evidence, discovery and legal procedures, convicted offenders databases, protecting the innocent, DNA in noncriminal cases P. Probability statistics Q. The future of DNA typing V. Human Remains and Entomology (5-6 weeks) A. Levels of organization – cell, tissue, organ, organ systems B. Four types of tissues (epithelial covered in unit 3) C. Human body systems overview D. The human skeleton and anatomy of bones E. Physical anthropology and the sexual dimorphism of bones F. Importance in determining time of death and decomposition G. Taphonomy (the history of a body after death) and archaeology: human remains in water environments (diatom taxonomy) and buried remains H. Class Insecta I. Metamorphosis and the life cycle of a fly J. Collection and challenges of entomological evidence K. Performing an autopsy VI. Physical Properties: Glass and Soil (2-3 weeks) A. Errors and estimates in lab measurements - significant figures B. The chemistry of matter: subatomic particle, elements, and compounds C. Analyzing evidence using density D. Interactions of light and matter E. Applications of spectrometry F. Characteristics of glass G. Refractive index and the forensic applications of glass H. The effect of projectiles on glass and fracture match I. Soil composition and color analysis J. Climate and soil formation K. Analysis of humic fractions of soils L. Microorganisms and their effects on evidence VII. Organic & Inorganic Analysis (5 weeks) A. Elements and compounds (inorganic and organic) B. Using the periodic table C. Modern atomic theory D. Isotopes – calculating mass and their role in scientific research E. Balancing chemical equations and gram-mole conversions F. Types of reactions G. The electromagnetic spectrum H. Properties of waves and the mathematics of light I. Physical separation of solid mixtures J. Chemical separation of solid mixtures: solubility and pH K. Chromatography: separating small amounts of material L. Electrophoresis: separating very similar substances M. Spectrometry: identifying unknowns by their mass N. The emission and absorption spectrum of elements O. Neutron activation analysis P. X-ray diffraction VIII. Hair, Fibers, and Paint and the Microscope (3 weeks) A. Lenses: how objects are magnified B. Using the compound microscope, stereomicroscope, and comparison microscope C. Mechanics of a scanning electron microscope in forensics D. Human vs. animal hair comparison E. Structure, growth, color, treatment and damage or hair F. The morphology hair and its forensic implications G. DNA analysis of hair H. Polymer composition and structure I. Fiber morphology J. Analysis and interpretation of synthetic fibers K. Paint and other coating compositions L. How cars are painted M. Identification of fiber and paint trace evidence using refractive index and fluorescence IX. Drugs and Toxicology (4 weeks) A. Organic chemistry and organic compounds B. Solubility and acid-base properties C. Major classes of drugs and their effects on the human body D. Testing process E. Ethyl alcohol and measurement of blood alcohol content F. Pharmaceutical materials G. Nonmedical agents H. Metal analyses I. Analytical methods: microcrystalline test, spectroscopy chromatography J. Drug control laws K. Applications of forensic toxicology X. Arson and Explosives (2 weeks) A. Thermal equilibrium B. Balancing chemical equations for combustion C. Redox reactions D. Thermochemistry of fire E. Heat capacity and phase changes F. The mathematics of calorimetry G. Kinetic molecular theory of gases H. Mathematics of gas laws I. Deliberately set fires: arson and incendiary J. Collection and preservation of arson evidence K. The role of accelerants and types of explosives L. Collection and analysis of explosives XI. Forensic Serology (3 weeks) A. Circulatory system – structures and functions B. The nature of blood - cell types and function C. Antigens, blood types, and antibodies D. Principles of heredity for blood characteristics E. Immunoassay techniques F. Species origin determination in bloodstains G. Size, shape, and directionality of bloodstains H. Stain patterns of blood; spatter angle of impact and velocity I. Interpretation of bloodstains on clothing and footwear J. Use of luminal photography for bloodstain pattern analysis K. Identification of other biological fluids: semen, saliva, urine, feces, vomitus, and vaginal secretions XII. Trace Evidence, Impressions, Firearms, and Tool Marks (1- 2 weeks) A. Biometrics – lip prints and saliva B. Coefficient of friction – determining a cars speed and direction C. Issues surrounding gun control D. Types of modern firearms, manufacturing, and ammunition E. Collection of firearms-related evidence F. Gunpowder residues and primer residues on hands G. Types of tool marks H. Processing of tool mark evidence at the crime scene I. Original equipment tires, replacement tires, and tire construction J. Tire tread nomenclature and sidewall information K. Collecting tire track evidence L. Headlamp analysis M. Vehicular accident analysis XIII. Botany (3 weeks) A. Plant classification, morphology, and reproduction B. Collection and challenges of palynological (pollen) evidence C. Linking suspect to scene via biological evidence D. Plants – the production of controlled substances XIV. Ethical, Legal, and Social Issues (to be incorporated throughout the year) A. Law enforcement and the law B. Forensic scientists, scientific values, and the law C. Scientifically reliable methods D. The great debate – discussion of ethical issues related to forensics (see Key Assignments for unit 15) E. Mock trial – take the evidence to court (see Assessment Methods)

Unit 1: Introduction to Forensic Science • Research the location of local and state crime labs: how are they organized, what services do they offer, how many cases are handled each year, what types of cases are most common? • Read Newsweek article The CSI Effect • Forensic Roles Group Research; divide the 18 specialty careers in forensics amongst 4 group members and describe the specialty area, responsibilities or job opportunities, and the education required • Activity - Leads vs. Needs; test your investigative techniques

http://www.crimelibrary.com/criminal\_mind/forensics/buddhist\_temple/index.html • Case Study - Jascalevich Murder Trial; offers an example of the legal and scientific issues involved in assessing the admissibility and value of scientific evidence Unit 2 - The Crime Scene and Physical Evidence • Activity: Probability and Class Evidence; students make a list of characteristics to describe students in their school. Using probability calculations, determine how many of such characteristics would be needed to narrow a suspect down to 1-2 students • Lab: Can This Evidence be Individualized? Students examine 13 types of evidence with stereomicroscopes to determine if it is 1) individual evidence, class evidence, or has probative value • Activity: Eye Witness demonstration; students unknowingly witness a crime and must give details regarding the event and identify the perpetrator in a line-up • Lab: Crime Scene Investigation; isolate, record, and search for evidence at a mock crime scene using proper forensic procedures • Case Study - Crafts Murder Trial; offers an example of how a conviction can be made even if a dead body is never found • Case Study - the Wayne Williams trial; circumstantial fiber evidence and probability determination Unit 3 - Fingerprints • Lab: Observing and Taking Fingerprints • Lab: Developing Latent Fingerprints • Research: Investigate the use of retinal scans as a means of identification. Is this a valid method of identification? What are advantages and disadvantages over the use of fingerprints? What about other biometric measurements? Unit 4 - DNA Fingerprinting • Lab: DNA Extraction from Bovine Thymus (lab) • Computer simulation - PCR and electrophoresis http://nobelprize.org/educational\_games/chemistry/pcr/ • Activity: Using a micropipette and gel box • Lab: DNA Fingerprinting (using rented equipment from the Santa Clara County Biotechnology Education Partnership) • Lab: PCR of the Alu gene with data entry to worldwide database online (using rented equipment from the Santa Clara County Biotechnology Education Partnership) \*Note - this lab may be completed in the future with another unit where the subject matter is not as lab intensive. • Activity: Creating Pedigrees from Electropherograms; students use electropherogram results to create a family pedigree • Activity: Identifying the Remains of the Romanovs

http://www.shodor.org/workshops/forensic/cases/romanov.html • Activity: Statistics Sampling Lab; students calculate the probability that one of their class mates committed a crime • Case study - The OJ Simpson Trial; how irrefutable evidence sets new precedents Unit 5 - Human Remains and Entomology • Lab: Fetal Pig Dissection - modeling an autopsy and investigate the various organ systems • Online Tutorial:

http://www.nlm.nih.gov/visibleproofs/education/anthropological/index.html • Lab: Estimating Age, Gender and Height from Bones at a Crime Scene • Field trip to medical examiner (future?) or the San Jose Technology Museum (2007) for the Body Worlds exhibit. Worksheet to accompany. • Activity: Spontaneous Generation? Maggots on meat. • Lab: Entomology In Action and Calculating Accumulated Degree Hour (time of death) • Interactive Crime Scene Entomology Collection http://www.pbs.org/wnet/nature/fun/crimescene\_flash.html • Video: Insect Clues (Nature) • Lab: Diatom Taxonomy in a Drowned Victim • Read - Body Farm article and complete questions Unit 6 - Physical Properties, Glass and Soil • Demo: Disappearance of Becke lines • Lab: Collecting and Analysis of Minerals and Soil • Lab: Observation and Characterization of Different Types of Glass • Lab: Determining Refractive Index • Calculations: Solving chemistry problems in forensics • Case Study - The Coors Kidnapping and Murder; conviction of Walter Osbourne from layers of soil trapped in wheels Unit 7 - Organic & Inorganic Analysis • Lab: Qualitative Analysis by Thin-Layer Chromatography • Lab: The Quantitative Analysis of Aspirin by Spectrophotometry • Lab: Flame Tests to Determine the Unknown • Lab: Analysis of White Powders; students will use forensic investigation methods introduced in this unit to identify unknown powders • Read: FDA’s Forensic Center: Speedy, Sophisticated Sleuthing http://www.fda.gov/fdac/features/695\_forensic.html; describe their uses of spectrometry, electrophoresis, and chromatography • Calculations: Solving chemistry problems in forensics • Case Study - The Assassination of President Kennedy; the use of neutron activation analysis Unit 8 - Hair, Fibers, and Paint and the Microscope • Lab: Microscopic Observation of Hair, Fibers, Fabric and Paint • Activity: Test Your Skills as a Forensic Hair Examiner http://dsc.discovery.com/fansites/onthecase/hair/photo.html • Lab: Thermal Decomposition and Burn Tests on Fabric • Lab: Distinguishing Fiber Type by Refractive Index and Fluorescence • Case study - Microscopic Trace Evidence; wood evidence in the Lindbergh kidnapping • Research - Investigate the legal aspects of taking hair samples from a suspect, similar to issues around fingerprinting. Is this a violation of the Fifth Amendment? • Activity: Sampling and Statistics; what are the chances that the fibers found at a crime scene belong to a student in the class? Unit 9 - Drugs and Toxicology • Lab: Presumptive Color Tests for Drugs • Demo: Alcohol Breath Analyzer http://chem.lapeer.org/Chem1Docs/Breathalyzer.html • Lab: The Quantitative Analysis of Aspirin by Spectrophotometry • Lab: Detecting Lead • Lab: Analysis of Drugs and Poisons • Research - prepare a one-page report on a toxin or poison of your choice including description, source, toxicity, symptoms, detection, cure, lasting effects, history, examples, and social impact, if any. (This is one of five topics to choose from. Other are Napoleon’s death, Beethoven’s death, Lincoln and Newton’s supposed mercury poisoning, and the stillborn foal epidemic in Kentucky, 2001) • Opinion paper - Write a paper analyzing the arguments about the legalization of drugs in the United States. Unit 10 - Arson and Explosives • Demo: Using Isopropyl Alcohol to Demonstrate Volatility and Flash Point • Demo: Touch Explosives using Ammonia and Iodine Crystals • Lab: Case of the Fallen Walkway; three parts investigate oxidation/reduction, the source and cause of corrosion, and identifying sacrificial metals • Case Study - The Crash of TWA Flight 800 • Calculations: Solving chemistry problems in forensics • Nova video: Hunt for the Serial Arsonist Unit 11 - Forensic Serology • Lab: Blood Typing Simulation • Activity: Detection of Blood Using Hemastix and Hydrogen Peroxide • Lab: Prepared Slides of Human and Animal Blood • Blood spatter tutorial

http://www.bloodspatter.com/BPATutorial.htm • Lab: Where’s the Shooter? Where’s the Victim? Calculating bullet trajectories • Case Study - Sam Sheppard’s Case Reopened: What the Blood Told • Case Study – What the FBI Said vs. the Black Panthers; using trajectory evidence to reconstruct the crime Unit 12 - Trace Evidence, Impressions, Firearms, and Tool Marks • Lab: Analyzing Lipstick with Thin-Layer Chromatography • Lab: Identification of Metals • Lab: Vehicular Accident Analysis; students will determine how fast a car was going by the skid marks and coefficient of friction in addition to identifying other trace evidence • Activity: Bullet Comparison and Firing Pin Impressions • Complete the firearm tutorial http://library.med.utah.edu/WebPath/TUTORIAL/GUNS/GUNINTRO.html Unit 13 Botany • Lab: Pollen Under the Microscope • Lab: Flowers for Freddy – plant morphology and taxonomy helps identify a suspect Unit 14 - Ethical, Legal, and Social Issues Debate the following: • Should DNA be taken from all people accused of a crime? • Should capital punishment be abolished? • Death sentence vs. life imprisonment? • Is there a “mean” gene? • Should teenagers be tried as adults? • Should prisoners be rehabilitated? • What measures can be done to make our campus a safer environment? • Do sports, movies, and music influence criminal behavior? • Should sexual offenders be sterilized?

Cells and Microbiology • Bacteria: Students will culture harmless bacteria in the lab and will demonstrate the ability to prepare the proper nutrient broth, streak the plate and transform the bacteria using sterile technique. • Cell Structure & Function: Students will analyze various slides obtained from a wide variety of histology groups and will consist of healthy and unhealthy tissue. Based on their analysis they will be able to identify conditions that may have contributed to the cause of death. Students will also prepare some of their own slides for examination and are responsible for the staining and proper mounting of the specimens • Microscopy: Students will have the opportunity to use advance microscopy techniques to view slides at 1000X power. They will also have samples viewed under an electron microscope. Students will label and draw detailed diagrams of all organisms viewed under the microscope. Genetics • ABO/Rh: Using stimulated blood samples, students will determine ABO and Rh Factor typing for mock paternity and crime scene investigations. Students will test the unknown blood samples along with controls and based on antigen-antibody complex formation will record the blood type. Genetic crosses, Monohybrid and dihybrid Punett squares, will then be used in conjunction with the blood typing to exclude and include suspects based on blood type inheritance • Pedigrees: Using Ted Bundy as an example, students will construct a pedigree based on phenotypical analysis and extrapolate potential genotypes based on the patterns of inheritance. Students will determine if there is a genetic link to behavior based on the analysis of the Bundy family. • DNA Isolation: Students will be responsible for DNA extraction, solution preparation, gel preparation and analysis for all molecular labs. • DNA Fingerprinting (PCR/Gel Electrophoresis): • Students will perform restriction enzyme digests on DNA samples and perform gel electrophoresis to separate the fragments. Students will then stain the gels with methylene blue (or ethidium bromide dependant on the sensitivity required) and will analyze their results. Restriction enzyme maps will be constructed and the DNA evidence will be interpreted. Band size will also be determined using graphs. • Students will isolate their own DNA and perform PCR to amplify a region of DNA known as D1S80 consisting of VNTRs. • Students will isolate their own DNA and perform PCR to amplify the 13 STR regions identified in CODIS to create their individual unique DNA profile. • Apply their knowledge of PCR, DNA and gel electrophoresis to analyze results found at a crime scene. • DNA stability over time: Students will evaluate the stability of DNA over time and based on various conditions of their choice. PCR and gel electrophoresis will be utilized • Karyotypes: Students will assemble normal and abnormal karyotypes from a wide variety of conditions. Based on the structural and numerical abnormalities, students will be able to positively identify the syndrome and sex of the individual. Ecology • Botany: Investigate how seeds, pollen and fungal spore evidence can be used to determine location and time of death in crime scene investigations based on the organisms’ life cycle • Entomology: • Students will diagram and describe the life cycle of a blowfly in a laboratory setting. Based on time, if given an unknown specimen, students should be able to approximate the time of death. Environmental factors, such as temperature, that effect the time of death will be analyzed. • Describe the order and function of various insects arriving to a corpse and how they contribute to the decomposition of a body. • Students will go out into different areas of the campus every month and document the various types of insects found. Based on their data they can identify the habitat and environmental factors that effect insects and how time of death can be calculated. • Solvent extraction and TLC (think layer chromatography) will be used to determine how blowflies can provide toxicological clues which can lead to a potential cause of death • Decomposition: Using meat, students will conduct experiments on the rates and stages of decomposition in various environments and will be able to describe how water, nitrogen, phosphorus, sulfur and other minerals are returned to their cycle and environment. • Food Chains: Based on chemical analysis students will be able to describe how various environmental pollutants can impact the food chain. • Soil Analysis: Students will analyze various types of soil for their physical and chemical properties. Based on their results they will be able to describe how these soils are unique to the areas from which they are found based on the environment. Human Physiology • Fingerprinting: Using fingerprint ink, students will roll their prints and analyze the basic and minutiae patterns. Calculate their ratio using Henry’s Classification System. Roll another person’s fingerprints and calculate their ratio using Henry’s Classification System. Identify dust/develop and lift prints using proper technique on various surfaces such as glass, wood, paper, tile, plastic, aluminum using ninhydrin, cyanoacrylate fuming, magnetic and original fingerprint powders, silver nitrate and fluorescent powder. Students will need to match these prints to various suspects in crime scene scenarios Identify a set of identical twins and analyze their fingerprints to understand the basics of inheritance. Participate in a mock crime scene where fingerprint evidence must be utilized to determine who committed the crime • Trace Evidence: Students will analyze their own hair structure microscopically and identify the following characteristics: surface pattern, cortex, medulla, root structure, tip structure and pigmentation from different types of hair locations. They will compare their findings by analyzing real hair samples from other individuals in the class of different ethnic backgrounds. Based on their findings they will be able to identify various types of information that can be gained from hair left at a crime scene such as: hair pulled or fell out, cut or color treated. Students will analyze hair samples from various types of animals microscopically and identify the following characteristics: surface pattern, cortex, medulla, root, tip and pigmentation. Based on their findings they will be able to identify unknown samples. Students will also analyze various types of other microscopic trace evidence throughout the year such as paint, ash, skin flasks, dust, pollen, fingernail fragments in various crime scene investigations. • Blood Splatter Patterns: Using their knowledge of the physical properties of blood, velocity and trajectories, students will determine the sequence of events that occur at a mock crime scene using blood splatter patterns and will relate these events to the type and degree of injury the victim sustained. They will also string the room to approximate points of impact. • Blood Detection: Students will conduct various presumptive tests such as the use of Luminol, Hemastix, Kastle-Meyer and analyze the results to locate blood evidence • Urinalysis: Students will perform mock urinalysis on samples of stimulated urine as well as a number of presumptive tests for the presence of protein, glucose and HGH (pregnancy test) and interpret their results based on the data. • Autopsy: Students will perform a mock autopsy on a fetal pig and will name, identify. draw and explain the function for the following systems: Nervous (Central and Peripheral), Excretory, Reproductive, Circulatory, Respiratory, Endocrine and Digestive. Proper protocol for examination, incision making, extracting, weighing, measuring and evaluating the organs for a potential cause of death. Students will document their findings using the proper format recognized by the Coroner’s office • Stomach Contents: Use indicators (Benedict’s, Iodine, Biuret) to detect the presence of common macromolecules • Forensic Ondontology: Using casts from various types of teeth, students will identify and match bite marks in terms of radius, tooth length and unique dental features. They will also cast their own bite marks found on evidence at a crime scene. • Wound Pattern Analysis: Using photographs, students will identify and describe the presence of wounds (including defensive wounds) made by various types of weapons found a crime scenes (knives, shotguns, bullets, ligatures) and how these weapons damage the dermis and underlying tissue. Based on these patterns, students will be able to identify the cause of death in mock crime scene investigations. • Lividity: Using photographs, students will identify and describe how lividity can be used to determine time of death. Students will discover how the relocation of a corpse will change the patterns of lividity • Forensic Anthropology: Students will view and measure replica bones from male and female skeletons as well as skull from European, Asian and African subjects to determine the various differences between sex and race. Bone structure will also be analyzed using pictures that show various types of wear and tear that can provide clues about the age, health, medical history and body size of the individual. • Core Body Temperature: Students will calculate and predict approximate time of death by researching and graphing how the body’s muscle mass cools as a function of time and ambient air temperature. They will also predict how heating systems and air conditioning could effect their calculations

Textbook:

Forenscie Science: An Intro Richard Soferstein

Pearson Prentice Hall

1st Edition

Primary text

Forensics

Folsom HS

Laboratory Science “d” /interdisciplinary

Grades: 11th,12th

Course overview:

Forensics is a third year of college-prep laboratory science for students that are college bound and/or interested in the field of forensics. This class will introduce students to the fields of forensic science and provide a general overview of the forensic sciences. Students will participate in many qualitative hands-on labs and simulations that develop the practical and theoretical aspects of forensics while developing proficiency in the eight practices of science and engineering detailed in the Next Generation Science Standards. This class will integrate previous science courses and demonstrate to the student the relevance of science education for practical use.

