Introduction to Forensic Science
Essential Questions:

What is forensic science?

How has forensic science evolved?
What do you think forensic science is all about?
Forensic Science is the application of science to the criminal and civil laws that are enforced by police agencies in a criminal justice system.

Forensic comes from Latin word *forum* - a community meeting place that was also a place for public justice.

"scientists must supply accurate and objective information that reflects events that have occurred at a crime scene" (Saferstein, 2008)
What kinds of scientists are involved in forensic science?
History of Forensic Science

~ 200 B.C. Archimedes uses water displacement to find density of gold crown

66 A.D. Nero murdered wife - put head on platter to show his mistress - identified by discolored front teeth

~3rd century - Chinese manuscript *Yì Yu Jì* referenced arson case

1149 - King Richard I of England creates coroner job to investigate questionable deaths
1686 - Marcello Malpighi - first notes of fingerprint characteristics - did not know value of them

1670- Leeuwenhoek - microscope

1776 - Paul Revere identified General Joseph Warren who died at the Battle of Bunker Hill by his false teeth

*1814 - Mathieu Orfila - "Father of Toxicology" - published first treatise on detection of poisons and their effects on animals

anthropometry - the study of human body measurements. (anthros = Greek for man) Examples: measured length of foot, width of head, height, arm span, elbow to fingertip, etc.
1879- Alphonse Bertillion - Developed system to Id. people by body measurements
1887 - Sir Arthur Conan Doyle - 1st Sherlock Holmes book

*1892 - Francis Galton - (nephew of Charles Darwin) showed how to classify fingerprints and using them in crime investigation

1901 - Karl Lansteiner - ABO blood groups

*1904 - Edmond Locard - **Locard's Exchange Principle** - "When two objects come into contact with each other, a cross-transfer of materials occurs."

*1915 - Leone Lattes - procedure for determining blood group of dried blood stain

1921 - first lie detector built by John Larson, U.C. Med student

1932 - FBI crime lab started
*1959 - James Watson and Francis Crick
structure of DNA

1977 - AFIS - automated fingerprint Id system

1986 - Cetus Corporation - first PCR technique (polymerase chain reaction) - takes minute amounts of DNA and can make multiple copies for testing

1991 - IBIS - Integrated Ballistics Id. System for bullets and shell casings

1998 - FBI DNA database NIDIS started
Forensic Scientists use the Scientific Method!

1. observation of evidence retrieved from crime scene

2. hypothesis based on observation - inductive reasoning, experience, imagination

3. Examine, test, and analyze to support/refute hypothesis

4. deductive reasoning to determine significance of evidence

5. Evaluate and verify all evidence
   all error must be stated
   consider standardization, reproducibility, validity, reliability and accuracy

   someone's fate may depend on this
Background of Law in U.S. Criminal Justice System

1. **U.S. Constitution** - laws that govern the country - overrules state laws

2. **Statutory Law** - "law on the books" - enacted by Congress based on Constitution

3. **Common Law/Case Law** - made by judge, precedents set in appellate court

4. **Civil Law** - "private law" deals with relationships between individuals
   ex. contracts, property
   noncriminal - marriages, divorces, wills, negligence, product recalls
   violations = fines, transfer of property
5. **Criminal law** - "Public law"
   regulation and enforcement of rights, acceptable limits in society
   state = plaintiff vs. __________
   **misdemeanor** - minor crime - theft, minor assault and battery, small
   amts. of illegal drugs
   **felony** - major crime - murder, rape, armed robbery, sexual assault,
   dealing drugs, fraud, auto theft, forgery
   -must prove guilt beyond reasonable doubt
   **violation** - fines, community service, probation, incarceration, life in
   prison/death penalty

6. **Equity Law** - injunctions, restraining order - not covered by common
   law

7. **Administrative law** - rules /laws established by agencies such as IRS,
   SSA, or military
**Bill of Rights** -

all collectors and handlers of evidence must be aware of these rights

The right:

- presumed innocent until proven guilty
- not to be searched unreasonably (person or home)
- not to be arrested without probable cause
- against unreasonable seizure of personal property
- against self-incrimination
- fair questioning by police
- protection from physical harm throughout the justice process
- to an attorney
- trial by jury
- to know charges against oneself
- cross examine prosecution witnesses
- speak and present witnesses
- not to be tried again for the same crime
Bill of Rights continued:

The right:

against cruel and unusual punishment
due process
speedy trial
against excessive bail
against excessive fines
to be treated equally, regardless of race, gender, religion, country of origin and other personal attributes
What do you think the procedures are during an arrest?
Criminal Procedures

1. Crime committed
   - gather evidence, suspects, investigation
   - report to prosecutor
   - if probable cause - arrest warrant

2. Arrested
   - booked - fingerprints, photo, possible line-up

http://www.gvnews.com/sav/images/Fingerprinting.jpg
Miranda Rights (Miranda vs. Arizona, 1966)
- You have the right to remain silent and refuse to answer questions
- Anything you say or do may be used against you in a court of law
- You have the right to consult an attorney before speaking to the police and to have an attorney present during questioning now or in the future
- If you cannot afford an attorney, one will be appointed for you before any questioning
- If you decide to answer questions without an attorney present, you will still have the right to stop answering at any time until you talk to an attorney
- Knowing and understanding your rights as I have explained them to you, are you willing to answer my questions without an attorney present?
booking continued:

