Chapter 1
Observation Skills

I. Scenario: Someone Was Stealing Trees
   • A farmer reported several valuable trees had been cut down and stolen.
   • Investigators followed the clues, observing tire tracks, traces of paint, and other evidence.
   • Police matched paint samples to the truck used in the theft.

II. Observation
   • A basic and important tool of a forensic investigator is the ability to observe, interpret, and report observations.
     A. Define
     B. Five senses
   • We are constantly collecting information through observations sight, hearing, smell, taste, and touch.
     C. Brain filtering
     i. Sensory overload
     ii. Filling in gaps

III. Witness and eyewitness accounts
   • Many things influence a witness and, therefore, impact his or her recollection and account of the situation.
     A. Perception
     B. Factors affecting observational skills
     C. The Innocence Project
   • Studies conducted by the project have found that faulty eyewitness identifications have contributed to up to 87 percent of wrongful convictions.
     i. Fact vs. opinion

IV. Practicing good observation skills
   A. Basic Tips
   B. Observational aids

V. Observation in forensic science
   • A forensic investigator finds, examines, and evaluates evidence using many tools, including observation skills.
     A. Define forensics
        i. Analytical skills
        ii. Deductive reasonings
     B. History of forensics
     C. Professions of forensic science

Chapter 2
Crime Scene Investigation and Evidence Collection

Lessons from the JonBenet Ramsey Case
   • In 1996, six-year-old JonBenet Ramsey was found murdered in the basement of her home.
   • This crime scene reveals how important it is for crime scene investigators to secure a crime scene immediately or valuable evidence may be lost forever.
   • To this day, the case remains unsolved.
Introduction
- The crime scene investigation team is responsible for recognizing, documenting, and collecting evidence.
- The evidence collected at a crime scene is all investigators have to go on to recreate a picture of what happened at the scene.

Principle of Exchange
- Physical transfer of materials such as hair, fibers, blood, and skin cells will occur whenever two people come in contact with each other. Dr. Edmond Locard was the first to describe this *principle of exchange*.
- The longer or more intense the contact between two people, the greater amount of trace evidence present.
- It is the job of the forensic examiner to recognize, collect and analyze this trace evidence to help solve crimes.

Types of Evidence
- Direct evidence, or first-hand observations, and indirect or circumstantial evidence are two ways to classify evidence.
- Circumstantial evidence is physical evidence that might be trace evidence or gross evidence. It includes blood, saliva, hair or fibers that can be used to imply fact but does not directly prove it.
- Evidence can also be divided into class evidence, which narrows evidence to a group, and individual evidence, which narrows evidence down to one person.

The Crime Scene Investigation Team
- The team is made up of legal professionals, such as police officers and detectives, and scientific professionals, such as a coroner and specialists like toxicologists, who work together to solve a crime.

The Seven S’s of Crime Scene Investigation
Securing the Scene
- The first responding police officer must make sure the scene is secure by first making sure all individuals in the area are safe and second by preserving evidence.

Separating the Witnesses
- Witnesses must not be allowed to talk to one another.

Scan the Scene
- The primary and secondary crime scenes must be determined and decisions regarding where photos should be taken are made.

See the Scene
- Photos of the overall area and close up photos with and without a measuring ruler should be taken.

Sketching the Scene
- A rough sketch and a neater final copy of the crime scene drawn to scale must be made.

Search for Evidence
- A spiral, grid, linear or quadrant pattern should be walked and location of evidence marked, photographed and sketched.

Securing and Collecting the Evidence
- All evidence must be properly packaged, sealed and labeled using specific techniques and procedures.
- An evidence log and a chain of custody must be attached to the evidence container.

Packaging Evidence
- Each piece of evidence should be wrapped in an appropriate sized bundle, placed and sealed in an evidence bag, with the collector's signature along the taped edge.
Chain of Custody

- Each person who comes in contact with a piece of evidence must use proper procedure and protocol in order to maintain responsible handling of evidence from crime scene to courtroom.

Analyze the Evidence

- A forensic lab processes all evidence the crime scene investigation team collects to determine the facts of the case and to eventually reconstruct the crime scene.