The course content begins with the formative and summative assessment that are utilized in all units that support the Common Core State Standards. Following that are specific units, which includes examples of activities pertaining to the unit, all laboratory components, and the specific Next Generation Science Standards addressed.

Prerequisites:

2 years high school level science with C’s or better (required)

Algebra 1 with a grade of C or better (required)

Course Content:

**Assessment**

Assessments are aligned with Common Core State Standards and Next Generation Science Standards and include a variety of formative and summative assessments.

1. Vocabulary and reading quizzes for each chapter- Students access text to determine the meaning of key terms, and other forensic science specific words and phrases.

2. Case study analysis- Students read and analyze case studies of crimes pertaining to unit of study; use of paired reading and summary protocol with whiteboard share out of summaries, or think-pair-share. Cases include Dr. Sam Sheppard in the Bloodstain Pattern Analysis, OJ Simpson in Forensic Serology/DNA unit and Impressions unit, Boston Marathon Bombing and Unabomber in the Explosions unit.

3. Chapter review questions

4. Laboratory activities to introduce or reinforce concepts in forensics- Students create an Evidence Log to record laboratory data, the analysis of data, and a report of findings (conclusion). Labs include a reading component to introduce concept(s); evaluation through rubric with self and peer review.

5. Challenge statements to assess student thinking- This writing component requires that students take a position (agree or disagree) and support their position with information from their text, readings done in class, video, or internet sources. Students respond individually, have small group dialogue, then are given an opportunity to rewrite their responses.

6. Unit Exam (1-2 chapters per exam depending on the unit)- Exams include multiple choice, short answer, written response involving crime scene evaluation procedure, evidence collection, or procedures for performing a forensic test. Lab practical component includes testing or analyzing evidence studied in the unit (i.e., Kastle-Meyer reagent test for presence of blood or hair and fiber analysis).

7. Group, Partner or Individual Projects- Include Forensics Timeline Poster and Presentation, Drug Analysis Powerpoint and Poster, Forensic Career Poster and Presentation, Crime Scene in a Box (students create crime scenes for other students to solve), Innocence Project Assignment or Forensic Science Board Game and Presentation.

8. Final Exam- one per semester

**Unit 1- Ch. 1-Introduction to Forensic Science, Ch. 2- The Crime Scene and Ch. 19- Careers in Forensics**

Lab Activities

* Personal Identification File: This activity has students create their own information file, including their fingerprints. Students compare and contrast their own fingerprints, describe patterns they observe, and compare and contrast their fingerprints to those of classmates, identifying most common and least common patterns in their group
* Clue Lab: Students play the classic board game "Clue" and identify elements of deductive and inductive reasoning
* Locard's Exchange Principle Lab:  After reading about Locard's Exchange Principle (every contact leaves a trace), students wear a new or clean lint free tshirt for the day before the lab and record all activities for the day. On lab day, students use hand lenses and microscopes to examine, remove, and catalog trace evidence found on the shirt
* Forensic Laboratory Tour: Students go online with in-class Chrome books or in computer lab and access [www.mycrimekit.com](http://www.mycrimekit.com/) to take a tour of a forensic laboratory, exploring lab set-up and different forensic disciplines
* Crime Scene Sketching: Students practice the appropriate steps to process a crime scene, including surveying an in- class crime scene, taking diligent notes, and creating a sketch of the scene, with accurate dimension measurements as well as location measurements for all pieces of physical evidence
* Anthropometric Quick Lab: Students read about anthropometry in the text, then take measurements of each other in groups of 3-4, comparing measurements and evaluating the usefulness of anthropometry as a means of identification.
* Chain of Custody Lab: Students collect and tag evidence, record detailed accurate description of evidence and where it was found, turn it in to "property room", and check out a new piece of evidence while maintaining the chain of custody
* CSI- A Case of Deductive Reasoning: Students play the role of a detective using deductive reasoning and analysis of entomological evidence from blowflies, weather information, and other physical evidence to solve a murder.

NGSS Targets

* Students analyze and interpret fingerprint patterns to determine the uniqueness of fingerprints
* Students engage in argument from evidence through a quick write in which they identify the type of reasoning they used while playing Clue and support it with evidence from the game
* Students plan and investigate through tshirt examination to confirm Locard's Exchange Principle
* Students construct explanations about where trace evidence from the tshirts was obtained
* Students obtain information from a variety of sources (internet, text) to investigate the services provided in a forensic laboratory
* Students obtain, evaluate, and communicate information by making an accurate depiction of a mock crime scene by measuring the classroom, identifying evidence in the crime scene and accurately depicting its location and condition, and exchanging information with classmates
* Students analyze and interpret human body measurements for comparison
* Students practice the important concept of chain of custody by modeling how evidence must be handled to be useful in court
* Students analyze and interpret entomological and weather information to determine the time of death and identify a most likely suspect

Learning Targets

* Define forensic science and list the major disciplines it encompasses
* Recognize the major contributions to the development of forensic science
* Describe the services of a typical comprehensive crime laboratory
* Learn where to search for information about forensic science on the internet
* Define physical evidence
* Discuss the role of the first officer who arrives at a crime scene
* Explain the steps to be taken to thoroughly record the crime scene
* Describe proper procedures for conducting a systematic search of a crime scene for physical evidence
* Define and understand the concept of chain of custody
* Understand the contributions the forensics pathologist, entomologist, and anthropologist can make to a homicide investigation

**Unit 2- Ch. 3-Physical Evidence and Ch. 4-Matter and Glass**

Lab Activities

* Probability and Class Evidence Lab: Students explore the importance of class evidence by collecting class information on clothing items and using the product rule to calculate the likelihood of possible combinations. Students read about blood protein evidence in the OJ Simpson trial, and relate the class information collected in class to the evidence presented in the Simpson criminal trial
* Nature of Light Web Exploration and Virtual Forensics Glass Analysis: Students read about the nature of light in the textbook, then explore online the wave and particle nature of light and the electromagnetic spectrum.  Next, students preview the Glass Analysis Lab online, using a virtual hotstage on a compound microscope and exploring how a GRIM 3 is used to measure refractive index
* Density Quick Lab: Students measure the density of regular (sphere, cylinder, and cube) and irregular objects, employing both formula (D= M/V; volume formulas used for various shapes) and the water displacement method
* Principles of Forensic Glass Analysis Lab: Students identify the chemical and physical characteristics and behavior of glass by determining density using several methods (water displacement, flotation through the construction of a density gradient) and glass fracture analysis to determine the type of glass at a crime scene and reconstruct the glass breaking event using sequencing through identification of radial and concentric fractures and the 3R rule

NGSS Targets

* Students use mathematics and computational thinking after obtaining information about common class characteristics of clothing of students in the classroom to calculate the probability of certain combinations in the total student population of our school. Additionally, students analyze and interpret that data to determine the usefulness of class characteristics, exploring how the the product rule increases the value of class evidence
* Students ask questions in a virtual exploration of the nature of light as a wave and as a particle in order to form a basis for understanding forensic analytical tools such as the GRIM 3 for determining refractive index, and spectrophotometers
* Students use mathematics and computational thinking to measure density of various irregular and regular objects, using formula and displacement methods
* Students develop and use a model by creating density columns to determine relative densities of very small glass fragments (flotation method) and contrast that to density determined by water displacement.
* Students construct explanations for differences in precision and accuracy of density measurements, identifying variables that influence outcomes
* Students engage in argument to match glass from a crime scene using evidence from density measurements and glass fracture analysis to support their claim

Learning Targets

* Identify the common types of physical evidence encountered at crime scenes
* Explain the difference between the identification and comparison of physical evidence
* Define and contrast individual and class characteristics of physical evidence
* Appreciate the value of class evidence as it relates to a criminal investigation
* List and explain the function of national databases available to forensic scientists
* Define and distinguish the physical and chemical properties of matter
* Define and distinguish elements and compounds
* Contrast the differences between a solid, liquid and a gas
* Understand the difference between the wave and particle theory of light
* Understand and explain the dispersion of light through a prism
* Describe the electromagnetic spectrum
* Define and understand the properties of density and refractive index
* List and explain forensic methods for comparing glass fragments
* Understand how to examine glass fractures to determine the direction of impact for a projectile

**Unit 3- Ch. 5- Drugs and Ch. 6- Forensic Toxicology**

Lab Activities

* Drug Analysis Foldable: Students create a graphic organizer by making a foldable to compare and contrast the various analytical procedures to ensure the specific identification of a drug
* Over the Counter Drug Analysis Lab: Students determine solubility, pH and reactions of known pain relievers and antacids, then use that information to perform tests and identify an unknown white powder.
* Paper Chromatography Lab- It's Magic: Students employ liquid chromatography techniques to separate a mixture of chemicals (ink) as a means of identifying them based upon their mass, color and chemical affinities.
* Alcohol in the Circulatory System: Students trace the flow of blood through the circulatory system and the respiratory system in order to understand how alcohol is absorbed and eliminated, and how breath testing devices are used to measure the alcohol concentration in blood

NGSS Targets

* Students obtain, evaluate, and communicate information pertaining to methods used to identify drugs by their physical and chemical properties
* Students analyze and interpret the results of drug testing in order to engage in an argument from evidence
* Students create chromatograms of various inks to identify suspect inks, using mathematics and computational thinking to calculate the Rf factor and the analysis and interpretation of the banding patterns of the inks in various solvents such as water and isopropyl alcohol
* Students construct explanations for the relationship between alcohol in the bloodstream and alcohol in alveolar breath

Learning Targets

* Compare and contrast psychological and physical dependence
* Name and classify commonly abused drugs
* Describe the laboratory tests normally used to perform a routine drug identification analysis
* Describe and explain the process of chromatography
* Explain the difference between thin-layer chromatography and gas chromatography
* Describe the use of ultraviolet and infrared spectroscopy for the identification of organic compounds
* Describe the concept and use of mass spectrometry for identification analysis
* Understand the proper collection and preservation of drug evidence
* Explain how alcohol is absorbed into the bloodstream, transported throughout the body, and eliminated by oxidation and excretion
* Understand the process by which alcohol is excreted in the breath via the lungs
* Understand the concepts of infrared and fuel cell breath-testing devices for alcohol testing
* Describe the commonly employed field sobriety tests to assess alcohol impairment
* Describe techniques that forensic toxicologists use to isolate and identify drugs and poisons

**Unit 4- Ch. 8- Forensic Serology and Ch. 9- DNA**

Lab Activities

* Blood Typing "WhoDunit" Lab: Students will perform A/B/O/Rh blood typing using a simulated blood product, and identify the most likely suspect in a robbery
* Kastle-Meyer Quick Lab: Students will learn how to confirm a sample is blood and how to locate blood samples at a crime scene
* Inheritance of Blood Type/Punnett square: Students determine probability of offspring blood type given parental blood types, utilizing monohybrid crosses and exploring concepts of dominance, recessiveness, and codominance, as well as genotype and phenotype
* DNA Forensics Lab: Students will perform gel electrophoresis to construct a DNA fingerprint as a means of positively identifying individuals based upon their unique DNA sequences
* Who's the Daddy? Lab: Students interpret STR loci profiles (electropherograms) utilizing authentic data to establish paternity

NGSS Targets

* Students analyze and interpret blood typing information after using simulated anti A, B, and Rh serums to test blood for agglutination reactions
* Students plan and carry out an investigation to identify the presence of blood using Kastle-Meyer reagent testing; students prepare blood and non-blood (i.e. ketchup, food coloring, paint) samples for testing by other lab groups
* Students use mathematics and computational thinking to construct and interpret Punnett squares
* Students obtain, evaluate and communicate information from DNA samples from a crime scene and three suspects, measuring the DNA bands created through gel electrophoresis to match crime scene DNA to a suspect
* Students analyze and interpret electropherograms that depict alleles as peaks on a graphs to establish the paternity of a child, utilizing real world data

Learning Targets

* Identify the A-B-O antigens and antibodies found in the blood for each of the blood types: A, B, AB, and O
* Understand and describe how whole blood is typed
* List and describe forensic tests used to characterize a stain as blood
* Understand the concept of antigen-antibody interactions and how they are applied to species identification and drug identification
* Contrast chromosomes and genes
* Learn how the Punnett square is used to determine the genotypes and phenotypes of offspring
* Identify the parts of a nucleotide and explain how nucleotides are linked to form DNA
* Understand base pairing as it relates to the double helix structure of DNA
* Contrast DNA strands that code for the production of proteins with strands that contain repeating base sequences
* Explain the technology of polymerase chain reaction (PCR) and how it applies to forensics DNA typing
* Contrast the newest DNA typing technique, short tandem repeats (STRs), with previous DNA typing technologies
* Describe the difference between nuclear and mitochondrial DNA
* Understand the use of DNA computerized databases in criminal investigation
* Identify necessary procedures for proper preservation of biological evidence for laboratory DNA analysis

**Unit 5- Ch.10- Crime Scene Reconstruction: Blood Stain Pattern Analysis**

Lab Activities

* Impact Angle and Area of Convergence: Students establish the location or origin of bloodshed by determining the directionality of the stain and the angle at which blood came into contact with the landing surface and the area from which the stains emanated
* Blood Spatter Tutorial Lab: Students learn about the nature of blood and how it behaves when dropped and projected
* Blood Spatter Lab: Students will analyze blood spatter and use this information to reconstruct an incident. Patterns created include simulated gunshot spatter, cast-off spatter, arterial spray spatter, expirated blood patterns, void patterns, contact/transfer patterns, flow and pool patterns, and drip trail patterns.

NGSS Targets

* Students develop and use models of blood spatter from various positions and with various tools to have a reference to interpret crime scene blood spatter.
* Students drop blood from different heights, establish the relationship of height to diameter, and measure angle of impact to establish position of blood spattering event, employing mathematics and computational thinking
* Students analyze and interpret data from a crime scene to establish the events that took place at the crime scene, employing documentation skills such as note-taking, sketching, and photography practiced in previous units
* Students construct explanations after data analysis to reconstruct a crime and communicate that information in the form of a detailed written report

Learning Targets

* Explain how surface texture, directionality, and angle of impact affect the shape individual bloodstains
* Calculate the angle of impact of a bloodstain using its dimensions
* Describe the classification of low, medium, and high-velocity impact spatter and describe how the classifications should be used
* Discuss the methods to determine the area of convergence and area of origin for impact spatter patterns
* Understand how various blood pattern types are created and which features of each pattern can be used to aid in reconstructing events at a crime scene
* Describe the methods for documenting bloodstain patterns at a crime scene

**Unit 6- Ch. 11- Trace Evidence I and Ch. 12- Trace Evidence II**

Lab Activities

* Hair Evidence Lab: Students will differentiate between human hair and nonhuman hair, using the microscope to identify parts of the hair and features that are important for species identification
* Fiber Evidence Lab: Students microscopically examine the features of various manufactured and natural fibers, then complete a hair and fiber challenge in which students identify unknown hair and fiber samples
* Murder and a Meal: Students analyze "stomach contents" of a murder victim for common monomers and polymers (starch, glucose, protein and lipids) found in food in order to identify the location of the victim's last meal
* Soil Analysis Lab: Students will use physical separation of soil (construction and analysis of soil density profiles, observations (odor, hand lens and microscope exam for color texture, presence or absence of plant and animal debris or other non-soil material) and chemical testing of soil (pH and phosphate testing) to uncover evidence.

NGSS Targets

* Students obtain, evaluate, and communicate information by microscopically examining hair and fiber from various sources, identifying unknown samples and communicating the evidence for a match
* Students ask questions about polymers and monomers in food and how they could lead to information about the location of a crime victim's last meal, leading them to construct explanations for the victim's whereabouts before death
* Students develop and use a model in the form of soil density profiles of suspects and crime scene soil samples
* Students analyze and interpret the results of the soil density profiles and chemical testing of soil to match crime scene soil samples to a suspect ​

Learning Targets

* Identify the cuticle, cortex, and medulla areas of hair
* List the three phases of hair growth
* Distinguish between animal and human hair
* List hair features that are useful for microscopic comparison of human hairs
* Describe proper collection of hair and fiber evidence
* Describe the role of DNA typing in hair comparison
* Understand the difference between natural and manufactured fibers
* List the properties of fibers that are most useful for forensic comparison
* Define and distinguish protons, neutrons, and electrons
* Define and distinguish atomic number and atomic mass
* Define and identify the monomers of common polymers such as carbohydrates, proteins, lipids, nucleotides
* List the important forensic properties of soil
* Describe the proper collection of soil evidence

**Unit 7- Ch. 13- Fire Investigation and Ch. 14- Investigation of Explosions**

Lab Activities

* Combustion Lab: Students test and classify the the burn patterns of various materials including natural and synthetic fabrics, metals and wood, then identify unknown materials through combustion characteristics
* Explosives Foldable: Students create a graphic organizer by making a foldable to identify the type and nature of explosives to distinguish between high explosives, low explosives, primary explosives and secondary explosives
* Chemistry and Explosions Activity: Students explore the relationship between combustion and explosions by examining the chemical equations of several common explosives such as black powder and nitroglycerin, and examine cases such as the Boston Marathon bombings and the use of pressure cookers

NGSS Targets

* Students develop and use models of combustion by observing patterns in the behavior of materials when burned, noting color of flame, smoke, odor, soot color, and rate of combustion
* Students plan and carry out investigations to test unknown materials through burn testing
* Students ask questions about how attainable materials can be used to make explosives, examining case studies such as Oklahoma City Bombing, the Shoe Bomber, the Unabomber and the Boston Marathon Bombings to obtain and evaluate information

Learning Targets

* List the conditions necessary to initiate and sustain combustion
* Understand the three mechanisms of heat transfer
* Recognize the telltale signs of an accelerant-initiated fire
* Describe how to collect physical evidence at the scene of a suspected arson
* Describe laboratory procedures used to detect and identify hydrocarbon residue
* Understand how explosives are classified
* List some common commercial, homemade, and military explosives
* Describe laboratory procedures used to detect and identify explosive residue

**Unit 8- Ch. 15- Fingerprints**

Lab Activities

* My Prints Lab: Students take their own fingerprints, and classify each of the prints as a loop (ulnar or radial), whorl (plain, central pocket, double loop or accidental) or arch (plain or tented).  Next, students identify ridge characteristics (or minutiae), and calculate the primary classification of their prints
* Flinn Fingerprinting Lab: Students lift fingerprints from various surfaces in the classroom using different powders (white, black and magnetic)
* Super Glue Fuming Quick Lab: Students place their fingerprints on a nonporous surface such as a glass slide or a soda can in order to use cyanocrylate to develop latent prints

NGSS Targets

* Students identify patterns and classify fingerprints, then use mathematics and computational thinking to calculate the percentage of loops, whorls and arches in each lab group, then as a whole class, comparing those percentages to known percentages of each class of fingerprints.
* Students use mathematics and computational thinking to compute the primary classification of their prints, based on the original Henry system, the first classification step in the FBI system (IAFIS)
* Students plan and carry out investigation of a crime scene using fingerprint lifting skills employing a variety of methods such as lifting prints with powder and cyanoacrylate fuming

Learning Targets

* Identify common ridge characteristics of a fingerprint
* List the three major fingerprint patterns and their respective subclasses
* Distinguish visible, plastic, and latent fingerprints
* List the techniques for developing latent fingerprints on porous and nonporous objects
* Describe the proper procedures for preserving a developed latent fingerprint
* Understand the use of Automated Fingerprint Identification Systems (AFIS) and the FBI's Integrated AFIS (IAFIS) and how primary classification of prints is the basis for the FBI system

**Unit 9- Ch. 16- Firearms, Toolmarks and Other Impressions**

Lab Activities

* Toolmark Challenge: Students examine various tools, make impressions with modeling clay, sketch the tools and take and record measurements. Students then study and inspect impressions and match them to the correct tool
* Footwear Impression Lab: Students create footprints in soil, and make casts of the footprints using dental stone or Plaster of Paris.  Students also match footwear prints to shoes to solve a crime
* Gunshot Residue Demo: In this demo, students learn about gunshot residue testing, witness the results of testing and identify the suspect who fired a weapon
* Comparing Bullets: Students go online with in-class Chrome books or in computer lab and access [www.mycrimekit.com](http://www.mycrimekit.com/) and [www.firearmsid.com](http://www.firearmsid.com/) to use a virtual comparison microscope to match striations, learn about lands, grooves, and rifling

NGSS Targets

* Students analyze data after examining and cataloguing the features of common household tools through measurement, sketching, and casting of the tool's surface and interpret the data to discover matching tool marks
* Students engage in argument from evidence to support the claims made in the identification of tool marks and footwear, correlating the important individual characteristics that may be present, including nicks and breaks on tool surfaces and wear patterns on shoes
* Students obtain, evaluate, and communicate information from reading and online sources to explore firearms identification, which includes bullet and cartridge comparisons

Learning Targets

* Recognize the class and individual characteristics of bullets and cartridge cases
* Understand the use of the comparison microscope to compare bullets and cartridge cases
* Explain the use of the NIBIN database
* Identify the laboratory tests for determining whether an individual has fired a weapon
* Explain the forensic significance of class and individual characteristics to the comparison of tool marks, footwear, and tire impressions
* Describe methods for collecting, casting or printing, and then comparing tool marks and footwear

**Unit 10- Ch. 17 Document Examination**

Lab Activities

* Handwriting Comparison Lab: Students read and examine handwriting samples from two famous case studies involving handwriting analysis: Adolf Hitler's Diary and Howard Hughes' will. Students then analyze their own handwriting, and identify unique characteristics.  Lastly, students receive a packet of exemplar handwriting samples and a questioned document, and must determine if the questioned document matches an exemplar

NGSS Targets

* Students obtain, evaluate and communicate information, reading case studies about Hitler's Diaries and Howard Hughes' will, and the criteria for handwriting analysis, including methods for obtaining known writing samples. Students then analyze and interpret the samples, note similarities and differences, and construct explanantions about the authenticity of the samples
* Students create exemplar and questioned documents for other students to analyze, then plan and carry out an investigation of a different set of handwriting samples to determine if the questioned document matches any of the exemplars provided

Learning Targets

* Define questioned documents
* identify common individual characteristics associated with handwriting
* List important guidelines for collecting known writings for comparison to a questioned document
* List some of the techniques document examiners use to uncover alterations, erasures, obliterations, and variations in pen ink

Textbook

Forensic Science: An Introduction

Richard Saferstein and Charles Fanning

Prentice Hall

2nd/2011

<http://www.MyCrimeKit.com>

primary text

**Forensic Science**

**Beaumont High School**

Laboratory Science “d” - Interdisciplinary Science

Course Overview:

Forensic science is an applied science course that challenges students in a manner that core science classes frequently do not. Forensic science provides students with a chance to actually apply the science they have learned to real world situations. Helping students understand the process and mechanics of science, as well as having them experiencing how science can be applied to real life situations is a driving force in a forensics classroom. As per popular media, many students are highly interested in Forensic Science and stimulate the students to learn the science behind the media shows. Forensic science is important in many careers in the legal system and in the medical field. Forensic science provides another science opportunity with hands on labs and project based learning.