- brought to a judge within 72 hrs. for arraignment
  - informed of charges, rights, bail
  - enter plea (guilty, not guilty, not guilty by reason of insanity, double jeopardy)
  - **nolo contendre** (no contest) - neither admits nor denies guilt, but accepts punishment
Pleading:

- if plead "guilty" - evidentiary hearing (no jury)
  - judge considers offense, past record and passes sentence

- if plead "not guilty" - judge decides if have enough evidence to go to trial, sets trial date and determines bail
  - if felony - may use "Grand Jury" - 16-25 people to determine if enough evidence, then indicted, trial date set

- if plead "not guilty by reason of insanity" - defendant has to prove "at the time of the commission of acts constituting the offense, the defendant, as a result of severe mental disease or deficit, was unable to appreciate the nature and quality of the wrongfulness of his acts" (1984 - Comprehensive Crime Control Act)
Plea bargaining - defendant pleads guilty to a lesser charge and prosecutor drops more serious charge to avoid cost and time of a trial.
-90% of all court cases
Types of Crimes = violations

1. **Infraction** - minor offense/petty crime
   - ex. jaywalking, traffic violation, littering = fine

2. **misdemeanor** - punishable no more than 1 year in jail
   - Ex. 1st drunk driving, vandalism, shoplifting, simple assault,
     trespassing, prostitution
   - fines - $250-2500, community service

3. **felony**
   - ex. arson, aggravated assault, burglary, robbery, homicide, rape,
     bomb threat
   - 5 yrs. to life in prison/ death penalty
   - fines up to $100,000
   - probation
Federal Rules of Evidence

= govern if, when, how and for what purpose proof of a crime is placed before a judge/jury
-what evidence is admissible in court - must be relative
-evidence must be reliable and person presenting must be believable and competent

heresay = testimony based on something someone else told them, not what they heard or saw themselves
    -inadmissible in court
Expert Testimony

-must establish credibility through credentials, background and experience

Frye Standard (Frye vs. U.S., 1923)
  = "general acceptance test"

"scientific evidence is admissible at a trial only if the methodology or scientific principle on which the opinion is based is sufficiently established to have gained general acceptance in the particular field in which it belong." (Only applies to new or novel scientific methodologies.)
Daubert Ruling (Daubert vs. Merrell Dow Pharmaceuticals, Inc 1993)
- newer version of Frye Standard
- sued over birth defects based on drug taken by mother
- "general acceptance" is no longer an appropriate standard for admissibility
- society is more complex and tech. sophisticated than in 1923
- applies only to federal courts, but states can use a guidelines

1. scientific theory or technique must be testable
2. theory or technique must be peer reviewed and published
   - must determine validity
3. rate of error or possible errors given
4. technique must follow standards
5. court decides if widely accepted technique or theory within the scientific community is admissible
Crime Laboratories

- oldest in L.A. (1923)
- FBI lab 1932 by J. Edgar Hoover
  - services all U.S. law enforcement agencies
  - largest in U.S.
- 1981-FBI Forensic Science and Research Center
  - U.S. has no national system of forensic labs
  - city, county, states have own
- about 350 public crime labs
  - function as part of police department or prosecution/district attorney office, medical examiner/coroner, some universities
  - staff 1-100 people
Causes of growth in crime labs

1. greater emphasis on securing evidence to prosecute

2. modern technology

3. increase in crime rates in U.S.
   -all drug seizures must have a chemical analysis before can be heard by a judge

4. DNA profiles - huge area!
   -back log of samples
Major Crime Labs

1. FBI in Quantico, Va.

2. DEA (Drug Enforcement Agency) - analyzes drugs

3. Bureau of Alcohol, Tobacco, Firearms and Explosions
   - analyze alcoholic beverages, weapons, explosive devices

4. U.S. Postal Inspection Service -
   ex. anthrax case

state and local labs
What do you think a crime lab does? What specialties might it have?
What does a Crime Lab Do?

1. **physical science unit**
   - chem, physics, geology
   - id drugs, glass, paint, explosives, soil

2. **Biology Unit**
   - biologists, biochemists, botanists, entomologists
   - id and perform DNA profiling (hair, blood, fibers), id botanicals, id insects and maturation stages

3. **Firearms unit**
   - examines firearms, discharged bullets, cartridge cases, shotgun shells, ammunition
   - analysis of garments/objects for gunpowder residue
   - trajectory
   - distance from target
4. Document Examination Unit
   - handwriting/typewriting analysis
   - analyze paper/ink, indented writing, obliterate erasures, burned or charred documents

5. Photography Unit
   - examines and records evidence
   - digital images, infrared, UV and x-ray
   - prepares photographic exhibits for courtroom

http://www.clouddome.com/specs/images/camera-tn.jpg
Other units

**toxicology** - body fluids/organs for presence or absence of drugs/poisons

**latent fingerprints**

**polygraph unit**-lie detector

**Voiceprint Analysis**- analysis voices from taped messages, telephone
-sound spectrograph - transfers speech into visual graphic display
called a voiceprint
What other forensic areas can you think of?
So what does a forensic scientist do???

1. analyze physical evidence  
   -free of bias, error vs. confession and eye witnesses

2. Determining admissibility of evidence  
   -Frye Standard  
   -Daubert ruling

3. Judging Scientific Evidence (Dr. Coppolino's case study)

4. Providing expert testimony  
   -cannot give a view with absolute certainty  
   -offers opinion based on reasonable scientific certainty

5. train law enforcement personal in proper recognition, collection and presentation of physical evidence
Forensic Science

http://www.ferrum.edu/majors/forensic.jpg