Crime Scene Reconstruction

- Forming a hypothesis of the sequence of events from before the crime was committed through its commission.

Staged Crime Scenes

- Staged crime scenes, such as a murder set up to look like a suicide, cause many problems because the evidence does not match the testimony of witnesses.

Chapter 6
Fingerprints

Scenario: Unaltered Identity

Historical Development

- Several ancient cultures used fingerprints on official documents.
- In western culture, the earliest record of the study of the patterns on human hands comes from 1684.
- In 1823, Jan Evangelist Purkyn described nine distinct fingerprint patterns including loops, spirals, circles, and double whorls.
- In 1879, Bertillon created a way of identifying repeat offenders through physical measurements.
- Sir Francis Galton verified that fingerprints do not change with age. Galton and Sir E.R. Henry developed the classification system for fingerprints that is still in use today in the United States and Europe.
- In 1891, Iván (Juan) Vucetich improved fingerprint collection and began printing all ten fingerprints.
- In 1896, Sir Edmund Richard Henry created a system that divided fingerprint records into groups based on whether they have an "arch," "whorl," or "loop" pattern. Each fingerprint card in the system was called a ten card. These cards were imprinted with all ten fingerprints of a person and marked with individual characteristics.

What are Fingerprints?

- All fingers, toes, feet, and palms are covered with small ridges that are raised portions of the skin, arranged in connected units called dermal, or friction, ridges. (Lips also have these ridges. The study of lip prints is called cheiloscopy.)
- When these ridges press against things, they leave a mark, an impression called a fingerprint.

Formation of Fingerprints

- Fingerprint patterns are formed during the 10th week of pregnancy.
- Creation of the fingerprints happens in the basal layer of the epidermis of the skin.
- These cells in the basal layer grow quickly and collapse and fold on top of each other.

Characteristics of Fingerprints

- Fingerprint characteristics are named for their general visual appearance. These patterns and are called loops, whorls, and arches.
- Two things a forensic examiner looks for on a fingerprint are the presence of a core and deltas.
A ridge count is another characteristic used to distinguish one fingerprint from another.

Basic fingerprint patterns of whorls, arches and loops can be further divided.

While looking at the basic fingerprint patterns can quickly help eliminate a suspect, in order to positively match a print found at a crime scene to an individual, more information is needed.

Every individual, including identical twins, has a unique fingerprint due to unique ridge patterns called minutiae (because the details are so small).

Types of Fingerprints

- There are three types of prints found by investigators at a crime scene. They are patent, plastic, and latent prints.
- Patent fingerprints, or visible prints, are left on a smooth surface when blood, ink or some other liquid comes in contact with the hands and is then transferred to that surface.
- Plastic fingerprints are actual indentations left in some soft material such as clay, putty, or wax.
- Latent fingerprints, or hidden prints, are caused by the transfer of oils and other body secretions onto a surface.

Fingerprint Forensic FAQs

Can fingerprints be altered or disguised?

- John Dillinger, Public Enemy Number One in the 1930's, tried to alter his fingerprints, but essentially he made his fingerprints even more unique.

How reliable is fingerprinting as a means of identification?

- Fingerprint identification is not flawless, because people enter and analyze information and people make mistakes.

How are fingerprints analyzed?

- In 1999, the FBI developed IAFIS, the Integrated Automated Fingerprint Identification System, which provides digital, automated fingerprint searches, latent searches, electronic storage of fingerprint photo files, and electronic exchange of fingerprints and test results.

How are latent fingerprints collected?

- Dusting surfaces with a fine carbon powder can make a fingerprint more visible. Tape can be used to ‘lift’ and preserve the fingerprint.
- Metal or magnetic powders can also be used to lift fingerprints.
- To recover a print from a surface that is not smooth and hard requires the use of different chemicals.

The Future of Fingerprinting

- New scanning technology and digital systems of identifying patterns have helped to increase the processing time and clarity of fingerprints.
- Technologies currently being developed use other physical features to identify people, including eyes, facial patterns, and the pattern of veins on the back of the hand or creases on the palm.