Prerequisites:

Biology (1 year) (required)

Earth or Chemistry (1 year) (Required)

Co-requisite:

Algebra 1 (required)

Course content:

**Introduction to Forensic Science Unit 1**

Topics

1. What is forensic science?

2. History and development of forensic science.

3. Divisions and functions of crime laboratories.

4. How forensic scientists use the scientific method when conducting research.

5. The laws and rules that govern collection and admission of evidence.

Learning Targets

1. Students can identify key inventions, people, and dates that led to forensic science.

2. Students can compare and contrast types of law in the United States' judicial system.

3. Students can identify individual rights guaranteed by the US Bill of Rights.

4. Students can compare and contrast different types of crimes and their penalties.

5. Students can discuss the federal rules of evidence, with specific concentration on *Frye v. United States* and *Daubert v. Merrell Dow Pharmaceuticals*.

Student Activities and Learning

1. Students can compile a list and an explanation of the duties of a forensic scientist though the reading of excerpts from the *Journal of Forensic Science*.

2. Student lead class discussion of the impact of the two legal decisions (Frye and Daubert) governing the use of science in assessing evidence and their effect on the judicial system.

3. Students choose key dates and describe why they are important to forensic science by creating a Forensic Time Line Poster.

4. Students choose one of the Bill of Rights, research it, and create a Powerpoint presentation to describe what it means to other students in the class in a presentation.

**Evidence Unit 2**

Topics

1. There are two general categories of evidence: testimonial and physical.

2. Eyewitness testimony must be evaluated for its reliability.

3. Forensic scientists concentrate on physical evidence.

4. There are several types of physical evidence including: individual and class evidence.

5. Probative value is increased by finding as much evidence as possible to link a suspect to the crime or victim.

6. A questions or unknown sample can be compared to a known or control sample.

7. All comparisons must be analyzed for the probability of a similar origin.

Learning Targets

1. Students can discuss why eyewitness testimony is not always reliable.

2. Students can determine the common types of physical evidence.

3. Students can differentiate between individual and class evidence.

4. Students can use probability calculations to evaluate class evidence.

Student Activities and Learning

1. Students read and review several case studies and discuss how the evidence was used in the trial. The case studies include: Coral Eugene Watts, Ronald Cotton, and Richard Crafts.

2. Students conduct a probability activity (calculate probabilities mathematically) using the clothing of the students in the class to illustrate why there must always be probability value associated with class evidence.

3. The students compile a list of what they would consider individual or class evidence from items placed around the classroom. Students explain why it is individual or class evidence.

4. Have a class interruption (custodian coming in yelling) occur and have students write about what just happened to prove that eye witness accounts are varied and sometimes wrong.

5. Use program FACES to create faces for forensic use after the witness saw them for a few seconds to show eye witness accounts are not always reliable.

**Evidence Testing Methods Unit 3**

Topics

1. Substances can be identified by the type and quantity of light they absorb using spectrophotometry.

2. Mass spectrophotometry identifies material by fragmenting them and measuring the relative abundance of the particles.

3. Gas chromatography separates mixtures on the basis of the distribution between a stationary liquid and a moving gas.

4. Electrophoresis separates materials based on migration rates.

5. The microscope is a major tool in forensic science.

6. Liquid chromotography is used to separate and or analyze complex mixtures.

Learning Targets

1. Students can distinguish between organic and inorganic materials.

2. Students understand that most materials can be identified by their chemical properties.

3. Students understand the properties of light and how it can be used to identify materials.

4. Students will develop a familiarity with different types of microscopes and demonstrate the ability to use them.

Student Activities and Learning

1. Students practice and become proficient at using microscopes to identify various items.

2. Students learn the limitations of microscope use in identifications.

3. Students practice viewing common items in a compound light microscope and a dissecting microscope to develop the skill needed to be proficient in later class assignments.

4. Students will use the spectrophotometer to identify materials.

5. Chromotography lab will be used to distinguish between the different pigments in plants that may show up at a crime scene.

6. Students learn advanced microscope techniques: care and use, measuring with a microscope, oil immersion. image preservation, and wet and dry mounts.

**Crime Scene Mapping Unit 4**

Topics

1. Evidence is gathered at a crime scene in order to reconstruct the sequence of events that occurred during a crime.

2. Crime scenes must not be compromised.

3. Crime scenes are documented in a variety of ways including: notes, photography, sketches, and video.

4. Evidence must be packaged correctly and maintained in the chain of custody.

5. Different types of evidence are collected in different ways and at different times.

6. The Fourth Amendment requires that evidence must be collected in a lawful manner.

Learning Targets

1. Students can demonstrate the proper sequence of events in processing a crime scence.

2. Students can document and systematically collect evidence at a crime scene.

3. Students can accurately package evidence and maintain the chain of custody.

4. Students will debate the section of the Fourth Amendment pertaining to 'search and seizure'.

Student Activities and Learning

1. Write a report about different cases where the crime scene was compromised and how this affected the investigation and the overall court case outcome. Students will be provied excerpts from the *Journal of Forensic Sciences*.

2. Students discuss case studies where the court had to make a decisio regarding the admissibility of evidence:

    a. Mincey v. The State of Arizona

    b. The State of Michigan v. Tyler

3. Students can properly collect, package, and document a mock crime scene in class. Students are presented with a crime scene with a variety of objects strategically placed. Students will: Take notes on what they believe happened and how it happened, locate all objects using precise measurements, and prepare a scale map of the complete scene. The students will write a discussion of the crime scene and relate the location of objects to their hypothesis.

4. Students will be collecting evidence using the different patterns of collection to find the evidence in a large area outside the classroom. Students will have to determine which pattern is best in each scenario.

**Fingerprints Unit 5**

Topics

1. The history of personal identification.

2. The unique characteristic ridges on fingerprints makes them useful for identification.

3. The biological explanation for how fingerprints form and why two people do not share the same prints.

4. A persons fingerprints are formed prior to birth and last a lifetime.

5. Automated fingerprint identification systems compare prints by concerting them into a geometric pattern.

6. Detecting, developing, and collecting fingerprints is a multi-step process governed by the type and location of the fingerprint itself.

7. Other body parts provide prints also: soles of feet, palms of hands, ears.

earning Targets

1. Students can define the basic properties that make a fingerprint useful for identification purposes.

2. Students can obtain an inked, readable fingerprint for each finger.

3. Students can identify general ridge patterns and apply to the Henry-FBI classification system.

4. Students can identify friction ridge characteristics and compare two fingerprints with at least ten points of identification.

5. Students can develop latent prints using physical and chemical methods.

Student Activities and Learning

1. Students can collect each others fingerprints and classify them based on the three basic patterns. This exercise demonstrates the variability of fingerprints and the need for a classification system.

2. Students can develop and lift latent fingerprints using both physical and chemical methods demonstrating the variety of methods available to the forensic investigator.

3. http://galton.org/fingerprints/books/henry/henry-classification.pdf    This website will be used to explain how fingerprinting became about. Students will have to read through the document and be able to summarize the very complex method of fingerprinting that is no longer used.

4. http://safety-identification-products.com/fingerprint-information.html   This website will be used by the students to research the history of fingerprinting and write a paper about how we arrived at our current system of fingerprinting.

5. http://www.fbi.gov/about-us/cjis/fingerprints\_biometrics/recording-legible-fingerprints/takingfps   This site will be used by students to learn how to take legible fingerprints and what to do for people who have scarred prints.

6. Henry’s Classification lab: Students collect a complete set of each other’s fingerprints. Each print is then analyzed for how they fit into a commonly used classification system. Students then calculate their Primary Classification in that system as well as calculate the probabilities of each print type.

7. Developing Lab: Students develop and ‘lift’ prints from a variety of surfaces using the appropriate methods. Methods include; fingerprint powder, cyanoacrylate fuming, Iodine fuming, Ninhydrin, and Physical developer. Emphasis is placed on method selection and proper technique. The lab write up will include a discussion of the qualitative data generated and which methods are more appropriate for different situations.

**Hair Evidence Unit 6**

Topics

1. Hair is a class characteristic that corroborates evidence or excludes suspects.

2. Hair samples can be matched based on their morphology, including cuticle pattern, pigment granule patterns, medullary index, and cortical fusi patterns.

3. Hair is made of polymers: molecules containing many identical repeating units (monomers).

4. Medullary patters can indicate the origin of a hair.

5. Hair has certain stages of growth: anagenic, catagenic, and telogenic.

6. Chemical dyes can be observed on hair.

7. Hair can be a chemical indicator of drugs, metabolites, vitamins, poisons, metals, smoke, or environmental pollutants.

8. DNA obtained from a hair follicle that has been forcibly removed can be an individual characteristic.

Learning Targets

1. Students can explain the structure of hair and identify which components are used in comparisons.

2. Students can distinguish between human and animal hair.

3. Students can determine the racial origins of a strand of hair.

4. Students can identify the requirements of hair sample collection.

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4. Students can identify the requirements of hair sample collection.

Student Activities and Learning

1. Collection, microscopic investigation, and identification of hair samples. (Classification and characteristics activity.)

2. Students can identify treatments on hair samples (dyes, bleaches, etc.) that provide addition class characteristics.

3. http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/july2000/deedric1.htm  This site will be used for students to identify differences in hair types and body locations. Students will put together a Powerpoint presentation about hair types.

4. Unknown hair (humans and animals) samples will be given to students to compare and identify against knowns using a microscope.

5. Hair identification lab: Students are given a variety of hair samples to analyze. The samples include; both human and animal hair in a variety of colors, dyed and bleached hair, and synthetic hair. Students will use the microscope to analyze the hair and prepare a hair identification notebook. Emphasis is placed on proper use of the microscope and identification of distinguishing morphological characteristics.

6. Hair matching lab: Students are given several unknown hair samples. Using their hair identification notebook and the knowledge gained in preparing it, they attempt to match the unknown hairs with known samples. Students will gain a deeper understanding of the value of class characteristics and the difficulty in matching them. The emphasis of this lab is on hair as a class characteristic and the probability of a match. **Note**: This lab requires a formal lab write-up.

**Fiber Evidence Unit 7**

Topics

1. Fibers are class evidence and can be used as circumstantial evidence to link victim, suspect, and a crime scene.

2. A fiber's value as evidence increases as physical and chemical characteristics narrow its origin to a limited number of sources.

3. Fibers can be of natural of synthetic origin.

Learning Targets

1. Students can distinguish between different types of fibers based on color, origin, and chemical composition (classification and identification activity).

2. Students can describe polymerization with regard to natural and synthetic fibers.

3. Students can evaluate the probative value of fiber evidence.

4. Students can explain how birefringence (double refraction) can be a powerful comparison test.

5. The variety of fibers means that the probability of a match is difficult to calculate.

Student Activities and Learning

1. Use dissecting microscopes and compound microscopes to describe, sketch, and classify fabric and fiber samples (classification and characteristics activity)

2. Perform a fiber sampling and statistics activity that illustrates the power of some fabrics as evidence and then discuss the case of OJ Simpson.

3. Fiber identification lab: Students are given a variety of cloth samples to analyze. The samples include: Natural, synthetic, and colored cloths. Students will use several tests to analyze the fibers and prepare a fiber identification notebook. Tests used include: Microscopic examination, burn test, weave identification, and thin layer chromatography. The emphasis of this lab is on conducting the tests in the correct manner.

4. Fiber matching lab: Students are given several unknown cloth samples. Using their fiber identification notebook and their knowledge of the appropriate tests, the students attempt to match the fibers of the unknown samples to known fibers. The emphasis of this lab is on lab techniques as well as fibers as a class characteristic and the probability of a match.**Note**: This lab requires a formal write-up.

**Document Examination Unit 8**

Topics

1. The authenticity of documents can be verified through qualitative analysis.

2. There are 12 characteristics commonly used to identify handwriting.

3. Common handwriting features are normally used as class characteristics.

4. Combinations of handwriting features can be used as individual characteristics.

5. Ink samples can be identified using chromatography.

5. Cyber crimes are increasing in frequency and affect a large portion of the population.

Learning Targets

1. Students can explain important guidelines for collecting known writing samples for comparison to a questioned document.

2. Students can analyze handwriting samples.

3. Students can identify erasures and develop impression writing.

4. Students can list safeguards against the counterfeiting of US currency.

5. Students can distinguish between common individual and class characteristics that are associated with handwriting.

6. Students can identify writing sources from various samples based on chromatography analysis.

Student Activities and Learning

1. Students will attempt blind, simulated, and traced forgeries to assess the difficulty in both doing them and detecting them.

2. Students will do an analysis of handwriting using a letter angle template

3. Students will access the Secret Service website and identify the distinguishing characteristics of legitimate paper money.

4. The following websites will be used to help students analyse their own handwriting and discuss the Zodiac killers handwritten notes and how they were used to help identify the suspect.

* http://www.lib.udel.edu/ud/spec/exhibits/forgery/wise.htm
* http://www.myhandwriting.com/celebs/ransom1.html
* http://www.secretservice.gov/money\_detect.shtml
* http://www.sfgate.com/news/article/Zodiac-s-written-clues-fascinate-document-expert-2644828.php

5.  Handwriting matching lab: The students are given several unknown writings (some with an attempt to disguise) and several known writings. Using the 12 standard matching characteristics students attempt to match known with unknown samples.

6. Ink matching lab: The students are given several writing samples (ink) several known samples. Using paper chromatography the students determine which samples were written with the same ink. In order to complete this lab, students must devise a way to extract the ink from the paper and place it on the chromatography paper as well as determine the appropriate solvent. The focus of this lab is on students developing their analytical ability to solve a problem. **Note**: This lab requires a formal write up.

**Drug Toxicology Unit 9**

Topics

1. A majority of all crimes are associated with illicit drug use so forensic labs spend most of their time and resources testing for these drugs.

2. The US DEA (United States Drug Enforcement Administration) classifies controlled substances into five categories.

3. The Controlled Substances Act establishes levels of classification based on the potential for abuse.

4. A presumptive test (screening test) is used to determine the type of drug.

5. A confirmatory test is a specific test that positively identifies a drug.

Learning Targets

1. Students can chemically identify illicit drug types.

2. Students can examine the DEA schedule of controlled substances and discuss the federal penalties for possession and use, as well as their physical effects.

3. Students can explain the difference between, and the need for, confirmatory and presumptive tests.

4. Students can explain how spectroscopy is used to identify drugs.

Student Activities and Learning

1. Students debate the legalization of drugs, including: Current laws and penalties, frequency of incarceration, social costs, and societal attitudes and concerns.

2. National Institute on Drug Abuse (NIDA): [www.drugabuse.gov](http://www.drugabuse.gov/)

3. Drugs of Abuse: www.dea.gov/

4. http://www.all-about-forensic-science.com/forensic-toxicology.html

5. http://www.firearmsid.com/KSP%20Evidence%20Manual/Drug%20Identification.html

6. Students can use the above websites to research and create a poster identifying the effects of drugs on the human body.

7. Students can use the spectrophotometer to identify different unknown drugs by comparing to known spectrophotometer readings.

8. Drug testing lab: The students are given several unknown powders (simulated drugs). They subject the powders to a series of preliminary color tests where they add a reagent to the unknown powder and use the resulting color as an indication of a particular drug. They then subject the powders that tested positive to two confirmation tests, thin layer chromatography and a microcrystalline test.

**Poison and Alcohol Toxicology Unit 10**

Topics

1. Toxicity of poisons is measured in terms of lethal dose.

2. The prevalence of alcohol use mandates laws to protect the public from the drinking driver.

3. Blood alcohol content is a measure of impairment.

4. Henry’s Law is the principle that guides the operation of the breathalyzer.

5. Psychophysical tests are frequently used as a screening device.

6. The AMA and the National Safety Council play a major role in establishing blood alcohol standards.

Learning Targets

1. Students can discuss the connection of blood alcohol levels to the law, incapacity, and test results.

2. Students can compare the lethal dose of various substances.

3. Students can differentiate between chronic exposure and acute exposure.

Student Activities and Learning

1. Students practice psychophysical tests to assess their value as a screening device.

2. The students discuss one of the case studies that led to the Supreme Court decision allowing collection of blood: Schmerber vs. California.

3. Students can use the following websites to aid in understanding of alcohol use and abuse.

* About Alcohol: www.intox.com/about\_alcohol.asp
* Forensic Toxicology slide show: www.stfrancis.edu/ns/diab/Forensic1/Toxicology1\_files/frame.htm
* How Breathalyzers Work: www.howstuffworks.com/breathalyzer.htm

4. Students can use math to calculate blood alcohol levels in various circumstances using the BAC formula.

5. Students will use technology to research a given poison and present information about that poison to the class.

6. LD50 calculations.

7. LD50 Bioassay lab to measure toxicity.

**Physical Evidence: Soil Unit 11**

Topics

1. The prevalence of soil makes it a valuable class characteristic.

2. Soil is a mixture of different sized grains resulting from the weathering of parent rock.

3. The composition of soil differs by area.

4. Soils can be differentiated by: color, particle size, density, acidity, appearance, and presence of organic or inorganic materials.

Learning Targets

1. The students can identify soils based on their forensic properties.

2. The students can relate soil type to locality.

3. The students can describe proper collection of soil evidence.

4. The students can interpret a topographic map.

Student Activities and Learning

1. The students read and discuss: Forensic Brief: Soil – The Silent Witness from the textbook, preparing them for the lab activity.

2. An Online report from Interpol about methods and advances in soil examination: www.interpol.int/Public/Forensic/IFSS/meeting13 Reviews/soil.pfd

3. An online PowerPoint Presentation on physical properties of soil:www.stfrancis.edu/ns/diab/ForensicCoursePPT/Ch4webGlass&Soil.htm

4. Soil matching lab: Students are given a soil sample from a crime scene (unknown sample) and they must find a match among several other samples (known samples). Because soil is a class characteristic, all tests must indicate a match and there must be enough tests to eliminate doubt. Students must conduct six separate tests on the soils to find a positive match: percent organics, UV light, percent magnetic material, color from soil chart (soils must be dried first), acidity, particle size (using multiple sieves), and density gradient profile. **Note**: This lab requires a formal write-up.

