Forensics at Argo Community High School

Contents

Semester One

Unit 1

Topic 1.1: Chapter 1: Observation Skills

Learning Objective: Determine how observations are used in everyday life and at a crime scene

Essential Knowledge

Observations can be improved with practice and are essential in crime-scene investigations. Errors in eyewitness testimony have been made, and the Innocence Project has been used to reevaluate cases

Topic 1.2: Chapter 2: Crime-Scene Investigation and Evidence Collection

Learning Objective: Identify the various components of crime-scene investigation and how they are used at the scene

Essential Knowledge

The Locard Principle of Exchange states that when a person comes into contact with an object or another person, a cross-transfer of physical evidence can occur.

Evidence is classified as direct or circumstantial. The circumstantial can further be classified as class or individual

The first responding officer secures the crime scene and separates eyewitnesses, and the evidence collection team takes pictures, sketches the scene, searches for evidence then properly collects evidence following chain of custody

Exclusion Statement:

Do NOT need to map outdoor crime scenes, know datum or subdatum points

Unit 2

Topic 2.1: Chapter 6: Fingerprints

Learning Objective: Analyze fingerprints for 1st level detail (pattern type: loop, whorl, arch) and 2nd level detail (minutiae)

Essential Knowledge:

Fingerprints begin to develop during the 10 week of gestation in a mother's womb and fingerprints are left on a surface due to the natural secretions present in the ridges of the skin

2 deltas and a core make a whorl pattern (~30 % of fingerprints), 1 delta and a core make a loop pattern (~65% of fingerprints) and no deltas make an arch pattern (~5% of fingerprints)

Twins will not have the same fingerprints because of their unique minutiae (ridge characteristics) and a fingerprint generally has ~150 ridge characteristics; minutiae include: ridge endings, bifurcation (fork), island ridge (short ridge), dot , bridge, spur (hook) eye, and delta

Learning Objective: Properly roll your fingerprint as well as use magnetic fingerprint powder to dust/lift fingerprints off a nonporous surface

Essential Knowledge:

Plastic, patent and latent fingerprints are types of prints that can be left at a crime scene

Latent fingerprints can be left on either a porous or nonporous surface and the way to lift/collect them will depend on the type of surface

IAFIS is the system that stores known fingerprints and provides digital, automated fingerprint searches, latent print searches, electronic storage of fingerprint photo files, and electronic exchange of fingerprints and test results

Unit 3

Topic 3.1 Chapter 3: Hair Analysis

Learning Objective: Differentiate the 3 layers of hair as well as how hair appears on different parts of the body

Essential Knowledge

The main purpose of hair is to regulate body temperature

Hair varies from region to region on the body of the same person and has its own shape and characteristics: head hair, eyebrows/eyelashes, beard/mustache, underarm, body, and pubic

Learning Objective: Analyze and distinguish human hair versus animal hair

Essential Knowledge:

Hair consists of two parts: a follicle and a shaft

a. The shaft, composed of keratin, is made up of three layers: the medulla, the cortex and the cuticle
b. The medulla of animal hair is much thicker (greater than 0.50) than in human hair (less than 0.33) and always continuous

Collect hair samples using tape or special vacuums then examined under the microscope; an analyze for either nuclear (if follicle present) or mitochondrial DNA (no follicle present)

Topic 3.2 Chapter 4: A Study of Fibers and Textiles

Learning Objective: Identify the difference between natural and synthetic fibers as well as the 5 different weave patterns

Essential Knowledge:

Fibers are classified into natural or synthetic

a. Natural come from animals, plants and minerals
b. Synthetic are stronger than natural

There are five weave patterns: plain, basket, twill, satin, and leno

Exclusion Statement: Don't need to go into great detail about the life cycle of hair (anagen/catagen/telogen phase)

Unit 4

Topic 4.1 Chapter 9: Forensic Toxicology

Learning Objective: Analyze how various celebrities have unexpectedly passed due to an overdose

Essential Knowledge

Environmental exposure to heavy metals, pesticides/herbicides, and plants/animals can cause poisoning