Chapter 8
Blood and Blood Spatter

Scenario: Blood Paints a Picture

Introduction
- Blood can be used in two ways as evidence during an investigation: to extract DNA for analysis or as physical evidence when blood spatter is studied.

Blood History
- Blood has been studied for thousands of years.
Composition of Blood
• Blood is a tissue that circulates around through the body.
• There are 3 kinds of cells which make up blood: red blood cells, white blood cells, and platelets. These cells are suspended in plasma.

Blood Cells
• Red blood cells (erythrocytes) carry oxygen and carbon dioxide. Red blood cells have hemoglobin, but no nucleus and no nuclear DNA.
• White blood cells (leukocytes) are immune system cells. They fight disease and produce antibodies. They are the only blood cells that contain DNA.
• Platelets (thrombocytes) assist in clotting when a blood vessel is damaged. They also repair damaged blood vessels.

History of DNA Profiling
• Dr. Alec Jeffreys used white blood cells for the first DNA profile.
• The Innocence Project helps free inmates falsely convicted of crimes by using DNA evidence.

Blood Typing
• This is a less expensive way to analyze blood evidence than DNA analysis.
• Blood typing is a form of class evidence because it can only identify a group of individuals.

Discovery of Blood Types
• In 1900 Karl Landsteiner discovered that there was more than one type of blood.
• Blood types are determined by proteins embedded within the cell membrane of red blood cells.

A and B Proteins
• Two proteins, embedded in the cell membranes of red blood cells, are called A and B.
• A person may have A proteins, B proteins, both A and B proteins, or neither A nor B proteins on their red blood cells.

Rh Factor
• Another blood protein is called Rh factor.
• It is estimated that 85% of the human population has the Rh factor protein.

Naming of Blood Types
• The name of the blood type depends upon the blood proteins present on the red blood cells.
• Examples of blood types are: A Rh+, AB Rh-.

Antibodies
• B lymphocytes (a specialized kind of white blood cells) secrete antibodies.
• Each antibody has a shape which is specific to one kind of antigen (foreign molecule, cell, or virus).

Antigen-Antibody Response
• There are two kinds of response by the immune system to foreign bodies.
• In one response, phagocytes (a kind of blood cell) engulf invaders.
• In the other response, B leukocytes produce specific antibodies against the invaders.

Agglutination
• There are 300 known blood group proteins.
• There are 1,000,000 known kinds of protein binding sites in each red blood cell.
• Antibodies can attach to more than one cell because they are Y-shaped.
• If there is an immune response to a blood transfusion, then agglutination will occur because of the double binding action of antibodies.
• When agglutination occurs, blood ceases to flow and death can result.

Blood Typing Tests
• There are three separate tests for blood typing: one for the A protein, one for the B protein, and one for Rh factor.

Additional Blood Proteins and Probability
• Two other common blood proteins are M and N proteins.

Probability and Blood Types
• You can calculate the probability (chance) of one person having a particular blood type.
Blood Spatter
• Blood spatter is a group of blood stains found in a crime scene.
• The pattern of blood spatter can be used to reconstruct a crime.

History of Blood Spatter Analysis
• Blood spatter has been used in investigative cases since 1894.

Blood Spatter Analysis
• You can tell four things from blood spatter: the direction in which the blood was traveling, the angle of impact between the blood and the wall or surface, the point of origin of the blood, and the blood’s velocity at the time of impact with the wall or surface.
• There are six different kinds of blood spatter.

Examination of Directionality of Blood
• The shape of an individual drop of blood can provide important clues in an investigation.
• Different forces act on the blood as it falls: gravity, cohesion, adhesion, and surface tension.

Lines of Convergence
• The location from which the blood originated can be determined if there are at least two blood spatters.

Crime Scene Investigation of Blood
• Even after washing a room of visible blood, some blood evidence remains.
• A compound called Luminol will cause hemoglobin to fluoresce under black light.
• There are four steps in investigating blood left at a crime scene: confirm that the stain is blood, confirm that the blood is human blood, determine the blood type, and perform a DNA analysis if necessary and if DNA can be isolated from the sample.