**Physical Evidence: Glass Unit 12**

Topics

1. Glass can be used as class evidence.

2. Glass bends light in a characteristic manner that can be used to identify its origin.

3. The forensic methods of comparing glass fragments are refractive index and density.

4. Glass fractures can be analyzed to determine the direction of impact of a projectile

Learning Targets

1. The students can compare densities of glass particles.

2. The students can compare the dispersion of light through different particles of glass.

3. The students can determine the direction of force by examining radial, concentric, and conchoidal fractures of broken glass.

Student Activities and Learning

1. Students break pieces of class and analyze the fracture patterns in preparation for the direction of force lab.

2. An online PowerPoint Presentation on physical properties of glass:www.stfrancis.edu/ns/diab/ForensicCoursePPT/Ch4webGlass&Soil.htm

3. Demo on density of glass samples: intro.chem.okstate.edu/ChemSource/Forensic/forechem8.htm

4. Glass density/ refractive index lab: Students are given a glass sample from the headlight of a car involved in a hit and run accident as well as samples from several different automobiles. Students find the density of each of the samples using water displacement and determine which one matches the crime scene glass. Students analyze the class data to assess the range of acceptable values and the probability of error. In part 2 of this lab students immerse the accident sample in a liquid and adjust the density of the liquid (adding solvent) until the glass piece remains suspended. They then repeat the test for each of the known sample. The piece that also remains suspended is a match. Students analyze the class data to determine the probability of error. In part 3 of this lab students immerse the accident sample in a liquid, shine a light through it, and adjust the density of the liquid (adding heat) until the ‘halo’ (becke line) around the edges of the glass piece disappears. They then immerse each of the known samples and if there is no becke line, it’s a match. Students analyze the glass data to determine the probability of error. Students gain a deeper understanding of Archimedes principle and refraction. This lab requires a discussion/opinion section assessing the three different tests for ease of use, accuracy, and value in court.

5. Direction of force lab: Students are given pieces from several different broken panes of glass. By analyzing the three different types of fracture lines they can determine from which direction the breaking force came.

**Forensic Serology Unit 13**

Topics

1. Blood's general characteristics can be used as class evidence.

2. The ABO blood typing system.

3. Antibodies mixed with different antigens will agglutinate.

4. The antigen-antibody reaction can be used to detect drugs.

5. A preliminary color test is used to both detect and identify blood.

6. The Precipitin test can determine if the origin of a blood sample is human.

7. Blood spatter patterns can be used to determine direction of travel, angle of impact, position of origin, and velocity.

Learning Targets

1. Students can distinguish blood stains from other stains.

2. Students can distinguish between animal and human blood.

3. Students can determine human blood type using the ABO/Rh system.

4. Students can analyze blood spatter patterns to determine velocity, direction, and height of fall

Student Activities and Learning

1. Blood splatter analysis lab to determine direction of travel, angle of impact, position or origin, and velocity.

2. Video: The Killers Trail: Sam Sheppard (NOVA) - Students can discuss the effects of serology on a case.

3. Microscope lab to determine whether blood is animal or human.

4. Blood typing lab: The students are given a crime scene scenario, a sample of (simulated) blood from the crime scene, and several suspect blood samples. Using the antibody-antigen reaction they match the blood type of the crime scene sample and a suspect sample.

5. Is it blood? Lab: The students are given several samples blotted on a piece of paper and their job is to determine if the sample is blood or some other substance. Students us three different tests (Kastle-meyer, Hemastix, and Luminol) on the samples. The write-up on this lab includes an analysis of each method; how well it works, how accurate is it, how difficult was it, why it works, and which is better.

6. Renter lab: This is a combination lab that requires students to use multiple testing methods to solve a crime. The students are given a crime scene scenario. Included with the scenario are several pieces of evidence; an apparently bloody rag, a sample of what could be a poisonous metal solution, and a fingerprint (one of the students prints kept from an earlier lab). In order to solve the ‘crime’ they must; Test the blood with any of three color tests (including control), test the metal using a flame test, and find the fingerprint among their classmates using the print classification system. **Note**: This lab requires a formal lab write-up

7. Blood spatter lab: The students are given a crime scene with (simulated) blood spatter. Using the same blood they must complete a series of experiments to determine the height, angle, and velocity of the crime scene spatter. Each of the three characteristics is related to the other so the experiments are extensive and the students develop a knowledge of geometry and physics as well as blood characteristics.

**DNA Analysis Unit 14**

Topics

1. DNA is an individual characteristic.

2. DNA can be extracted from blood, semen, urine, bone, hair follicles, and saliva.

3. DNA fingerprinting can be used to identify suspects, clear the innocent, establish paternity, and match organ donors with recipients.

4. Restriction enzymes are used to recognize and cut DNA at specific points.

5. Gel electrophoresis is a procedure used to separate DNA fragments according to size.

6. PCR is a technique used to make multiple copies of DNA from a small sample.

7. FBI CODIS (combined DNA index system) electronically links federal and state databanks to share DNA profiles.

Learning Targets

1. Students can explain the structure of DNA.

2. Students can describe the function of restriction enzymes.

3. Students can calculate the probability of specific DNA sequences.

4. Students will describe and explain the purposes of the following techniques:

    PCR, RFLP, STRs, Microarray

Student Activities and Learning

1. The students do a statistical analysis of combinations of restriction enzymes to illustrate the power of multiple tests and discuss the case of Clinton/Lewinsky.

2. Students can use the following websites to assist in learning and understanding of DNA and DNA policies for admission in court cases.

* http://science.howstuffworks.com/life/genetic/dna-evidence.htm
* http://www.cstl.nist.gov/div831/strbase/intro.htm
* <http://www.justice.gov/ag/dnapolicybook_cov.htm>

3. Students will conduct a gel electrophoresis to separate DNA sequences cut with restriction enzymes to match a suspect to an unknown in a mock case.

4. DNA lab: The students will extract DNA and subject the samples to a restriction enzyme, and run the results through electrophoresis to determine if any of them match. The emphasis on this lab is on communication and cooperation as well as the technological aspects. **Note**: This lab requires a formal write-up.

**Time of Death Investigations Unit 15**

Topics

1. Algor, livor, and rigor mortis are indicators used to determine time of death.

2. Stages of decomposition include autolysis, putrefaction, and diagenesis.

3. Insects metamorphose through four principle stages (egg, larva, pupa, adult) at a rate that is dependent upon weather conditions and exposure

4. Insects can help determine the postmortem interval (PMI).

5. Insects can provide assistance in connecting suspects to victims and crime scenes as well as drug detection and contraband tracking

Learning Targets

1. Students can distinguish among major insect types associated with carrion.

2. Students can identify the relationship between insect type and the stages of death.

3. Students can estimate the time of death from a case description.

4. Students can explore variables affecting the determination of time of death.

Student Activities and Learning

1. Students review the life cycle of several different fly species to prepare for the time of death lab.

2. Students will use the following websites to aid in understanding entomology for determining time of death.

* http://www.forensic-entomology.com/
* http://www.sfu.museum/forensics/eng/pg\_media-media\_pg/entomologie-entomology/
* http://www.sfu.museum/forensics/eng/pg\_media-media\_pg/entomologie-entomology/

3. Students will draw posters of the life cycles of various insects to learn life cycle phases and time frames in order to be able to determine time of death accurately.

4. Time of death lab: The students are provided with a crime scene that contains a dead carcass. They will process the scene exactly how it would be done if it were a human body. This includes mapping all nearby objects, collecting any evidence, and filling out the dead body report. Completing the dead body report involves taking temperatures at several locations, assessing the body for wounds/scavenger damage, etc. The time of death is determined by the temperature, stage of decomposition of the body and by the age of insect larvae found on the body. The age of a maggot is determined through microscopic examination. Students gain an understanding of multiple biological concepts: decomposition, insect morphology, and metamorphosis. **Note**: This lab requires a formal write-up.

**Forensic Anthropology Unit 16**

Topics

1. Forensics anthropology is a type of applied science used in the legal system to identify unknown remains.

2. Bone structure and microscopic examination can be used to identify animal vs. human remains.

3. Bone structure can be used to identify sex, age, height, race, and diseases.

4. With facial reconstruction, proportion is more important than accuracy.

5. Bone markings may provide clues to the cause of death.

Learning Targets

1. Students can distinguish between male and female skeletons.

2. Students can determine an age range of unknown remains.

3. Students can describe the differences in skull features of the three major racial groups.

4. Students can estimate height by measuring long bones.

Student Activities and Learning

1. Students complete an exercise on determining the height and sex of a deceased person using the long bones of the body and the Os pubis illustrating what can be learned from skeletal remains.

2. Students will watch the following video to learn about how skeletal remains are used to identify people.

* NOVA video: Anastasia:  Dead or Alive
* <http://www.pbs.org/wgbh/nova/teachers/activities/2209_anastasi.html>

**Firearms Unit 17**

Topics

1. Bullet weight, size, and rifling marks are class characteristics.

2. Striations on bullets are individual evidence.

3. Forty percent of all gun deaths are homicides in the United States.

4. Distance from a target can be determined by a combination of factors that include residues and entry patterns.

Learning Targets

1. Students can describe the key steps in the manufacture of firearms that provide for forensic identification.

2. Students can identify problems inherent in bullet matching.

3. Students can describe and explain the Greiss test and the Test for Lead Residue.

Student Activities and Learning

1. Students view different bullets and cartridge casings with a dissecting microscope to help them understand tool marks and striations.

2. Students use the following websites to help understanding of firearm markings and identifications.

* http://www.firearmsid.com/Case%20Profiles/ToolmarkID/toolmark.htm
* http://library.med.utah.edu/WebPath/TUTORIAL/GUNS/GUNINTRO.html
* http://www.firearmsid.com/
* http://www.ok.gov/osbi/

**Arson Unit 18**

Topics

1. Fire is an oxidation reaction.

2. Two factors affect the speed of the reaction: The physical state of the fuel and the temperature.

3. Searching a fire scene and determining the origin.

4. Collection and preservation of arson evidence requires specialized skills.

5. Analysis of flammable residues (accelerants).

Learning Targets

1. The students can identify the chemical equation for fire and explain why it is exothermic.

2. The students can explain the process of pyrolysis.

3. The students understand the requirements of an arson scene investigation.

4. The students can identify evidences that indicate arson.

Student Activities and Learning

1. Students will review the following websites to learn about arson, accelerants and the psychological ideals of people that commit these crimes.

* http://www.trutv.com/shows/forensic\_files/techniques/accelerants.html
* http://www.ncids.com/forensic/arson/arson.shtml
* http://www.nij.gov/topics/law-enforcement/investigations/fire-arson/Pages/welcome.aspx

**Explosive Unit 19**

Topics

1. The main difference between explosion and fire is the speed of the reaction.

2. Low explosives under normal conditions will burn rather than detonate.

3. Any fuel mix with an oxidizing agent can be an explosive.

4. History of the development and use of explosives with both military and civilian applications.

5. Collection and analysis of explosives.

Learning Targets

1. The students can describe the explosive process.

2. The students can identify the properties of low explosives, primary explosives, and secondary explosives.

3. Collection and analysis of explosives.

Student Activities and Learning

 1. The following websites will be used to show explosions and how combustion occurs - rather than start fires on campus.

* http://forensicsciencecentral.co.uk/explosives.shtml
* http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/april2002/kelleher.htm
* http://www.nij.gov/topics/law-enforcement/investigations/crime-scene/guides/explosion-bombing/Pages/welcome.aspx

**Bio-Weapons Unit 20**

Topics

1. Advantages and disadvantages of bio-weapons.

2. History of bio-weapon development and use.

3. Types of bio-weapons.

4. Bio-weapon detection and defense.

5. Forensic examination of bio-weapon evidence.

Learning Targets

1. The students can identify the main types of bio-weapons.

2. The students can explain the difficulty in detecting bio-weapons before the fact and in criminal investigations.

3. The students understand the processes involved in bio-weapon identification.

Student Activities and Learning

1. Research bio-weapon use. Students will read and present out different articles about bio-weapon use in the US and abroad.

2. The following websites will be used to show students how the US government responds to bio-threats.

* http://www.fbi.gov/about-us/lab/forensic-response/cbrnsu
* http://nopr.niscair.res.in/bitstream/123456789/2716/1/IJBT%207(1)%2023-31.pdf

3. Viral transmission lab:  Students model how a viral bio-weapon could potentially be spread in a population by sharing water from their cups, some of which contain phenolphthalein.  After the sharing is done students perform the hypothetical virus test by adding a drop of dilute sodium hydroxide to their cups to see who was infected.  Students analyze the class data for infection explaining how the virus can travel between people.

Textbook:

Forensic Science for High School

Barbara Deslich and John Funkhouser

Publisher: Kendall Hunt Publishing Companry

2006

Supplemental Materials

Criminalistics:  An Introduction to Forensic Science Laboratory Manual.  Meloan James Saferstein. Pearson Education 2011

Class Textbook Online Supplement
http://wps.prenhall.com/chet\_saferstein\_forensicintro\_2/?key=18495173091544121882222011

Virtual Lab Supplement
http://media.pearsoncmg.com/pcp/pcp\_73138\_saferstein\_crim/

http://wps.prenhall.com/chet\_saferstein\_forensicintro\_2/153/39348/10073292.cw/index.html

http://wps.prenhall.com/chet\_saferstein\_criminalistics

American Academy of Forensic Scientists http://www.aafs.org/

CA Assoc. of Criminalists http://www.cacnews.org/

Combined DNA Index System http://www.fbi.gov/hq/lab/codis/index1.htm

Crime Museum http://www.crimemuseum.com/criminal\_mind/forensics/

Crimes and Clues http://www.crimeandclues.com/

DNA-related Animations http://www.dnalc.org/ddnalc/resources/animations.html

Case Summaries Involving DNA Testing http://www.denverda.org/DNA/DNA\_INDEX.htm

Current CA Law and Federal Funding http://www.dnaresource.com/

America Prosecutors Research Institute http://www.shodor.org/workshops/forensic/cases/stapleton.html

FBI Youth http://www.fbi.gov/kids/6th12th/6th12th.htm

Virtual Forensic Database http://www.virtualmuseum.ca/Exhibitions/Myst/en/index.html

Interactive Games http://nobelprize.org/educational\_games/

Court TV http://www.courttv.com/forensics\_curriculum/

Forensic Science http://library.thinkquest.org/04oct/00206/lo\_index.htm

Young Forensic Scientists Forum http://www.aafs.org/yfsf/resources.html

STR Internet Database http://www.cstl.nist.gov/biotech/strbase/

Cybrary Criminal Justice Directory http://talkjustice.com/cybrary.asp

Firearms ID http://www.firearmsid.com/members/login.htm

Physical Evidence Bulletins http://www.cci.ca.gov/Reference/peb/peb.html

Visible Proofs http://www.nlm.nih.gov/visibleproofs/education/

Face Recognition at http://www.iqbiometrix.com/products\_faces\_40.html

Forensic Science Laboratory Manual and Workbook

Authors: Thomas Kubic and Nicholas Petraco

2005

 **Forensic Science**

**Pajaro Valley High School**

College Preparatory Elective “g”

Discipline: Laboratory Science - Integrated Science

11th,12th

Course overview:

The aim of Forensic Science is four-fold. First, it provides students with core content knowledge and meaningful understanding of the frameworks of Forensic Science.  Second, the course stimulates students to hone skills in scientific investigation and methodology.  Third, this course introduces students to a range of sub-disciplines within forensic science and makes evident its interrelation with other branches of science. And fourth, this course improves students' powers of communication and transferable skills of research and composition.

Prerequisites:

Integrated Science 1 (recommended)

Biology (recommended)

Course Content:

**UNIT 1: Intro to Forensic Science**

1. By the conclusion of this unit, students are able to define forensics and describe the development of forensic science over history. They will be able to name the various careers in forensic science and the services that a crime lab provides. Students will know the differences between perceived roles of a forensic scientist as opposed to the actual role. Students will know the tools used by scientists to investigate crimes, and be able to identify, class, categorize, document, and collect evidence at a crime scene.

2.**Basic Forensic Science Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 2: Trace Evidence**

**1.**For this unit, students will be proficient in the collection and analysis methods for hair, fiber, and various trace evidence.  They will know the growth cycle, characteristics, and structures of human hair and will demonstrate that the morphology of hair varies from person to person, allowing it to be examined as evidence.  Students will understand that the characteristics of hair vary between different species and can be used to identify them.  Students will be able to identify fibers having characteristics that can used to identify their originating materials.  Finally they will identify that trace elements, metals, soil samples, paint samples, glass fragments can all be used as evidence to identify suspects in a crime.

Unit 2. **Trace Evidence Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene. Students will identify relevant evidence, categorize and properly document it. Students then must use the correct tools in order to collect this evidence. After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect. They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene. Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit

**UNIT 3: Print Analysis**

1. Students will understand and demonstrate that a fingerprint is an individual characteristic that is not duplicated from person to person.  They will also understand that fingerprints have general ridge patterns that permit them to be systematically classified.  After analyzing a mock crime scene, students should be able to identify and perform various fingerprint location, collection and preservation techniques.  Besides just fingerprints, students will discuss that all objects have distinguishing physical characteristics that can be identified in an impression; demonstrate that objects can be identified by their impression through comparing key physical characteristics and know the methods for collecting, identifying and comparing this impression evidence.

2. **Print Analysis Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 4: Firearms, Ammunition, and Ballistic Analysis**

1. By the end of this unit, students will understand that ammunition can be linked to a particular firearm through ballistic analysis. Students will understand that each gun leaves identifying marks on ammunition to accurately link it back to that particular gun. Students will also analyze the trajectory of the bullet in order to predict where the killer was standing at the time of firing the weapon. They will also look at gun powder residue to determine the proximity of the killer to the victim or to determine if the suspect is indeed the killer.

2. **Firearms, Ammunition, and Ballistic Analysis Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 5: Organic Analysis**

1. Students will know that the structure of DNA is unique to each individual and can be used as a means of identification. They will also understand that DNA evidence can be found anywhere where a body has been in contact, a minute amount of DNA evidence can be analyzed using various technological methods and mitochondrial DNA can be used as an alternate source of DNA when nuclear DNA is unavailable. This DNA can be found in bodily fluids and can be obtained using Locard’s Exchange Principle is applied to DNA evidence.

2. **Organic Analysis Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 6: Death: Meaning, Manner, Mechanism, Cause & Time (Forensic Anthropology, Pathology, And Entomology)**

1. The main goal of this unit is to understand that the dead body of a victim contains an abundance of evidence that can be used to identify the mechanism of death.  Students will demonstrate that the human body can be identified by the measurements of skeletal and odontological remains.  Various procedures performed during an autopsy will also be studied.  Students will also develop and demonstrate that entomological evidence can be used to determine factors leading up to death along with the time of death (along with using core body temperature and Newton's Law of Cooling).  Finally students will define and identify evidence of livor mortis, rigor mortis, and algor mortis.

2. **Forensic Pathology Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 7: Forensic Serology**

1. By the conclusion of this unit, students are able to define serology and its use in forensic science.  They will be able to identify blood types and understand that specific blood tyes can be associated with individuals and used as evidence.  Students will demonstrate that the location, distribution and appearance of bloodstains and spatters can be analyzed to reconstruct and interpret the events that produced the bleeding.  Finally students will understand and demonstrate that bodily fluids can be collected and analyzed as a source of evidence, including blood, sweat, urine, and saliva.

2. **Forensic Serology Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 8: Toxicology**

1. By the conclusion of this unit, students are able to identify various drugs or chemicals present in the body at the time of death or moments leading to it.  Students will focus primarily on alcohol, illegal or prescription drugs, poisons, metals, and gases (such as carbon monoxide).  Students will know what is a safe and lethal amount of these various toxins and know the types of tests used to test for each one.

2. **Toxicology Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 9: Handwriting, Forgery and Counterfeiting**

1. By the conclusion of this unit, students will understand the purpose of document analysis in forensic science, including the fact that document analysis is used to determine authenticity & ownership of documents as well as to detect fakes and forgeries.  In doing so, students will demonstrate that every method of document creation leaves specific identifying characteristics that can be used to determine the source of the document whether it was created by photocopiers, inkjet printers, laser printers, typewriters or fax machines.  Students will also demonstrate that inks and pigments are developed from a specific mixture of chemicals that can be separated and analyzed to determine their identity through the use of chromatography which works to separate constituent components of a liquid mixture.  Finally students will know that each person has unique handwriting traits that can be used to identify the author of a document and the points of similarity that are used to identify handwriting samples.