Learning Objective: Define controlled substance, examples, and schedules

Essential Knowledge

Drugs are divided into five classes based on the reactions they produce: narcotics, depressants, stimulants, hallucinogens, and anabolic steroids

a. Illegal drugs have no medical use
b. Controlled substances are legal drugs whose sale, possession, and use are restricted because of the effects of the drug, potential for abuse, and how easily someone can become dependent on the drug

Controlled Substances Act recognizes 5 schedules: Schedule I is most dangerous due to the highest potential for abuse and have no medical use whereas Schedule V is widely used for medical purposes with low potential for abuse

Learning Objective: Calculate blood alcohol concentration and identify the impact of weight and metabolic rate

Essential Knowledge

Use the following equation to calculate blood alcohol concentration:

BAC (from chart) - (metabolic rate x time) = actual blood alcohol concentration)

***There are variations on this calculation*

Unit 5

Topic 5.1: Chapter 7: DNA Profiling

Learning Objective: Explain the structure and function of DNA

Essential Knowledge:

DNA is a nucleic acid containing genetic information necessary for a cell to replicate and make proteins. The code of DNA is found within the sequence of nitrogenous bases.

Variations in the noncoding regions of DNA are the basis for forensic investigation.

Learning Objective: Describe polymerase chain reactions (PCR) and its importance in evidence collection/analysis

Essential Knowledge:

DNA is considered individual evidence and can be recovered from white blood cells, skin cells, semen, saliva, and hair

Small samples can be collected and amplified using polymerase chain reactions so it can be analyzed

Need to avoid contamination when collecting AND need to keep DNA samples in a dry, cool environment

Learning Objective: Analyze DNA using STR profiles

Essential Knowledge:

Short tandem repeats (STRs) are now used for DNA analysis because of the shorter repeating bases and ease of recovery

Numbers in the STR represent number of repeat bases, most commonly 4 letter repeats

STR can be a decimal. 9.3 is very common for TH01. It means 9 repeats and just 3 of the 4 base pairs. Somewhere in history there was a mutation where one of the base pairs went missing, and then that mutation was passed down

Topic 5.2: Chapter 8: Blood and Blood Spatter

Learning Objective: Describe the parts of blood and their function

Essential Knowledge:

CODIS--Combined DNA Index System-- contains DNA records

Blood contains red blood cells, white blood cells and platelets and is carried through the body suspended in plasma

Plasma represents the greatest component of blood, white blood cells contain the nucleus

Learning Objective: Identify blood type use simulated samples

Essential Knowledge:

Blood type is class evidence used to exclude a suspect

If the antigen on red blood cells is present, the blood contains that blood (A antigen present, A blood)

i. When testing, if antibody B reacts with antigen A, it will agglutinate (clump) and that means antigen A is present in the blood
ii. Type A is most common, Type AB is least common

Universal donor is O- and universal recipient is AB+

Learning Objective: Examine various blood spatter patterns based on height and angle and calculate angle of impact

Essential Knowledge:

Blood that falls from a given height will result in a circular pattern. The higher up the droplet falls the greater the size of the circle and will produce more satellites. There IS terminal velocity and a maximum diameter is obtained

Blood that falls at an angle will result in an elliptical shape with the elongated end pointing in the direction of travel

Calculate angle of impact using the following equation:

$$\sin^{-1}(\text{width/length})$$

Learning Objective: Detail how blood at a crime scene is identified as: (1) blood and (2) human blood. If confirmed to be blood and human, explain how to collect.

Essential Knowledge:

Chemical tests on blood include:

a. Luminol: tests if blood was cleaned from a scene (WILL destroy the sample)
b. Kastle-Meyer: detects if the sample is blood
c. ELISA (Enzyme-Linked Immunosorbent Assay) test: detects if blood is human

Blood evidence should be dry and placed in a paper bag

Semester Two

Unit 1

Topic 1.1: Chapter 12: Death: Manner, Mechanism, Cause

Learning Objective: Determine the manner, cause and mechanism of death

Essential Knowledge:

There are four ways a person can die, known as manner of death: natural, accidental, suicidal, and homicidal. A fifth manner, undetermined, is stated on a death certificate if a specific cannot be determined (further investigation needed)