2. **Handwriting, Forgery, and Counterfeiting Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

**UNIT 10: Psychological Profiling & Interrogations/ Confessions**

1. By the end of this unit students will understand how law enforcement psychologically profiles and interrogates suspects. Students will study basic psychology to not only determine what triggered the murder, but why the killer chose the method and manner, and any post offense behavior that may take place. All of this will help law enforcement catch the suspect. Students will know the legal rights these suspects have under interrogation, and what constitutes a confession.

2.  **Psychological Profiling Mock Crime Scene**

Students will be presented with a mock crime scene in which they demonstrate the proper protocol in legally dealing with said crime scene.  Students will identify relevant evidence, categorize and properly document it.  Students then must use the correct tools in order to collect this evidence.  After the evidence is collected, students will then use lab techniques to analyze it in order to find a suspect.  They will then write a 3 to 4 page paper on documenting their methods on how they approached and processed the crime scene.  Students will also include their rationale behind their actions using vocabulary and knowledge gained throughout this unit.

Textbook:

Forensic Science – Fundamentals and Investigation

Author: Anthony J. Bertino

Publisher: Cengage

Edition: 2nd edition/ 2016

<http://ngl.cengage.com/search/productOverview.do>?

Websites:

Forensics: An Online Textbook

Mr. Lazaroff and Mr. Rollison

Staples HS, Westport School District

<http:////shs.2.westport.k12.ct.us/forensics/online.textbook.htm>

Phet Interactive Simulations Phet Colorado Education <https://phet.colorado.edu/>

Ck-12 CK-12 CK-12 Foundation <http://222.ck12.org> /

**Forensic Science**

**Monte Vista High School**

Laboratory science d” / Biology/Life Sciences

11th, 12th

Forensic Science is a third or fourth year, college preparatory, elective science for those students interested in the detailed investigation practices used in the criminal justice system. This rigorous, multidisciplinary course integrates concepts and lab techniques from the fields of biology, chemistry, physics, Earth science, anatomy and physiology to analyze and interpret evidence within the realm of our legal system. Students will use the scientific method to solve mock criminal investigations and explore how science and inquiry can be applied to the criminal justice system. Students will apply their knowledge of investigation to the analysis of the following: crime scene analysis, physical/chemical analysis of evidence, fingerprint analysis, microscopy, hair, fiber, blood (serology), wounds, glass, chromatography, drug, toxicology, entomology, impressions, soil samples, anthropology, documents, firearms and DNA analysis. Students will actively participate in labs and activities relating to the investigation of crime scenes and the analysis of evidence while emphasizing potential career pathways, critical thinking, problem solving, observations, data analysis, data collection, digital photography, writing, speaking, listening and technology in addition to scientific skills and techniques which meet Common Core and Next Generation Science Standards.

Prerequisites:

Completion of Biology with C or higher. Chemistry with a C or higher and Algebra 1 C or higher (required)

Course Content:

Unit- General

**Unit - General**

For all units covered in the text this general format will be used:

While reading the chapter students will define key terms, answer all learning objectives, write out all key points. Read case studies and write what they learned from the case study. Write if they think something in the investigation could/should be done differently, if so what; and if there was a verdict did they agree with it, why or why not. This gets students to use critical thinking skills from the very beginning. In addition, students will find additional information and answer specific questions the teacher presents. All homework will be discussed in class the following day. See example for chapter 1 lesson plan for textbook.

Students will view videos of procedures needed to conduct evidence testing. This will help with recall of prior knowledge and help prepare students for the actual labs they will be doing by explaining purpose of and proper technique and safety to conduct needed lab tests.

Students conduct labs that will enable them to test evidence and interpret the results when they find similar evidence at mock crime scenes. Students will create and maintain a “reference library” with detailed explanation, in their own words, of how to complete all lab tests and a sample of all test results, control, positive and negative. They will refer back to their “reference library” when they are testing evidence from mock crime scenes. Their “reference library” will become their Professional Portfolios at the conclusion of the course showing examples of their skills learned in this class.

Students will solve a daily two minute mystery and/or challenging lateral thinking puzzle to improve their critical thinking and deductive reasoning skills

Guest speakers will present on topics of study and discuss career options in forensic science.  Guest speakers include: forensic dentist, retired district attorney, ATF (alcohol, tobacco and firearms) agent, judge, crime lab technician, police detective, undercover narcotics agent, police officers,   blood spatter expert, medical examiner, fire fighter. Field trips are taken to facilities activity involved in forensic science: sheriff’s office, morgue, crime labs, court house, and prison

Students will be assessed several ways; 1) on material learned in the textbook by multiple choice, true/false and matching tests 2) on lab activities by active participation, behavior, attendance, effort, demonstration of skills acquired, accurate findings and test results, proper use of safety skills and protective clothing 3) Complete lab handouts and worksheets, 4) Crime scene cases will be graded according grading rubric provided by teacher; crime scene cases must include all documents needed for a complete police report (sketch, photos, evidence), test of evidence (show and explain results), written analysis of crime scene, findings and how the crime occurred, who committed the crime (must be based on evidence found at the mock crime scene) which is then presented to the class. Students do work individually and with group members. Students will view examples of work done by previous students.

This class focuses on Common Core and Next Generation Science Standards including literacy skills: observing, reading, writing, listening, speaking/presenting, using technology for lab tests and presentation creation and delivery.

**Forensic Science Chapter 1 Lesson Plans for textbook**

1. **Definition and Scope of Forensic Science**
	1. Read about Ted Bundy.
	2. Answer Learning Objective 1 and 2.
	3. Briefly describe the history and development of forensic science. You could make a time line.
	4. When did forensic science become more the rule than the exception?
	5. Explain Bertillon's system. Do you think it was very reliable for forensics detection?
	6. Write the Key Points on page 14
2. **Crime Laboratories**
	1. Answer Learning Objective 3 and 4
	2. List the 10 services offered by a crime lab. Include a brief description of each unit and give an example of the kind of evidence that they would be responsible for..
	3. Write the Key Points on page 23
3. **The Functions of the Forensic Scientist**
	1. Answer Learning Objective 5, 6,and 7
	2. What is physical evidence?
	3. Which of these three types of evidence is the best and why? Confession, Eye Witness, Physical Evidence?
	4. Write the Key Points on page 31

* By the end of the chapter students will have completed the following:
1. Define all Key Terms
2. Answer Review questions
3. Answer Application and Critical Thinking
4. Read case Reading and answered Case Analysis questions

**Unit 1 - Introduction to Forensic Science and the Crime Scene**

1. Introduction to Forensic Sciences.
	1. Definitions (terms)
	2. History
	3. Specialties
2. Scientific Method
	1. Observations (laboratory Journal/Notebook)
		1. Characteristics comparison
			1. Similar characteristics, associated to same/similar sources
			2. Dissimilar characteristics, cannot be associated with same source
			3. No conclusion can be reached, exhibiting similarities & differences.
		2. Class vs. individual characteristics
	2. Hypothesis (logical explanations)
	3. Tests (with controls)
	4. Assessments (against hypothesis)
	5. Refinement/Retesting (retesting hypothesis)
	6. Confirmation/Independent testing (redundancies)
	7. Communication/Publication of results (theory)
3. Safety
	1. Laboratory safety procedures
	2. Safety clothing/apparatus
		1. Gloves/glasses/protective clothing (how to put on and remove)
		2. Emergency shower/eye wash (location of all safety/emergency equipment in classroom & how to use equipment)
	3. Emergency procedures
		1. Activate emergency medical services (EMS) – Call 911
		2. Initiate safety response protocols
	4. Materials Safety Data Sheets
4. Incident Processing (Crime Scenes)
	1. Protocols (Standard Operating Procedures)
	2. Personnel tasks (responsibilities)
	3. Documentation
		1. Sketching/diagramming (triangulations)
		2. Capturing digital images (still and video)
	4. Chain of custody/chain of possession
	5. Proper collection of evidence
		1. How to handle evidence
		2. Type of containers for evidence collection
			1. Dry evidence
			2. Wet evidence
		3. Federal rules of evidence
		4. Eyewitness accounts
			1. How accurate are they?
			2. How good of an eyewitness are you?
		5. Wounds – how to ID (Simulaids Forensic Wound Pack)
		6. Pattern ligature
		2. Slash
		3. Shotgun
		4. Intermediate range flake
		5. Intermediate range round
		6. Ecchymosis
		7. Petechiae
		8. Intermediate Range
		9. Shotgun Close Range
		10. Exit gunshot
		11. Contact gunshot
		12. Screwdriver
		13. Bite partial
		14. Hesitation
		15. Single edge knife
		16. Blunt bat
		17. Bite complete (not shown)
		18. Double-edge knife
		19. Bunny ears exit wound
		20. Contact wound
		21. Exit small wound
		22. Exit large wound
		23. Contact hand gun
		24. Exit wound ice pick

**Labs**

1. Deductive Reasoning Exercise: The Deadly Picnic. (second day of class)

This exercise challenges students to critically analyze evidence and emphasizes the importance of thorough observations and note taking at the crime scene. Students will photograph and draw the crime scene, mark and record the evidence. They will list what the evidence should be tested for.  After given information on all suspects the students will determine who killed Mr. Brooks and write how the crime occurred. The students will use prior knowledge and will learn what needs to be completed at a crime.

1. Locard’s Exchange Principle

Students will wear a new white T-shirt for one day. They will keep a time line of everything they did for that day. Then the shirt will be placed in a Ziploc bag with the time line and given to the teacher. Teacher will make copies of the timelines and give each student a T-shirt and three timelines. The students will collect trace evidence from the T-shirts, store the evidence in druggist folds, examine under the microscope and deduce whose shirt they have from the evidence and write why they know. The student’s deduction of whose shirt it is must be backed up by reference to the trace evidence found on the shirt. Students will use critical thinking and hone their observation skills.

1. The Crime Scene
	* Crime Scene Sketching and Digital Photography: How to properly sketch a crime scene; rough sketch and final draft, including proper labeling of case information, evidence, and legend, to scale and triangulate from a non moving point of origin. How to properly take digital photos of the crime scene, from panoramic to close ups with and without rulers.
	* How to properly secure and control the crime scene, collect and preserve evidence from a crime scene, how to walk through a crime scene, grid search, quadrant/zone search, spiral search. Securing and controlling the crime scene.
	* Crime Scene Reconstruction: Sketch a crime scene, collect the evidence and then recreate another group’s crime scene from their sketch. Write up what makes a good crime scene sketch and what should have been included in the sketch you received from the other lab group to make it easier to accurately recreate the crime scene. Students will compare the original crime scene to the one they created to see how accurate they were and to learn how to create a more accurate crime scene sketch.
	* Eyewitness Accounts and how accurate are they. Watch videos on eyewitness accounts, watch the Innocence Project, observe mock crimes and be an eye witness; how accurate are you?
2. Who Am I?
	* Students use deductive reasoning to determine age, gender, race, occupation, marital status, children, residency, health status and hobbies by looking at discarded belongings.

 Objectives - After completing this unit students will be able to:

* Define forensic science and list the major disciplines it encompasses
* Recognize the major contributors to the development of forensic science
* Account for the rapid growth of forensic laboratories in the past forty years
* Describe the services of a typical comprehensive crime laboratory in the criminal justice system
* Compare and contrast the *Frye* and *Daubert* decisions relating to the admissibility of scientific evidence in the courtroom
* Explain the role and responsibilities of the expert witness
* List the specialized forensic services, aside from the crime laboratory, that are generally available to law enforcement personnel
* Define physical evidence
* Discuss the responsibilities of the first police officer who arrives at a crime scene
* Explain the steps to be taken to thoroughly record the crime scene
* Describe proper procedures for conducting a systematic search of a crime scene for physical evidence
* Describe proper techniques for packaging common types of physical evidence
* Define and understand the concept of chain of custody
* Understand the contributions the forensic pathologist, entomologist, and anthropologist can make to a homicide investigation

Knowledge - After completing this unit students will be able to:

1. Describe the different types of evidence
2. Explain how evidence is deposited
3. Explain why certain evidence may be more likely to be found than others
4. Describe the different values of certain types of evidence in court proceedings
5. Explain the importance of Locard’s “Exchange Principle” of evidence
6. Explain the reasons for isolating and protecting a crime scene from outside contamination
7. Explain the importance of the “chain of evidence”
8. Explain the steps for thoroughly recording the crime scene
9. Describe the proper procedures for conducting a systematic search of a crime scene for physical evidence
10. Understand the limitations of eyewitnesses

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Evaluate types of evidence law enforcement should search for in specific crimes
2. Evaluate the use of certain types of evidence in court proceedings
3. The students learn how to recognize and collect evidence as well use scientific techniques for analysis.
4. Evaluate the importance of Locard’s “Exchange Principle” of evidence
5. Be able to secure a crime scene
6. Search a crime scene
7. Collect evidence and retain the “chain of evidence”
8. Draw and use a crime scene sketch
9. Be able to take photographs of a crime scene that can be used in court
10. Be able to identify wounds and what weapon caused them.

**Unit 2 –Fingerprints and Impressions**

1. Fingerprints
	1. Roll prints
	2. Dusting and lifting latent prints (magnetic carbon powder)
	3. Chemical procedures for latent print processing/development
		1. Formation of latent prints (perspiration/sweat pores in dermal ridges)
		2. Friction ridges (epidermal layers)
		3. Iodine fuming (porous surfaces)
		4. Cyanoacrylate (superglue) fuming
		5. Ninhydrin soak
	4. Analyze prints (classify, determine ridge characteristic)
2. Impressions
	1. Types
		1. Footwear (forensic podiatry)
		2. Tire tracks
		3. Strangulation/ligature marks on skin
		4. Bite-marks (forensic odontology)
		5. Tool marks
	2. Capturing digital images (in situation and close up, with and without ruler)
	3. 2-D impressions
	4. 3-D impressions casting (preparation, mixing, pouring, cleaning)
	5. Documentation
	6. Compare impressions to actual evidence to find a match
	7. Databases (forensic databases: Paint, Shoe Prints and Beyond) National Institute of Justice
	8. Sampling errors
	9. Probability and statistics

**Labs**

1. Fingerprints

Students will watch videos on how to take, lift, process, and analyze prints to help prepare them for this unit. Students will take each other’s prints, classify the prints (arch, loop, whorl) and determine ridge characteristics (bifurcation, ridge ending, etc.). Then students will plant their own prints and practice lifting latent prints from different surfaces, to determine which surfaces provide the best to worse prints; they will practice lifting prints on campus. Students will make print cards of their fingerprints; put prints on different items, and switch with another lab group. Students will use different techniques to develop each print, including iodine crystals, cyanoacrylate fuming (super glue), ninhydrin, magnetic powder and carbon dust of different colors. Then they will analyze, label, compare, evaluate and verify whose prints they have. Students will have to use the techniques that they learned to correctly identify whose prints they have developed and lifted.

1. Impressions - Shoe Print, Tire Impressions, Tool Marks, and Bite Marks

Students learn that impression evidence includes any markings produced when one object comes into contact with another, leaving behind some kind of indentation or print. Evidence encountered includes footwear impressions, tire impressions, bite marks and markings created by tools and similar instruments. There are three different types of prints visible, plastic and latent. Students will learn how to make impressions of teeth and tools in clay. Students will match shoe prints, tool marks, bite marks, tire impressions and tell the direction a car was traveling by its tire tracks. Students will use data bases to determine brand of shoes by sole pattern and brand of tire by thread pattern, then find out where those shoes and tires are sold.

 Students apply what they learned about class characteristics, individual characteristics and wear characteristics for shoes and tires. Students will examine their own shoe on all sides for unique features, cuts that interrupt the pattern on the sole, wear or rub marks on the outer edge, and manufacturing defects; along with measuring the length and width of the shoe. They will make a note of each feature in their report.

Students are given a shoe print and several shoes of the same brand and size. Students have to use the knowledge they learned to match the shoe print with the correct shoe, state in a formal police report why they think the shoe matches the print and share their findings with the class. Students will repeat this lab making casts of shoe prints, exchanging their cast, shoe that made the cast and other shoes of the same brand and size with another lab group. Students will complete a written report and share with the class their findings and why they think the shoe they chose matches their cast.

**Fingerprints and Impressions**

Objectives - After studying this chapter you should be able to:

* Review the common types of physical evidence encountered at crime scenes
* Explain the difference between the identification and comparison of physical evidence
* Define and contrast individual and class characteristics of physical evidence
* Appreciate the value of class evidence as it relates to a criminal investigation
* List and explain the function of national databases available to forensic scientists
* Explain the purpose physical evidence plays in reconstructing the events surrounding the commission of a crime
* Know the common ridge characteristics of a fingerprint
* List the three major fingerprint patterns and their respective subclasses
* Distinguish visible, plastic, and latent fingerprints
* Describe the concept of an automated fingerprint identification system (AFIS)
* List the techniques for developing latent fingerprints on porous and nonporous objects
* Describe the proper procedures for preserving a developed latent fingerprint
* Explain the forensic significance of class and individual characteristics to the comparison of footwear, tire impressions and tool mark.

Knowledge - After completing this unit students will be able to:

1. Explain why physical evidence is important.
2. Identify the basic types of fingerprint classification
3. Describe the types of fingerprints found
4. Describe the reasons and importance of fingerprint databases
5. Describe the methods of retrieving latent fingerprints
6. Understand the value of impressions left at a crime scene

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Collect and identify physical evidence
2. Make a druggist fold.
3. Know what type of containers to store evidence in
4. Understand what physical evidence should be tested for
5. Classify fingerprints
6. Process latent prints on a variety of surfaces using different methods
7. Comparing fingerprints found at the crime scene with known samples
8. Make casts of impressions and molds of tools
9. Identify and match impressions with the evidence found at a crime scene

**GUEST SPEAKER – Forensic Dentist**

**Unit 3 - Physical and Trace Evidence – Using the Microscope and Hair and Fiber**

1. Microscope (compound and stereoscopic)
	1. Parts and function of microscope
	2. Proper care and use of microscope
		1. Handle, carry and store
		2. Use of diaphragm (light)
		3. Use of mechanical stage
		4. Cleaning lens
	3. Viewing specimens under microscope (how to focus and find field of depth)
		1. Low power
		2. Medium power
		3. High power
	4. Making slides
		1. Wet mount
		2. Dry mount
2. Hair
	1. Morphological regions (hair structures)
		1. Cuticle (scales)
		2. Cortex (pigment)
		3. Medulla (core)
			1. Type of medulla
			2. Medullary index
	2. Sebaceous glands
	3. Sweat (apocrine) glands
	4. Hair follicle receptors (nerve sensors)
	5. Anagen phase (growth)
	6. Catagen phase (regressing)
	7. Telogen phase (resting)
		1. Growth from root out (cellular division) adding to hair length
		2. Approximately 1.0 cm every 28 days in humans
	8. Toot sheath
	9. Hair-follicle cycling and hair growth
	10. Hair types (body locations)
		1. Head (scalp) hair
		2. Public hair
		3. Limb hair
		4. Auxiliary (underarm) hair
		5. Eyebrow, eyelash, trunk (chest) hair
	11. Racial origins
		1. Caucasian
		2. Negroid
		3. Mongoloid
	12. Hair treatment
		1. Natural hair color
		2. Dyed hair
		3. Green hair due to chlorine
	13. Age of hair
		1. Baby
		2. Young child
		3. Teen
		4. Adult
		5. Older adult (gray hair)
	14. Degree of curl
		1. Straight
		2. Curly (several different levels of curliness)
	15. Hair for chemical indicators (over time)
	16. Animal hair
		1. Dog
		2. Cat
		3. Horse
		4. Cow
		5. Possum
		6. Llama
		7. Bear
		8. Seal
		9. Wolf
		10. Squirrel
		11. Hamster
		12. Ginny pig
		13. Deer
		14. Sheep
3. Fibers
	1. Textiles definitions (natural vs. synthetic)
	2. Natural (plant and animals)
		1. Cotton
		2. Wool, silk, cashmere, mohair
	3. Synthetic (man-made)
		1. Polyester, nylon, acrylics, rayon, acetate
	4. Microscopic analysis
		1. Microscopic cross-sections (shapes: round, trilobal, serrated, irregular)
		2. Colors (dyes, printed, absorption, discoloration)
		3. Fabrics (construction, knitted, woven)
	5. Flame tests (fiber reaction to heat source)
	6. Solubility tests (reaction to know chemicals)

**Labs**

1. Microscope

Students will first conduct a virtual microscope lab to refresh their knowledge and practice proper handling, care and use of the compound and stereoscopic microscope including how to adjust the diaphragm, objective power and field of depth to obtain superior results for each piece of evidence look at under the microscope. Students will also learn how to prepare dry-mount and wet-mount slides for examination under the compound microscope; students will use both compound and stereomicroscopes in class when examining trace evidence and learn when it is appropriate to use each type of microscope.

1. Hairs

Students will bring in samples of hair, different types of human (different color, degree of curl, natural and colored, and hair from different body parts) and animal hair to view under the microscope. Students will learn how to prepare hair samples on glass slides to identify features of hair such as color, natural vs. colored, overall shape and length, scale patterns, cuticle, root type, cross-sectional shape and structural features ,cellular structure of medulla and medullary index, pigment distribution and degree of curl. Students will learn to cast hair scale impressions to distinguish human hair and different types of animal hairs.

1. Fiber

Students will use five exemplar fibers to create a sample data base of common fibers. Students will learn to identify these fibers by viewing them for microscopic appearance, shape and luster; fibers will be sketched under low, medium and high power. Cross-sections of the fibers will be taken and observed under the microscope at the appropriate power and sketched. Students will conduct a “burn test” with all of their fibers and record how each fiber reacts when approaching the flame, in flame, removed from flame, odor and residue; along with solubility tests.

1. Crime Scene – Lab Activity
	1. This crime scene uses a real “live” dead body, my daughter volunteers. Students take pictures, mark evidence, measure, sketch crime scene, and take notes. Every unit has at least one crime scene so the students switch off tasks.
	2. Students collect trace evidence, hair and fiber and are given police background information on the crime. The evidence and samples from the five suspects are tested by each group. Students use what they have learned to document all hair and fiber evidence tests along with fingerprint analysis and conclude who killed Mimi Poe. Students have to write up how they think the crime occurred and who killed Mimi Poe using the results of their tests and present their findings to the class.

Physical and Trace Evidence - Hairs and Fiber

Objectives - After studying this chapter you should be able to:

* Recognize and understand the cuticle, cortex, and medulla areas of hair
* List the three phases of hair growth
* Appreciate the distinction between animal and human hairs
* List hair features that are useful for the microscopic comparison of human hairs
* Explain the proper collection of forensic hair evidence
* Describe and understand the role of DNA typing in hair comparisons
* Understand the differences between natural and manufactured fibers
* List the properties of fibers that are most useful for forensic comparisons
* Describe the proper collection of fiber evidence

Knowledge - After completing this unit students will be able to:

1. Describe the parts of a hair
2. Explain the lack of evidentiary value in hair comparisons
3. Describe the basic types of fibers in use today

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Use microscopes to compare hair and fiber
2. Use “burn test” to compare fibers taken from crime scene with exemplars taken from suspects.

**Unit 4 - Serology**

1. Human circulatory system
	1. Arterial vs. venial bloods
	2. Red blood cells (erythrocytes – no DNA)
	3. White blood cells (leukocytes)
	4. Platelets
2. Blood types
	1. A, B, AB & O
		1. Defined/characteristics
		2. Use Punnett Square to determine blood type probability
	2. RH factor
3. Presumptive test (is it blood) (Kastle-Meyer test, hemastix, hydrogen peroxide)
4. Chemiluminesce testing (luminal, BlueStar)
5. Documentation of bloodstains
	1. Photography and drawings
	2. Proper collection of blood samples
6. Bloodstain terminology
	1. Spines
	2. Satellites
	3. Tails
	4. Passive
	5. Projected
	6. Expiration pattern
7. Bloodstain classifications
	1. Spatter group (passive drop, arterial spurt, cast-off, impact – low, medium, high impact)
	2. Non-spatter group (smear, swipe, wipe, pattern, transfer, pool and flow)
	3. Angle of impact calculations
	4. Point of convergence (2-D intersection of blood spatter to determine height of bloodletting )
	5. Area of origin (3-D intersection of blood spatter to determine exact position of bloodletting)
		1. Mathematical equations ‐(tangent trigonometric function)
	6. Void (absence of blood stain in area with continuous blood stain pattern
8. Reconstruction of crime by analysis of blood patterns

**GUEST SPEAKER –  BLOOD SPATTER EXPERT**

LAB

1. Bloodstain Pattern Analysis (BPA)

Students will watch videos and read about blood spatter to better understand the topic before starting. Students will use non-human or synthetic blood in this lab. Students will drip blood from a pipette at different heights, photograph, draw sample and record measurements in lab while standing still; repeat walking, running from one height, accurately draw and record all data. This data will be used to determine which direction a bleeding person is traveling and the speed at which they are traveling. Students will conduct different types of blood spatter; drip, arterial spurt, cast-off, angle of impact and non-spatter group (smear, swipe, wipe, pattern, transfer, pool and flow. Students will beat a bloody sponge with a blunt object to simulate high velocity impact spatter; then calculate 2-D Point of convergence and 3-D Area of origin. Students will submit all of their findings and lab work to teacher for evaluation. Outstanding work will be kept in the reference library for use in future mock crime scenes.

1. Students in lab groups will create their own crime scenes with blood stains and any other evidence we have studied so far. Lab groups will switch crime scenes, document, photograph, sketch crime scene; analyze blood stains and other evidence, write up how the crime happened then present to the class. Their story has to explain all evidence at crime scene. The group that created the crime scene will then share their crime scene story if it is different.

Forensic Serology (blood and blood spatter)

Objectives - After studying this chapter you should be able to:

* List the A-B-O antigens and antibodies found in the blood for each of the four blood types: A, B, AB, and O
* Understand and describe how whole blood is typed
* List and describe forensic tests used to characterize a stain as blood
* List some common field reagents used to enhance bloody footprints.
* Understand the concept of antigen–antibody interactions and how it is applied to species identification and drug identification
* Contrast chromosomes and genes
* Learn how the Punnett square is used to determine the genotypes and phenotypes of offspring
* List the laboratory tests necessary to characterize seminal stains
* Explain how suspect blood and semen stains are to be properly preserved for laboratory examination
* Describe the proper collection of physical evidence in a rape investigation
* Understand how gravity affects blood spatter flight.
* Understand blood stain terminology

Knowledge - After completing this unit students will be able to:

1. Understand that latent blood can be seen with chemical enhancement (Luminol)
2. Describe different blood stain patterns based on source, direction, and angle of trajectory
3. Understand how blood type is genetically passed down from parent to offspring.
4. Calculate angle of impact, point of convergence and area of origin of blood spatter

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Determine students blood type (Nurses from John Muir Hospital will do this)
2. Determine the direction and trajectory of blood stains (simulated blood and nonhuman blood)
3. Identify different types of blood patterns (simulated blood and nonhuman blood)
4. Create a mock crime scene with blood spatter; must have a minimum of seven different types of blood patterns and they must be able to come from a single incident.
5. Investigate a mock crime scene and in a written report recreate how the crime occurred according to the blood evidence at the scene.

**Unit 5 - Forensics Entomology**

1. Introduction
2. Study of insects and other arthropods in respect to legal matters
3. Estimating time of colonization (eye laying)PostMortem Interval (PMI)
	1. Body temperature
	2. Progression of rigor mortis
	3. Insect activity (most accurate measure after onset of purification, 3+ days)
	4. Introduction to dichotomous taxonomic keys (larval and adult insect identification)
	5. Necrophagous species (Blow Flies, Flesh Flies – behavior and life cycles)
	6. Parasites and predators (Soldier Flies, Beetles)
	7. Omnivores and opportunists (scavabger activity)
4. Common fly life cycles
	1. Female laying eggs within minutes of death (exposure to environment) 200-300 eggs in orifices
	2. Eggs hatching 1-2 days later (temperature dependent)
	3. Three larval (Instar) stages, ID by spiracles over a few days to a few weeks
	4. Puparium transformation (outer cuticle of 3rd Instar larva hardens), pupation
	5. Adult hatching, taxonomic identification (confirmation)
5. Environmental impact/influence factors
	1. Sources for weather data (NASA, local TV/radioweater bureaus
		1. Temperature range (daily, weekly, seasonal)
		2. Humidity, precipitation
		3. Diurnal/nocturnal cycles
	2. Seasonal variations
	3. Determining temperature history at scene
6. Insect types and taxonomy
7. Detailed entomology calculations (calculate average temperature body/insects were exposed to)
8. Rearing maggots to adulthood to identify/confirm species
	1. Recording time/temperature until larvae pupate
	2. Measure and draw larvae daily
9. Estimate time of egg laying (from knowledge of development rates per species at rearing temperatures, “counting” backwards to estimate age of maggots collected when body was discovered)
10. Time of Colonization (TOC) vs. Time of Death (TOD) vs. Post Mortem Interval (PMI)

LAB (Critters on Cadavers)

1. Students will rear maggots by putting liver in Tupperware containers they prepared and setting them outside for 24 hours for blow flies to lay eggs on. Containers will be brought back in the classroom and checked for parasites and predators, all information will be recorded daily. Once maggots hatch they will be observed under the stereoscope daily, measured and drawn. A data table of the temperature outside and in the classroom will be maintained. Once maggots pupate the holes in the Tupperware containers will be taped so flies do not escape into the classroom. Maggots in different stages of development and adult flies will be kept in specimen jar in alcohol to use as exemplars for future labs. Maggots, pupa and flies will be identified using dichotomous taxonomic keys.

1. Students will discover two decomposing corpses; they will photograph and sketch both crime scenes, collect maggots from each corpse, record ambient temperature, soil temperature under corpse and near corpse, temperature of corpse and maggot mass. Students will return to classroom with evidence including any parasites and predators, students will determine time of colonization by observing larval (Instar) stages, pupa and flies at scene. Using this information students will deduce time of death of each corpse. Students will grind up maggots and test for drugs to see if corpse had drugs in their tissue at the time of death.

**Forensics Entomology**

Objectives - After studying this chapter you should be able to:

* Understand how post-mortem interval (PMI) pertains to forensic entomology
* List the phases of the blow fly life cycle.
* Describe the proper collection and storage of specimens in the field.

Knowledge - After completing this unit students will be able to:

1. Use of taxonomic keys
2. Understand how weather effects of larval insects/blow flies, maggots development
3. Understand reason for taking temperatures at different locations where body was found
4. Understand how larval development

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Identify local insects
2. Sample collection of larval insects/blow flies, maggots
3. Culture/grow-out of larvae through pupa stage to hatching of adults
4. Track and evaluate environmental/ambient weather influences
5. Calculate time of colonization
6. Estimate time of death

**Unit 6 – Toxicology (poison detection, alcohol and narcotics)**

1. Alkenes and alkynes
2. Controlled drugs
	1. Hallucinogens (cannabis, KSD, PCP, MDMA/ecstasy)
	2. Stimulants (cocaine, speed/meth, crank)
	3. Narcotics (morphine, heroin, opium, codeine)
	4. Depressants (barbiturates, Quaaludes, valium)
	5. Prescriptions, Rx, OTC (over the counter drugs)
3. Poisons
	1. History of poisons
		1. History of poisons
		2. Elements of toxicology
		3. Measuring toxicity (toxins, chronic exposure, acute toxicology, synergism, antagonism, chelating agents)
	2. Heavy metals (environmental poisons/pollutants)
		1. Lead poisoning
		2. Mercury poisoning

**GUEST SPEAKER – Alcohol, Tobacco and Firearms Agent (ATF)**

Lab- White Powders: A lab on standardized tests used to identify unknown substances

Students are given  five exemplar powders, including table salt,  to observe and test and determine positive test results. They are told these powders are drugs, except the table salt. Observations/tests include: microscopic observations, chemical reactions (acetic acid, sodium carbonate, Lugol’s solution, water) and heat tests. Data is recorded in their lab and a copy for their reference library.  Students are then given a baggie of powder and told it was confiscated from a locker at a neighboring high school. Unknown powders are to be tested to determine if they are drugs and if so, which type. Students write a formal report on results of drug test explaining what drug it is and how they know; this is in preparation to be an expert witness in court.

Objective - After studying this chapter you should be able to:

* Compare and contrast psychological and physical dependence
* Name and classify the commonly abused drugs
* Describe the laboratory tests normally used to perform a routine drug identification analysis
* Describe and explain the process of chromatography
* Explain the difference between thin-layer chromatography and gas chromatography
* Describe the utility of ultraviolet and infrared spectroscopy for the identification of organic compounds
* Describe the concept and utility of mass spectrometry for identification analysis
* Understand the proper collection and preservation of drug evidence

**Knowledge –**After completing this unit students will be able to:

1. Explain how to analyze drugs to determine what type of drug it is.
2. Poison identification; arsenic, cyanide, and thallium
3. Drug detection
4. Analysis of over the counter drugs, used as “cutting agents”

**Skills (Lab Activity Based) -**After completing your labs/Activities students will be able to do the following:

1. Analysis of powders found at crime scene to determine what they are; write a formal report on procedures conducted and results.

**Unit 7 – DNA Analysis**

1. Cytology (cellular biology)
	1. Cellular structures
	2. Cellular organelles
	3. Nucleus
	4. Deoxyribonucleic Acid (DNA) Profiles
		1. Chromosomes
		2. Genes
		3. Proteins (enzymes)
		4. DNA structure (right-handed, double helix)
		5. Base pairs (adenine, thymine, guanine & cytosine)
		6. DNA “Fingerprinting” history in forensics
		7. RFLP (restriction fragments length polymorphism) analysis
			1. Isolation of DNA
			2. Cutting with restriction enzymes
			3. Sorting by base strands (length/size) electrophoresis
			4. Analyzing (identifying specific alleles)
			5. Polymerase Chain Reaction (PCR)DNA Amplification
				1. Separation
				2. Primer addition
				3. Synthesis of new chains (duplication activities)
				4. Heating/cooling cycles (3 hours to make 1 million copies)
				5. Mitochondrial DNA
2. FBICODIS database (CombinedDNA information system)
	1. Statistical analysis of potential matches in a defined population
	2. Probability of “twinning” genetic match of DNA

Lab – DNA fingerprint

      Students watch several videos topics include: how to use a micropipette, how restriction enzymes cut DNA, interpreting DNA sequence. This is to help prepare students for this lab. Students will practice proper use of micropipettes. Students will receive DNA from a crime scene and five suspects, use restriction enzymes to cut the DNA into fragments, pipette the DNA into gels, run the electrophoresis gels so the DNA is sequenced, analyze the gels and determine whose DNA was at the crime scene. Students will then solve the crime they were given, write up their results and present to the class.

Objective - After studying this chapter you should be able to:

* Name the parts of a nucleotide and explain how they are linked to form DNA
* Understand the concept of base pairing as it relates to the double-helix structure of DNA
* Contrast DNA strands that code for the production of proteins with strands that contain repeating base sequences
* Explain the technology of polymerase chain reaction (PCR) and how it applies to forensic DNA typing contrast the newest DNA-typing technique, short tandem repeats (STRs) with previous DNA-typing technologies
* Describe the difference between nuclear and mitochondrial DNA
* Understand the use of DNA computerized databases in criminal investigation
* List the necessary procedures for proper preservation of biological evidence for laboratory DNA analysis

**Knowledge –**After completing this unit students will be able to:

1. Explain how crime scene evidence is collected DNA analysis
2. Understand the process involved in DNA electrophoresis
3. Interpret DNA once sequenced

**Skills (Lab Activity Based) -**After completing your labs/Activities students will be able to do the following:

1. Complete DNA electrophoresis lab and be able to interpret DNA to determine if any of the suspects DNA was at the crime scene

**Unit 8– Forensic Anthropology (skeletal remains analysis)**

1. Osteology (study of bones)
2. Human skeletons (206) bones in adult body)
	1. Long bones
	2. Short bones
	3. Flat bones
	4. Irregular bones
	5. Estimating stature (height)
		1. Femur, tibia, humerus & radius measurements
		2. Height estimation equations
	6. Sex determination
		1. Pelvis (OS pubis sacrum & ilium) sexual characteristics
		2. Skull features (forehead, mastoid process, mandible, zygomatic arch)
	7. Skeletal age calculations
		1. Teeth erupting
		2. Bone growth
		3. Epiphyses (growth plates, forming and uniting)
	8. Racial determination (skull determinations)
		1. Caucasoid (narrow nasal aperture)
		2. Negroid (longer-long bones, degree of curvature)

Objective - After studying this chapter you should be able to:

* Know basic anatomy, how many bones in an adult and where they are located.
* Understand vocabulary.
* Describe proper collection of glass evidence

Knowledge – After completing this unit students will be able to:

1. Be able to properly use Vernier calipers.
2. Explain how to determine age, gender, race, and height from bones.

**Skills (Lab Activity Based) -**After completing your labs/Activities students will be able to do the following:

1. Analyze bones to determine age, gender, race, and height.

**Sherlock Bones: Identification of Skeletal Remains Lab Activity.**Three different sets**(**Caucasian male, African female, juvenile Asian female)

This lab provides students with experience with the process of epiphyseal union as well as using Vernier caliper. Students will be given a few bones, and then take the role of a forensic anthropologist to determine as much information as possible about the bones to help indentify the individual. Students will become familiar with some of the techniques performed by a forensic anthropologist as well as some of the challenges one may encounter along the way. Framework Science Standards (LS2), (LS3), and (LS4) are all utilized in this lab activity (Ecosystems: Interactions, Energy, and Dynamics, Heredity: Inheritance and Variation of Traits, Biological Evolution: Unity and Diversity). This kit has been aligned with all published National Standards. Pre- and Post-laboratory assessments and vocabulary words all target specific Science and Engineering Practices and common core standards. In addition, concepts that link the real world with scientific standards are explored. Students will complete worksheets to determine age, gender, race and height of their remains. Students will then write a report and present their findings to the class, they will be graded on their ability to correctly determine age, gender, race, and height.

**Unit 9 – Glass**

1. Glass analysis
	1. Composition of glass
	2. Glass samples as evidence (properly collecting, preservation)
	3. Different types of glass
		1. Soda-lime glass
		2. Colored glass
		3. Plate glass
		4. Safety glass (tempered glass)
		5. Laminated glass
		6. Optical glass
		7. Pyrex glass
		8. Lead crystal
		9. Glass students will work with (window pane, water glass, lead crystal, mirror, car windshield, car window, car headlight, Pyrex, tempered glass)
	4. Density of glass (mass divided by volume)
	5. Density of glass fragments (sink/float)
	6. Refractive index
		1. RI (n)
		2. Snell’s law
		3. “Becke” line
	7. Glass fracture analysis (determines which side of glass projectile entered and the order in which projectile holes were made)
		1. Direction of fracturing force (3 Rs)
		2. Conchoidal fractures (concentric & radial)
		3. Sequence of fractures

Lab

Students will bring in different types of glass and determine using data bases what type of glass it is and how it is different from other types of glass. This information will be shared with their lab group and classmates. Students will learn proper and safe handling of glass; they will break different types of glass to observe how it shatters and breaks, (this includes a car windshield) and determine the physical properties of the  glass fragments, density and refractive index and create an exemplar file to keep in their reference library. Students will receive sheets of window pane glass and make mock projectile holes in it with nails; they will use this data to determine direction of force and sequence of fractures. Students will complete a lab report with drawings, observations, data tables and analysis.

Objective - After studying this chapter you should be able to:

* Define and understand the properties of density and refractive index
* Understand and explain the dispersion of light through a prism
* Describe the electromagnetic spectrum
* List and explain forensic methods for comparing glass fragments
* Understand how to examine glass fractures to determine the direction of impact for a projectile
* Describe proper collection of glass evidence

Knowledge – After completing this unit students will be able to:

1. Determine if glass was shot with a projectile from the inside or outside of a building.
2. Analyze glass to determine type of glass

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Determine if glass fragment is consistent with type of glass suspect claims it is
2. Analyze glass fractures to determine projectile entry and order

**Unit 10 – Document Examination**

1. Introduction of key terms
2. Observations of handwriting samples
	1. Pressure of the strokes
	2. Size of the letters
	3. Slant of the stokes
	4. Connection of the letter
3. Ink chromatography
4. Type writer/printer analysis

Lab

Students will perform both physical and chemical analysis of handwriting materials found at a crime scene. The procedures they will follow cover checking for erasures, abnormal positioning of a signature, use of different inks, and differences in handwriting or typing. Students will then determine who wrote the kidnappers note using handwriting and ink chorography. They will write a report and present to the class.