The reason someone dies is known as the cause of death; examples include disease, poisoning or heart attack

The specific change in the body that brought about the cessation of life is known as a mechanism of death; examples include exsanguination or cardiopulmonary arrest. Often times this is multifactorial and can get complex

Learning Objective: Estimate post-mortem interval using rigor mortis, livor mortis, algor mortis, stomach contents and stages of decomposition

Essential Knowledge:

Algor mortis is the cooling of the body following death and post-mortem interval (PMI) can be estimated using the following calculation

- Heat loss = rate x time. Normal body temperature = 37°C
- 1st 12 hours, body loses 0.78°C /hour
- After 1st 12 hours, body loses 0.39°C /hour

Livor mortis is death color and PMI can be estimated; the reddish-purple color (caused by the hemoglobin from red blood cells spilling into blood vessels) starts 2 hours after death and becomes permanent 8 hours after death

Rigor mortis is, roughly, death stiffness and PMI can be estimated; it starts around 2 hours after death starting with the small muscles (in the face) then going to the larger muscles. Peak rigor is around 12 hours and is not permanent and begins to leave from the smaller muscles (face) then to the smaller muscles.

For algor, livor, and rigor mortis, ambient temperature, activity before death and body mass (among other factors) will impact the estimated PMI

An autopsy is a medical examination to determine the cause and manner of death. Stomach contents, changes in the eye, and stages of decomposition are examined

Unit 2

Topic 2.1: Chapter 14: Forensic Anthropology

Learning Objective: Identify the correct bones in the body

Essential Knowledge:

Babies have about 270 bones that fuse into 206 bones as an adult

- Bones begin as cartilage. Ossification is the process that replaces cartilage with bone. Osteoporosis is a loss of bone density, causing an increased risk in fractures
- Bones provide information regarding past injuries (broken bones), disease and nutritional deficiencies

Learning Objective: Determine the biological sex of an individual using characteristics of the skull and pelvis. Ancestry can also be determined based on skull characteristics.

Essential Knowledge:

The biological sex of a skull and pelvis can be determined based on a variety of characteristics

- A more square eye and mandible, a thick and larger upper brow ridge, a prominent occipital protuberance, a low and sloping frontal bone and a rough, robust surface indicate male characteristics of a skull
- A subpubic angle greater than 90 degrees, a rectangular and wide pubis, a flattened oval pelvic cavity and a shorter tailbone indicate female characteristics of a pelvis

Ancestry can be determined by looking at the shape of eye orbits, the nasal spine, the nasal index, prognathism, and nasal opening. Currently the ancestries compared are European, African, and Asian

Learning Objective: Estimate the age and height of an individual using the bone evidence of an individual.

Age can be estimated based on the skull sutures and the presence of wisdom teeth

- Third molars (wisdom teeth) come in after age 17, if at all
- The lambdoidal suture begins to close at 21, ends at 30. The sagittal suture closes at 32. The coronal suture closes at 50.

Long bones (humerus, radius, ulna, femur, tibia, and fibula) are used to estimate the height of an individual using databases that use mathematical relationships. Calculations are based on ancestry and biological sex (given in a chart) and include a range for the height

Notable Statement:

The squamosal suture is not included in the given data table but mentioned in the reading/text.

Exclusion Statements:

Do not need to go into epiphyses, diaphysis, or growth plates
Do not need to go into extensive detail about the approximate age based on the ossification of various regions of the body
Do not need to go into the process of skeletal trauma analysis

Unit 3

Topic 3.1: Chapter 16: Casts and Impressions

Learning Objective: Create and analyze footwear impressions

Essential Knowledge:

Plastic, patent and latent impressions are types of impressions that can be left at a crime scene

Footwear evidence gives clues about the crime scene, person(s) at the scene, and events that occurred at the scene, usually considered class evidence. A person's gait can provide information about an individual

When collecting impression evidence, always photograph first.

- Latent impressions can be collected using an electrostatic lift
- Plastic impressions can be collected by creating a cast using Plaster of Paris or Dental Stone
- Casts can be collected in the snow but need to use snow wax (normal casting materials generate heat)

Shoe size, foot length and the height of an individual do not always correlate and is not an accurate way to estimate height

Learning Objective: Examine tire impressions and identify an unknown vehicle based on number of ribs, track width, and wheelbase information.