 Objective - After studying this chapter you should be able to:

* Define questioned documents
* Know what common individual characteristics are associated with handwriting
* List some important guidelines for collecting known writing for comparison to a questioned document
* Recognize some of the class and individual characteristics of printers an photocopiers
* Lit some of the techniques document examiners use to uncover alterations, erasures, obliterations and variations in pen inks

Knowledge – After completing this unit students will be able to:

1. Describe 12 types of handwriting exemplars of handwriting traits
2. Demonstrate an example of each of the 12 exemplars of handwriting traits
3. Indentify the major goals of a forensic handwriting analysis
4. Describe some of the technology used in handwriting analysis
5. Distinguish between the terms forgery and fraudulent

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Learn basic technique of ink chromatography and how it can be used as evidence
2. Learn basic type writer/printer analysis
3. Learn basic handwriting analysis and how it can be used to determine who wrote the questioned documents

**Unit 11 – Ballistics**

1. Introduction to key terms
2. Firearm identification
3. striations and rifting
4. Gunshot residue (GSR)
5. Differences between handgun and shotgun projectiles
	1. Shotgun pellet patterns
6. Bullet caliber and shell gauge

Lab

1. Students will compare both bullets and cartridge cases using a Virtual Comparison Microscope (VCM) and see if they can match the bullets and casings. This will be completed on the website FirearsID.com <http://www.firearmsid.com/>
2. Students will be given clothing that has been shot with different types of guns, handguns (22 caliber, 357 caliber), rifles (22 caliber) shotguns (12 gauge, 20 gauge, 410 gauge), the boxes that the clothing was on when it was shot and the bullets, shells and casings that were fired. Students will use these to learn how to identify the type of pattern different weapons leave (amount of pellet spread for different shotguns and from different distances) so they can identify what weapon was used at the mock crime scene. To make the bullet damage on the clothing look more realistic all clothing had baggies of blood behind them when they were shot so all clothing has blood spatter at the site of the bullet entry. These clothes are used on crime scene mannequins and students have to explain why they suspect the caliber gun they do. Mannequins will also have wounds on them (Simulaids Forensic Wound Pack) that will correspond with the type of bullet wound the victim sustained.

 Objective - After studying this chapter you should be able to:

* Discuss the difference between a handgun, rifle and shotgun
* Distinguish between a bullet and a cartridge
* Discuss rifting on a gun barrel and how it affects the flight of the projectile
* Explain the relationship between barrel size and caliber

Knowledge – After completing this unit students will be able to:

1. Explain how bullets are test-fired and matched (observe this during crime lab field trip)
2. Understand the role of ballistics recovery and examination at the crime scene
3. Determine the position of the shooter based on bullet trajectory

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Determine if someone has recently shot a gun using GSR kit
2. Match bullets to determine if they came from the same gun.
3. Determine type of gun used by spray pattern and entry of projectile on clothing and wound on victim.

**Unit 12 – Soil Sciences**

1. Introduction to Earth Sciences
2. Forensic soil examinations (purpose and procedure)
3. Soil sampling
	1. Proper collection and storage
	2. Sample size
	3. Depth of sampling
4. Mechanical sieve (particle size) field analysis
5. Texture classification of soils
	1. Wet
	2. Dry
	3. Organic content
	4. Inorganic content
6. Chemical property analysis
7. Plant tissue Lab
8. Students will look at several soil samples under a stereoscope and conduct tests to determine how each sample is different; texture, density, organic composition. Then students will be given unknown soil samples and they will have to properly collect and store soil from an area and match the unknown soil to the area it came from. If plant material is found at the crime scene students will try to find the same plant in the area of the crime scene. Students will write a report on their findings and present to the class.

1. In crime scenes students will compare soil left by shoeprints and soil left on shoe soles to soil at the victim’s residence, suspect’s residence and other places of interest using the skills they have learned. Students will determine where the soil originated and write a report on their findings and present to the class.

 Objective - After studying this chapter you should be able to:

* Discuss the different characterizes found in soil
* Distinguish between organic and inorganic properties found in soil

Knowledge – After completing this unit students will be able to:

1. Recognize various soil types and describe some method for examining soil samples
2. Understand how to properly collect and store soil samples.
3. Explain how you can tell where soil came from
4. Understand the role of soil and plant samples in solving a crime

Skills (Lab Activity Based) - After completing your labs/Activities students will be able to do the following:

1. Determine where soil in a crime scene came from by performing soil analysis
2. Determine if evidence is plant tissue and why that is important

**Other Topics**

1. Forensic Aspects of Fire Investigation and Forensic Investigation of Explosions are discussed by students in their forensic method power point presentation and covered by the guest speaker from ATF.
2. Computer Forensics is discussed on our field trip to the crime lab
3. Careers in Forensic Science are discussed throughout the year and covered by each guest speaker

This course is very much a hands-on laboratory course; well in excess of 60% of the time the students are actively involved in activities, practicing skills and improving their capabilities. The sequence of topics covered in the school year is based upon the perceived pattern of crime scene processing activities. From the simple initial crime scene sketches with triangulation of the critical evidence to the detailed DNA analysis of trace evidence stains, capturing students attention as their recognition of advanced skills continues. After each new skill set is learned students will be presented with several mock crime scenes where they will use their new skills along with already acquired skills (to enhance these skills) to solve the crime. In each mock crime scene students must: document crime scene (sketch & photograph), mark and collect evidence (keeping chain of custody and putting evidence in correct type of containers), bring body back to lab to check for wounds and what caused the wounds, conduct all tests that can be conducted from their crime scene. Students are to determine on their own which tests need to be conducted and how to conduct them; they are to use their “reference library” to aid in this procedure. Students will interview witnesses and some of the crime scenes will be taken to court (see court cases). Students work independently and in team scenarios (with rotating responsibilities), delegating and sharing in tasks. There are many mock crime scenes including simulations from real cases. Crime scenes include but are not limited to: stabbing, strangulation, beaten with baseball bat, shooting, Molotov cocktail, arson, school vandalism, missing person presumed dead, kidnapping, theft, threatening letters, poison.

Students will view videos of procedures needed to conduct evidence testing. This will help with recall of prior knowledge and help prepare students for the actual labs they will be doing by explaining purpose of and proper technique and safety to conduct needed lab tests; giving students’ confidence to conduct their labs. Students use virtual labs and online web sites to practice their skills, learn how to conduct tests that we do not have equipment for and learn more about forensic science.

Students conduct labs that will enable them to test evidence and interpret the results when they find similar evidence at mock crime scenes. Students will create and maintain a “reference library” with detailed explanation, in their own words, of how to complete all lab tests and a sample of all test results, control, positive and negative. They will refer back to their “reference library” when they are testing evidence from mock crime scenes. Their “reference library” will become their Professional Portfolios at the conclusion of the course showing examples of their skills learned in this class.

Several times a year students will use their creativity to make their own crime scene for other lab groups to solve. These crime scenes may include a mannequin body with wounds and any of the different types of evidence they have learned about to date. Once all evidence has been collected, tested, crime scene scenario has been established and written, each group will present their findings. Then the group that staged the crime scene will present their side of the story and students will discuss any discrepancies between the two groups if any exist. We will discuss how to set up better crime scenes and how to better analyze them. Some of these crime scenes will be taken to court (see court cases). Students will also create their own” CSI” video for the class to watch, which will be discussed and analyzed by the class after viewing.

**Research Project -**Presentation on important topics in forensic science

Students make a professional power point presentation on a forensic science topic/method and present to class. Must include outline for audience to take notes, a visual aid (may include but not limited to actual item pertaining to topic, ie: ballistics gel with bullet holes and video of ballistics gel being shot, poster, video clips), a current event on the topic and a quiz to test for knowledge/understanding of the concepts being presented. Students will dress professionally for this presentation and will be graded according to teacher provided rubric which includes: Evidence of preparedness, Presentation Style, Quality of Power Point, Discussion of key points, Visual Aid, Outline or worksheet, given to class, Test Questions, Many different sources (including professional journals), Site sources on power point, Effort.

**Court Cases:**Students will exhibit their knowledge of forensic science and be expert witnesses when their crime scene is taken to court. Other students will be the judge, bailiff, attorneys, witnesses and jury. Students will be graded on their ability to correctly answer questions regarding the evidence they collected and tested; the questions will be created and asked by the teacher.  As the year progresses and students become familiar with this process the students will take over more of the court room questions and proceedings. The students will determine if the accused is guilty or innocent and then address the class with their reason, so students can learn how to be better expert witnesses and collectors and presenters of evidence.

Guest speakers will present on topics of study and discuss career options in forensic science.  Guest speakers include: forensic dentist, retired district attorney, ATF (alcohol, tobacco and firearms) agent, judge, crime lab technician, police detective, undercover narcotics agent, police officers,   blood spatter expert, medical examiner, fire fighter. Field trips are taken to facilities activity involved in forensic science: sheriff’s office, morgue, crime labs, court house, and prison

Students will be assessed several ways; 1) on material learned in the textbook by multiple choice, true/false and matching tests 2) on lab activities by active participation, behavior, attendance, effort, demonstration of skills acquired, accurate findings and test results, proper use of safety skills and protective clothing 3) Complete lab handouts and worksheets, 4) Crime scene cases will be graded according grading rubric provided by teacher; crime scene cases must include all documents needed for a complete police report (sketch, photos, evidence), test of evidence (show and explain results), written analysis of crime scene, findings and how the crime occurred, who committed the crime (must be based on evidence found at the mock crime scene) which is then presented to the class. Students do work individually and with group members.

This class focuses on Common Core and Next Generation Science Standards including literacy skills: observing, reading, writing, listening, speaking/presenting, using technology for lab tests and presentation creation and delivery.

Textbooks:
Forensic Science: An Introduction

Richard Saferstein, Ph.D.

Pearson/Prentice Hall

1st edition/2008

<http://wps.penhall.com/chet_saferstein_Forensicscience_1/59/15205/3892671.cw/index.html>

Illustrated Guide to Home Forensic Science Experiments

Robert Bruce Thompson & Barbara Fritchman Thompson

Publisher: O’Reilly

Edition: 1st edition/2002

Crime Scine
Pam Walker

Jossey-Bass

Fist edition

Crime Scene Investigations: Real Life Science Labs for grades 6-12

Pam Walker & Elaine Wood

Jossey-Bass

1st edition/ 1998

Crime Scene Investigation

Barbara Harris, Kris Kohlmeier, Robert D. Kiel

Teacher Ideas Press 1999

Top Shelf Forensics

Barbara Deslich and John Funkhouser

J. Weston Walch 2003

Forensic Laboratory Science and Deteective Mystery Writing

Gary Schitz

Flinn scientific, inc. 1994

Basic Laboratory Exercises for Forensic Science

Richard Saferstein, Ph.D.

Pearson/Prentice Hall

1st edition/2007

<http://wps.prenhall.com/chet_saferstein_forensicscience_1/59/15205/3892671.cw/index.html>

Websites

Firearms ID Jeffrey Scott Doyle

<http://222.firearmid.com>

Forensic Illustrated- Step Under the Tape

<http://bsapp..com/forensics_illustrated/index.html>

Crime Scene Investigator Netowrk

<http://www.crime-scene-investigator.net>

UD Virtual Compound Microscope – University of Delaware

https://www.udel.edu…/microscope/scope.html

AFSP – Associaiton of Forensic Science Providers

<http://www.afsp.org.uk/node/52>

National Institute of Justice

<http://www.nkj.ogv/journals/258/forensic-databases.html>

MULTIMEDIA

The Killer’s Trail: The story of Dr. Sam Sheppard (NOVA)

Cold Case Files: The Most Infamous Cases

The autopsy files (HBO)
Autopsy: confessions of a Medical Examiner

Autopsy 2: Voices from the Dead

Dr. Michael Baden

The Zodiac

CSI (CBS)

The Innocence Project

Eyewitness (4 episodes) (BBC)

National Geographic: Secrets of the body farm

Other

Hidden Evidence, David Owen

The Casebook of Forensic Detective, Colin Evans

The Second Murder 2 Casebook, Colin Evans

Threads of Evidence, Herma Silverstein

Every Contact Leaves a Trace, Connie Fletcher

Forensics for Dummies – D.P. Lyle MD

The Forensic Casebook, N.E> George

Bloodstain Pattern Analysis, Tom Bevel and Ross M. Gardner

Two-Minute Mysteries Collection, Donald J. Sobol

Challenging Lateral Thinking Puzzles – Paul Sloane & Des Machala

**Forensic Science**

**Paloma Valley HS**

Laboratory Science “d” Biology/Life Sciences

Grade Levels: 11th, 12th

Course Overview:

**Elements of Forensic Analysis**

1. The nature and role of forensic science.
2. The value of forensic science to the society.
3. The historical development of forensic science.
4. The development of forensic science and laboratories in the United States.
5. The operations of forensic science laboratories.
6. The importance of anthropometry and fingerprint identification to the development of the forensic sciences.
7. The nature of the scientific method and how it might operate in everyday situations.
8. The key role that the scientific method plays in all aspects of forensic science and investigations.
9. The main specialty areas of forensic science and the scope of each of them.
10. The elements of forensic analysis and the types of results forensic science can provide.

Student Activities and Learning

1. Students can compile a list and an explanation of the duties of a forensic scientist though the reading of excerpts from the*Journal of Forensic Science*.

2. Student lead class discussion of the impact of the two legal decisions (Frye and Daubert) governing the use of science in assessing evidence and their effect on the judicial system.

3. Students choose key dates and describe why they are important to forensic science by creating a Forensic Time Line Poster.

4. Students choose one of the Bill of Rights, research it, and create a Powerpoint presentation to describe what it means to other students in the class in a presentation

**Physical Evidence and the Legal System**

1. How physical evidence is created during an incident.
2. The nature of impressions, imprints, indentations, and striations.
3. The Locard Exchange Principle and its centrality to forensic science.
4. How physical evidence might be classified in ways that are useful to investigators.
5. The major uses for physical evidence in cases.
6. The steps required for the effective discovery and use of physical evidence.
7. Basic practices of physical evidence labeling, packaging, and preservation.
8. Different types of laboratory analysis and their applicability to different types of evidence.
9. The importance of reporting and testimony to the forensic scientist’s function.
10. How the need for social organization developed into the rule of law.

Student Activities and Learning

1. Students can compile a list and an explanation of the duties of a forensic scientist though the reading of excerpts from the*Journal of Forensic Science*.

2. Student lead class discussion of the impact of the two legal decisions (Frye and Daubert) governing the use of science in assessing evidence and their effect on the judicial system.

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**Crime Scene Procedures, Techniques, and Analysis**

1. How crime scene processing is different from crime scene analysis.
2. The different types of crime scenes.
3. Initial actions at a crime scene.
4. Establishing crime scene security and reasons for maintaining security.
5. The steps in crime scene processing.
6. The process of evidence recognition based on hypothesis formulation.
7. The schemes for searching crime scenes.
8. The importance of and major methods for crime scene documentation.
9. Making notes.
10. Making sketches and types of sketches.
11. Technical and forensic guidelines for photography.
12. Videotaping crime scenes.
13. About the duty to preserve crime scene work product.
14. Different methods of collecting physical evidence and applicability to different categories of evidence.
15. Numbering and description of physical evidence from the scene.
16. Various types of packaging for different types of evidence.
17. Types of controls and standards for each type of physical evidence.
18. Submission of physical evidence for laboratory analysis.
19. Crime scene analysis and crime scene reconstruction.
20. The difference between reconstruction and re-enactment.

Student Activities and Learning

1. Write a report about different cases where the crime scene was compromised and how this affected the investigation and the overall court case outcome. Students will be provied excerpts from the *Journal of Forensic Sciences*.

2. Students discuss case studies where the court had to make a decisio regarding the admissibility of evidence:

    a. Mincey v. The State of Arizona

    b. The State of Michigan v. Tyler

3. Students can properly collect, package, and document a mock crime scene in class. Students are presented with a crime scene with a variety of objects strategically placed. Students will: Take notes on what they believe happened and how it happened, locate all objects using precise measurements, and prepare a scale map of the complete scene. The students will write a discussion of the crime scene and relate the location of objects to their hypothesis.

4. Students will be collecting evidence using the different patterns of collection to find the evidence in a large area outside the classroom. Students will have to determine which pattern is best in each scenario.

**Examination and Interpretation of Patterns for Reconstruction**

1. The difference between reconstruction and individualization patterns.
2. Evidence patterns that can be collected, primarily for individualization, are called individualization patterns.
3. There are 10 major patterns for reconstruction: blood spatter, glass fractures, track and trail, tire and skid marks, clothing and article or object, gunshot residue, projectile trajectory, fire burn, MO and profiling, and wound, injury, & damage.
4. Some reconstruction patterns must be compared with experimentally produced patterns fro interpretation.
5. Reconstruction patterns must be documented.
6. Reconstruction patterns usually cannot be “collected” as such.
7. Blood droplets moving through air behave predictably according to physical laws.
8. Reconstruction from blood patterns is partially based on knowing the number of blood sources at a scene.
9. The side of broken glass from which force was applied to cause the breakage can be determined.
10. The order of gunshots or other impact points can sometimes be determined in glass that is broken but still essentially in one piece.
11. Foot, footwear, tire, or blood trail patterns can help reconstruct the number of persons at a scene and their movements.
12. Tire and skid mark patterns are used by traffic accident reconstruction experts to estimate position and speed of vehicle.
13. Clothing, article, or object patterns are based on looking for unusual or unexpected arrangements or disorder in a scene.
14. Tears, cuts, or damage to clothing or other objects can provide information for reconstruction.
15. Gunshot residue patterns on target surfaces can be used to estimate muzzle to target distances.
16. Trajectory analysis (ballistics) can help to establish the positions and orientations of shooters and victims in shooting cases.
17. Ballistics should not be confused or equated with firearms identification.
18. Burn patterns at suspicious fire scenes can help establish origin and cause of fires.
19. Burn patterns are used by fire investigators along with analysis of the overall scene and investigation of mechanical and electrical equipment to help determine origin and cause.
20. MO refers to repeat offender’s habits and can be used to help connect related cases.
21. Criminal profiling involves statistical and psychological analysis to give insight in unsolved cases and on previous offenders.

Student Activities and Learning

1. Use dissecting microscopes and compound microscopes to describe, sketch, and classify fabric and fiber samples (classification and characteristics activity)

2. Perform a fiber sampling and statistics activity that illustrates the power of some fabrics as evidence and then discuss the case of OJ Simpson.

3. Fiber identification lab: Students are given a variety of cloth samples to analyze. The samples include: Natural, synthetic, and colored cloths. Students will use several tests to analyze the fibers and prepare a fiber identification notebook. Tests used include: Microscopic examination, burn test, weave identification, and thin layer chromatography. The emphasis of this lab is on conducting the tests in the correct manner.

4. Fiber matching lab: Students are given several unknown cloth samples. Using their fiber identification notebook and their knowledge of the appropriate tests, the students attempt to match the fibers of the unknown samples to known fibers. The emphasis of this lab is on lab techniques as well as fibers as a class characteristic and the probability of a match.**Note**: This lab requires a formal write-up.

**Physical Pattern Evidence and Technological Examinations**

The three types of forensic analysis of physical patterns.

1. Direct physical matching versus indirect physical matching.
2. Impression marks can be imprints (effectively two-dimensional) or indentations (three dimensional).
3. Striations are caused by a moving object making a dynamic impression.
4. Striation marks are characteristic of firearms, toolmark and some other evidence.
5. Using class and individual characteristic of patterns to compare for common origin is a multiple step process.
6. Comparisons between questioned and known patterns can lead to identification, exclusion, or they may be inconclusive.
7. Requirements for knowns (exemplars) differ according to the type of pattern.
8. The process involves pattern recognition, comparison, identification of class characteristics, then use of individual characteristics to try to achieve positive individualization.
9. The methods of pattern evidence comparison have come into question by a few courts as not sufficiently scientifically-based to meet the Daubert criteria for admissibility of scientific evidence into court.
10. Footwear and tire impressions are the most common individualization patterns, leaving aside fingerprints, firearms, and document evidence (such as handwriting).
11. Shape and form patterns (such as handwriting and human hair shaft morphology) are compared in a manner similar to the way the human mind recognizes people and objects.
12. Several other individualization patterns include bite marks, certain skeletal features, and voice patterns.

Student Activities and Learning

1. Students read and review several case studies and discuss how the evidence was used in the trial. The case studies include: Coral Eugene Watts, Ronald Cotton, and Richard Crafts.

2. Students conduct a probability activity (calculate probabilities mathematically) using the clothing of the students in the class to illustrate why there must always be probability value associated with class evidence.

3. The students compile a list of what they would consider individual or class evidence from items placed around the classroom. Students explain why it is individual or class evidence.

**Fingerprints and Other Personal Identification Patterns**

1. Fingerprints are an old and very valuable type of physical evidence.
2. What friction ridge skin is and how it makes up fingerprints.
3. Fingerprints for personal identification dates back to medieval times, but in the West, dates back to the 19th century in British India and the United Kingdom.
4. Fingerprints can be classified and the most useful system is the 10-print classification system developed by Henry.
5. Large files of 10-print cards cannot be searched for individual prints.
6. AFISs contain individual print images and can be searched for individual prints efficiently and quickly.
7. There are established procedures for collecting and preserving latent fingerprints and items from scenes suspected of having latents.
8. The three types of evidentiary fingerprints: visible, patent, and latent.
9. Methods for visualizing latent fingerprints.
10. Processing latent prints with maximum efficiency and results requires a systematic approach.
11. The approach commonly used in fingerprint comparisons and identification can be summarized “ACE-V” (Analysis, Comparison, Evaluation, and Verification).
12. Fingerprint identification specialists belong to a professional organization that has its own professional journal and offers certification.
13. Other patterns for personal identification include palm and sole prints, bite marks, certain skeletal features, lip and ear prints, and voice identification.
14. Methods for the identification of human remains.
15. The method used to identify human remains depends on the circumstances, the condition of the remains, and the number of possible identities.

Student Activities and Learning

1. Students can collect each others fingerprints and classify them based on the three basic patterns. This exercise demonstrates the variability of fingerprints and the need for a classification system.

2. Students can develop and lift latent fingerprints using both physical and chemical methods demonstrating the variety of methods available to the forensic investigator.

**Questioned Document Examination**

1. The wide variety of evidence that can be examined by a questioned document examiner.
2. The evolution of an individual’s handwriting from childhood to adulthood.
3. The major steps in preparing a document.
4. Special problems involving in properly collecting and preserving document evidence.
5. The science and technology that underlies handwriting and handwriting comparison.
6. Class and individual characteristics as applicable to handwriting.
7. The importance, and proper methods, of collecting known writing samples.
8. Basic approaches to the comparison of known and evidentiary writings.
9. The important nonhandwriting examinations performed by document examiners.
10. The examination of documents produced on typewriters, computer printers, and copy machines.
11. The examinations used to reconstruct altered documents.
12. Some techniques for deciphering of charred documents.
13. Techniques used to look for and read indented writing on a document.
14. The problem of trying to determine when a document was written.

Student Activities and Learning

1. Students will attempt blind, simulated, and traced forgeries to assess the difficulty in both doing them and detecting them.

2. Students will do an analysis of handwriting using a letter angle template

3.  Handwriting matching lab: The students are given several unknown writings (some with an attempt to disguise) and several known writings. Using the 12 standard matching characteristics students attempt to match known with unknown samples.

4. Ink matching lab: The students are given several writing samples (ink) several known samples. Using paper chromatography the students determine which samples were written with the same ink. In order to complete this lab, students must devise a way to extract the ink from the paper and place it on the chromatography paper as well as determine the appropriate solvent. The focus of this lab is on students developing their analytical ability to solve a problem.

**Toolmarks and Firearms**

1. Understand the nature of toolmarks.
2. The different types of toolmarks.
3. The importance of looking for trace evidence associated with toolmarks.
4. The proper ways to collect and preserve toolmarks.
5. The examination and comparison process.
6. General nature of firearms.
7. The function and importance of the cartridge in the operation of a firearm.
8. The importance of rifling to firearm performance and forensic examination.
9. The major important types of firearms.
10. Proper procedures for collecting and preserving firearms and firearm evidence.
11. Major steps in the examination of a firearm and firearms evidence.
12. Growing importance of firearms data banks to investigation and prosecution.
13. Potential utility of examination of even highly damaged firearms evidence.
14. Uses of firearms evidence in reconstructing shooting incidents.
15. How and why firearms serial numbers are defaced.
16. Major techniques for restoring defaced serial numbers.

Student Activities and Learning

1. Students view different bullets and cartridge casings with a dissecting microscope to help them understand tool marks and striations.

2. Students use the following websites to help understanding of firearm markings and identifications.

* http://www.firearmsid.com/Case%20Profiles/ToolmarkID/toolmark.htm
* http://library.med.utah.edu/WebPath/TUTORIAL/GUNS/GUNINTRO.html
* http://www.firearmsid.com/
* http://www.ok.gov/osbi/

**Blood and Physiological Fluid Evidence: Evaluation and Initial Examination**

1. How some terminology associated with forensic biological evidence analysis has changed because of DNA typing.
2. What blood is and some of its different constituents.
3. How to collect and package biological evidence to best preserve it, and what control and comparison specimens are necessary for biological evidence analysis.
4. The relationship of certain types of control and comparison specimens to possible evidence contamination, and how contamination may be avoided or controlled.
5. How forensic scientists do initial examinations of biological evidence.
6. How blood is identified - presumptive and confirmatory tests.
7. How different physiological fluids are identified.
8. How sexual assault cases are investigated, and the role of forensic scientists.
9. Different types of sexual assault cases, and how the role of the forensic science lab might differ depending on the type of case.
10. Drug-facilitated sexual assaults (“date-rape” drug cases), and how they are investigated.
11. The genetic basis for the individuality of blood and body fluids.
12. The classical (conventional) genetic systems used to type forensic specimens before DNA.

Student Activities and Learning

1. Blood splatter analysis lab to determine direction of travel, angle of impact, position or origin, and velocity.

2. Video: The Killers Trail: Sam Sheppard (NOVA) - Students can discuss the effects of serology on a case.

3. Microscope lab to determine whether blood is animal or human.

4. Blood typing lab: The students are given a crime scene scenario, a sample of (simulated) blood from the crime scene, and several suspect blood samples. Using the antibody-antigen reaction they match the blood type of the crime scene sample and a suspect sample.

**DNA Analysis and Typing**

1. How basic genetics works, and how “genetic markers” work with biological evidence analysis and typing.
2. What DNA is, including its structure and functions.
3. The “classical” genetic markers—how forensic scientists partially individualized biological evidence before DNA typing.
4. How genetic marker typing helps individualize biological evidence—some concepts of population genetics.
5. Where DNA is found in the body—nuclear and mitochondrial DNA (mtDNA).
6. How DNA technologies developed: RFLP, dot-blots, and STRs.
7. What the polymerase chain reaction is and its importance in biological research and forensic DNA analysis.
8. Current DNA typing methods, how they work and how DNA tying individualizes biological specimens.
9. DNA databases and data banks—CODIS.
10. The forensic applications of DNA typing: criminal, civil, human identification, parentage testing.
11. Some of the newer DNA technologies: “Y” chromosome and single nucleotide polymorphisms (SNPs).
12. The strengths and limitations of DNA technology and how they relate to the media hype and the ultimate potential.

Student Activities and Learning

1. The students do a statistical analysis of combinations of restriction enzymes to illustrate the power of multiple tests and discuss the case of Clinton/Lewinsky.

2. Students can use the following websites to assist in learning and understanding of DNA and DNA policies for admission in court cases.

* http://science.howstuffworks.com/life/genetic/dna-evidence.htm
* http://www.cstl.nist.gov/div831/strbase/intro.htm
* <http://www.justice.gov/ag/dnapolicybook_cov.htm>

3. Students will conduct a gel electrophoresis to separate DNA sequences cut with restriction enzymes to match a suspect to an unknown in a mock case.

4. DNA lab: The students will extract DNA and subject the samples to a restriction enzyme, and run the results through electrophoresis to determine if any of them match. The emphasis on this lab is on communication and cooperation as well as the technological aspects. **Note**: This lab requires a formal write-up.

**Arson and Explosives**

1. The science underlying combustion (fire).
2. Commonly encountered fuels.
3. Importance of pyrolysis in the combustion of solid fuels.
4. Useful investigative information available from careful examination of a fire scene.
5. Primary reasons fro individuals setting arson fires.
6. Proper examination and processing of materials collected in the investigation of suspicious fires.
7. The most commonly encountered ignitable liquids used as accelerants in arson fires.
8. Laboratory analysis process for evidence from suspicious fires.
9. The science underlying an explosion.
10. Commonly used explosive materials.
11. Necessary components of an explosive device.
12. Processing and sampling of an explosion scene.
13. Laboratory analysis of explosive devices and residues.
14. Different approaches to examination of exploded and unexploded devices.
15. How explosives are identified from the analysis of explosive residues.

Student Activities and Learning

1. Students will review the following websites to learn about arson, accelerants and the psychological ideals of people that commit these crimes.

* http://www.trutv.com/shows/forensic\_files/techniques/accelerants.html
* http://www.ncids.com/forensic/arson/arson.shtml
* http://www.nij.gov/topics/law-enforcement/investigations/fire-arson/Pages/welcome.aspx

2. The following websites will be used to show explosions and how combustion occurs - rather than start fires on campus.

* http://forensicsciencecentral.co.uk/explosives.shtml
* http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/april2002/kelleher.htm
* http://www.nij.gov/topics/law-enforcement/investigations/crime-scene/guides/explosion-bombing/Pages/welcome.aspx

**Drugs and Drug Analysis and Forensic Toxicology**

1. Why a substance is called a drug.
2. The nature of drug dependency and its two major forms.
3. The impact of drug abuse on society and how society reacts.
4. Each of the major classes of abused drugs, with examples.
5. The rationale behind the controlled substances laws.
6. Processing of suspected controlled substances samples through the crime lab.
7. The major analytical steps from initial physical description to unambiguous identification.
8. The important distinction between qualitative and quantitative analysis.
9. The analysis of body fluid and tissue samples for drugs and poisons (forensic toxicology).
10. The critical role of alcohol and drugs in impaired driving cases.

Student Activities and Learning

1. Students debate the legalization of drugs, including: Current laws and penalties, frequency of incarceration, social costs, and societal attitudes and concerns.

2. National Institute on Drug Abuse (NIDA): [www.drugabuse.gov](http://www.drugabuse.gov/)

3. Drugs of Abuse: www.dea.gov/

4. http://www.all-about-forensic-science.com/forensic-toxicology.html

5. http://www.firearmsid.com/KSP%20Evidence%20Manual/Drug%20Identification.html

6. Students can use the above websites to research and create a poster identifying the effects of drugs on the human body.

7. Students can use the spectrophotometer to identify different unknown drugs by comparing to known spectrophotometer readings.

8. Drug testing lab: The students are given several unknown powders (simulated drugs). They subject the powders to a series of preliminary color tests where they add a reagent to the unknown powder and use the resulting color as an indication of a particular drug. They then subject the powders that tested positive to two confirmation tests, thin layer chromatography and a microcrystalline test.

**Materials Evidence**

1. Materials evidence is used primarily for indicating possible connections.
2. The nature of and difference between transfer and trace evidence.
3. The most common sources of materials evidence.
4. The major categories of materials evidence.
5. The process of examination of materials evidence.
6. The major techniques for collecting materials evidence.
7. Five more important types of materials evidence.
8. The range of fibers encountered as evidence.
9. The structure and growth of human and animal hair.
10. The proper collection of hair control standards.
11. The laboratory examination and comparison of fiber and hair evidence.
12. The nature of paint and the importance of architectural and automotive paint evidence.
13. The collection of proper paint control standards.
14. The laboratory analysis and comparison of forensic paint evidence.
15. The nature of glass and its manufacture.
16. The proper collection of glass evidence.
17. The laboratory analysis and comparison of forensic glass evidence.
18. The composition of soil.
19. The common forensic occurrences of soil evidence.
20. The proper collection of soil evidence.
21. The laboratory analysis and comparison of forensic soil evidence.

Student Activities and Learning

1. Soil matching lab: Students are given a soil sample from a crime scene (unknown sample) and they must find a match among several other samples (known samples). Because soil is a class characteristic, all tests must indicate a match and there must be enough tests to eliminate doubt. Students must conduct six separate tests on the soils to find a positive match: percent organics, UV light, percent magnetic material, color from soil chart (soils must be dried first), acidity, particle size (using multiple sieves), and density gradient profile. **Note**: This lab requires a formal write-up.

2. Glass density/ refractive index lab: Students are given a glass sample from the headlight of a car involved in a hit and run accident as well as samples from several different automobiles. Students find the density of each of the samples using water displacement and determine which one matches the crime scene glass. Students analyze the class data to assess the range of acceptable values and the probability of error. In part 2 of this lab students immerse the accident sample in a liquid and adjust the density of the liquid (adding solvent) until the glass piece remains suspended. They then repeat the test for each of the known sample. The piece that also remains suspended is a match. Students analyze the class data to determine the probability of error. In part 3 of this lab students immerse the accident sample in a liquid, shine a light through it, and adjust the density of the liquid (adding heat) until the ‘halo’ (becke line) around the edges of the glass piece disappears. They then immerse each of the known samples and if there is no becke line, it’s a match. Students analyze the glass data to determine the probability of error. Students gain a deeper understanding of Archimedes principle and refraction. This lab requires a discussion/opinion section assessing the three different tests for ease of use, accuracy, and value in court.

3. Direction of force lab: Students are given pieces from several different broken panes of glass. By analyzing the three different types of fracture lines they can determine from which direction the breaking force came.

Textbook:

Introduction to Forensic Science and Criminalistics

R.E. Gaenssien, Howard A. Harris and Henry Lee

McGraw Hill

2008

Forensic Science

Los Angeles Leadership Academy High School

Laboratory Science “d” – Biology/Life Science

9th,10th,11th,12th

Course Overview:

Students will get a real world view of the science behind forensic investigations by becoming the investigators and lab technicians. Students learn the skills it takes to analyze crime scenes, hypothesize scenarios, and run diagnostic tests on the evidence. There is an introduction into the various roles and jobs available to those studying criminals and crime scenes, so students will be able to make an educated decision about career choices involving biology, criminology, anthropology, and lab technicians.

Prerequisites:

Algebra I or Integrated Math I (required)

Course content:

**Unit 1: An Introduction to the Investigation**

Students will study the historical significance as to how forensics became a science. Students will discover career choices in forensic science. Students will learn about the steps of the scientific method through experimentation and investigation. Students will collect evidence and analyze a crime scene by making observations and sketches. Students will discuss eyewitness accounts and their influence in analyzing a crime scene. Crime Scene Investigation has a series of steps students will participate in as they analyze crime scenes. Investigation includes learning about the types of evidence, transfer of evidence, and the seven "S"s: Securing the crime scene, Separating the witness, Scanning the scene, See the scene, Sketch the scene, Search for evidence, and Secure and collect evidence.

Students will produce a lab report based on the seven S system for crime scene investigation. A scenario will be set up and taped off so students can go through the seven steps. In the end, students will meet with their teams and determine what crime occurred, what was the weapon, and hypothesize about a possible scenario. In conclusion, they will write up a lab report with their observations and a conclusion as to what happened.

**Unit 2: Human and Animal Hair, Plant components, and Synthetic Fibers**

Students are given perspective as to the importance of identifying, collecting and analyzing hair, fibers, and textiles. They will use microscopes and chemical tests to determine the difference between types of hair and fibers. Students will be given the historical background and techniques for analyzing hair, fibers, and textiles. Students will study the structure of hair from people to animals so they can identify an unknown sample. Students will study various plant and man made fibers and determine if the fibers were a direct or secondary transfer. Students will compare and match pollen grains, plant fibers, and location of various plant species as related to palynology.

Students will conduct a microscope lab investigation to identify hair and fibers. Students should be able to identify hair as human or animal based on its cortex and texture, while fibers are identified by weave, thread count, natural or synthetic, and color. Students will produce an expert presentation of their findings to the class.

**Unit 3: Fingerprints, DNA Profiling, Blood and Blood Splatter**

Students will analyze their own fingerprints and unknown criminals to identify characteristics of fingerprints as they are unique by genetic makeup. Patent, plastic and latent fingerprints are created by the students and then analyzed. The newest scanning, digital, and technological used in identifying fingerprints, eyes, facial recognition, ear prints and dna are discussed. Next, the historical perspective of how DNA profiling of biological evidence (saliva, urine, semen, and hair) were being used as evidence in court. Students model the structure and processes of DNA replication, transcription, and translation. The function of DNA in human cells and the coding is demonstrated through DNA electrophoresis, variable number of tandem repeats, and short tandem repeats. A profile is then created using tissue and inheritance matching. Population genetics helps students pinpoint a certain gene present in a certain population. Students then go into the historical use of blood and DNA profiling as well as blood typing. Students learn about types of cells, the components of blood, and antibodies by using blood typing, agglutination and probability of a particular blood type. Lastly, examination of blood splatter analysis using analytical and diagnostic tools to determine lines of convergence and directionality and presence of blood.

Students will use a simulation to learn how to read electrophoresis results and identify common markers from the crime scene, victim, and suspect to deduce a correlation. Students will be able to explain the steps of DNA profiling: extraction, restriction fragments, amplification, and electrophoresis. Students will produce a worksheet showing the steps to collecting, analyzing, and recording results of their electrophoresis.

**Unit 4: Suspect Analysis: Drug Identification, Toxicology, Handwriting, Forgery, Counterfeiting**

It is important to link a suspect to a crime or victim, so in this unit students determine a suspects link to a crime by identifying drugs, unknown powders, toxins, handwriting in a note, forgery, and counterfeiting in the evidence. Students are introduced to the definition and function of toxicology, methods of exposure to toxins in humans, and factors involved in drug toxicity. Toxins studied include poisons, controlled and illegal substances, organic toxins, alcohols, bacterial toxins, heavy metals and pesticides. Students then examine handwriting using the twelve characteristics of letters, lines, and formatting. Technological devices used for handwriting analysis (biometric signature pads, computerized analysis of handwriting, F.I.S.H. forensic informational system for handwriting) are discussed as students develop skills in measuring and critically analyzing different samples of writing. A brief overview of forgery, fraud, and counterfeiting closes the unit.

Students will produce their own samples of handwriting for analysis and then compare other student's handwriting to their own. After learning the basic characteristics of handwriting analysis students will analyze a ransom note and suspect samples and answer several questions about the suspects handwriting and how is the ransom note a key component to solving the crime.

**Unit 5: Death, Soil and Bones**

Students acquire analytical and computational skills in learning how to determine the time of death, components of soil, and identification of bones. Students will decipher the time, manner, cause and mechanism of death by looking at livor mortis, rigor mortis, algor mortis, stomach and intestinal contents, changes of the eye, stages of decomposition and insect development. Soil will be broken down into its components as students learn about soil profiles, chemistry, and pH of soil samples. Students will have the opportunity to collect and examine several types of sand and soil samples. They will classify sand grains then check mineral composition to determine if sand is continental, volcanic, or skeletal (biogenic). Once skills are gained about death and soil analysis, students will apply their forensic anthropology skills as they study bones. Students start out with the history of anthropology, move into the characteristics and development of bones and then dive deep into what bones can tell us known as osteobiography. Bones reveal whether the victim is male or female, age, height, and race. Students discover processes for using bones, such as gathering DNA, observing for trauma, and distinguishing marks.

Students are walked step by step through the traditional method of facial reconstruction and then observe a video of how computer graphics and reenactment are used to reconstruct a victim's body form bones, such as King Richard III. Students will be able to critically analyze the skull to determine the age, sex, and race of the skull and add the final touches of hair, eyes, and skin color. Students will produce a final facial reconstruction using a picture of an unknown victim's skull.

**Unit 6: Glass Evidence, Cast Impressions, Tool Marks, and Ballistics**

Students analyze glass evidence by determining the type and properties of the samples using a variety of techniques: density, refractive index, Snell's law, Becke lines, thickness, and fracture patterns. Students learn to classify and identify types of cast impressions: patent, latent, and plastic using shoe, dental and tire impressions. Students will be able to distinguish impressions based on tread, wear patterns, length, and size. Evidence collection is done using photographs, lifting latent impressions using electrostatic dusting or gel lifting, and casting in plaster or plastic. To understand tool marks requires students to explore impressions and tool characteristics. The three kinds of tool marks covered in this course are indentation, abrasion, and cutting. Students will examine tool marks macroscopically and microscopically. They will learn about the new technology being used to identify tool marks and how tool marks are used in court cases. Ballistics covers the history of gun powder and firearms so students can use their knowledge and measuring skills to determine gun type and the distance and trajectory shots were fired. Understanding ballistic evidence requires students to understand how firearms, bullets, cartridges, and calibers work. Students study cartridge and bullet castings, markings, breechblock, headstamp markings, firing pin marks, gunshot residue and parts left behind in matching the evidence with the criminal.

Students will measure the trajectory and determine a shooter's position by looking at models and simulations of various victims shot in the head. Student's will depend on their analytical and computational skills to determine the range, angle, and height of the shooter. Students will produce a written report justifying their results by showing how they analyzed the data.

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