Essential Knowledge:

A tire is comprised of ribs and grooves that provide traction.

A car has distinguishing features including the track width, wheelbase, tire size, and turning diameter (can find this information in a chart)

Learning Objective: Analyze teeth impressions

Essential Knowledge:

Dental records or DNA extracted from teeth can be used to identify remains.

Bite mark evidence can help identify a suspect in an investigation, though can be controversial (ex. Ted Bundy)

Exclusion Statement:

Do not need to discuss accident reconstruction in great detail (very few police officers are certified in accident reconstruction as it is very difficult to pass)

Unit 4

Topic 4.1: Chapter 17: Tool Marks

Learning Objective: Analyze tool mark impressions and correctly identify the tool that produced the tool mark.

Essential Knowledge:

Tool marks are considered a form of class evidence

There are three major categories of tool marks: indentation marks, abrasion marks, and cutting marks

Tools have unique characteristics from manufacturing processes and use over time

Collect tool marks by first photographing then either casting the impressions themselves and collecting the entire object if possible. Package all evidence in separate containers

Topic 4.2: Chapter 18: Firearms and Ballistics

Learning Objective: Explain the terminology associated with firearms.

Essential Knowledge:

Modern firearms are divided into two types: long guns and handguns

- Long guns (rifles and shotguns) fire bullets, shots/pellets or slugs
- Handguns (semiautomatic and revolvers) fire bullets
- Cartridges contain the primer powder, gunpowder, bullet and casing
- Rifling - the grooves and lands inside the barrel - is a spiral pattern left on a bullet; helps the distance and accuracy (like a football thrown with a spiral
- The caliber is the measure of the diameter of a bullet

Collection and analysis of firearm evidence depends on what is being examined

- Can analyze the impressions left on spent cartridge casings
- Can take samples of gunshot residue (GSR) from victim and potential suspect
- Can examine the striation patterns on the fired bullet (use a comparison microscope)

Generally the entrance wound is smaller than the exit wound

Learning Objective: Use the trajectory of a projectile to estimate the location of a shooter.

Essential Knowledge:

Use the trajectory of a projectile to estimate the location of a shooter using tangent

$$\text{Tan}(\text{angle of impact}) = \text{height of shooter}/\text{distance to victim}$$

NIBIN - National Integrated Ballistic Information Network - is the firearms and projectiles database

Exclusion Statements:

Do not need to go into detail on saw marks on bones
Do not need to discuss Ballistics Evidence Standards

Unit 5

Topic 5.1: Chapter 10: Handwriting Analysis, Forgery, and Counterfeiting

Learning Objective: Describe and provide examples of 12 characteristics of handwriting

Essential Knowledge:

An exemplar is a standard document of known origin and authorship

- Examine 12 characteristics in the handwriting to help distinguish from one sample to another
- The use of various writing instruments, a person's mood and age or the person's being under the influence of drugs, alcohol or medications can impact a person's handwriting

Analysis of handwriting samples are completed through infrared spectroscopes, biometric signature pads, and computerized analysis

Learning Objective: Define forgery and give examples of forged items

Essential Knowledge:

Forgery is the making, altering, or falsifying of checks, employment records, legal agreements, licenses or wills with the intention of deception

- If financial gain accompanies a forgery, it is called fraudulence or fraud
- Frank Abagnale (the character the movie Catch Me If You Can is based on) helped create methods to prevent check forgery (after he himself forged many checks)
- Literary forgery can be detected based on paper used, ink used, or if chemicals were used on the paper

Learning Objective: Define counterfeiting and describe ways to detect counterfeit currency

Essential Knowledge:

Counterfeiting is typically the forging of currency but can also be the production of name-brand products, coins or postage stamps

- The Secret Service has added features to paper currency to prevent it from being copied
- The feel of the paper itself it the easiest way to detect counterfeiting. Other ways are the watermarks, the intricate/detailed lines, and the security threads
- A counterfeit detecting pen contains iodine that reacts with the starch in regular paper to cause a blueish-black color (98% effective)