Forensic Science
UIUC Forensics Workshop
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Forensic Sciences
Careers in Forensic Science

Why is there such great interest?

• Positive (mostly TV)
  – CSI (all three)
  – NCIS
  – Bones
  – FBI Files
  – Autopsy
  – New Detectives
  – Medical Detectives
  – Forensic Files

• Negative (mostly NEWS)
  – OJ Case
  – Innocence Project
  – Press on “bad” science
  – Press on “bad” scientists (Fred Zane)
  – Press on “bad” labs (Houston, Detroit)
Careers in Forensic Science

• Some of the Realities (vs. TV)
  – It’s not glamorous – lab work hardly ever is
  – We don’t go to crime scenes
  – We don’t interview suspects
  – We don’t drive Hummers
  – We don’t all look and dress like movie stars
  – There are more profilers on TV than in reality
  – We don’t do “everything”
Forensic Science

• Forensic Scientist
  – Specializes in one discipline
  – Does not go to crime scenes
  – Does not carry a gun
  – Does have at least a Bachelor’s in some science (Biology, Chemistry, Biochemistry)
  – Works case until done (could be years)
  – Goes to court often
Careers in Forensic Science

• Some of the Realities (vs. NEWS)
  – Nearly all forensic scientists are ethical people
  – We do use good science and try to keep up with technology
  – We try very hard to be impartial in our analysis and in the courts
  – We have to constantly learn to keep on top of our discipline
Careers in Forensic Science

- Disciplines – these are the mainstream sections which are in most forensic labs
  - Drug Chemistry
  - Forensic Biology/ DNA
  - Fingerprints
  - Firearms
  - Trace
  - Toxicology
  - Questioned Documents
Forensic Science

• Collection and analytical process
  – Must avoid contamination
  – Must avoid loss of sample
  – Must avoid degradation of sample
Forensic Science

• Illinois State Police mobile crime laboratory
Forensic Science

• Side view
Forensic Science

• Trace Analysis
  – Though small, this section completes a large variety of analyses
  – Utilize organic and inorganic analytical methods
  – Test both individual and class types of evidence
Forensic Science

- **Gunshot Residue**
  - Left behind on hands of a person who fired a gun
  - Can tell if a person possibly fired a gun
  - Left on clothing and skin of shooting victim
  - Can be used to determine the distance between the victim to the gun
Residues on suspect’s hand
Residues on victim’s clothing
Forensic Science

- **Gunshot Residue**
  - On hands
    - Suspect might have fired a gun
    - Suspect might have been close to someone who fired a gun
    - Residue disappears after a few hours
    - Residue washes off with soap and water
Forensic Science

• Gunshot Residue
  – On clothing
    • Determines how close to the gun the victim was
    • Useful to determine truth in alibi stories
SEM/EDX
Residues from victim’s clothing

CCI Blazer 38Sp 125gr JSP
Forensic Science

• Hairs and Fibers
  – Class type of evidence
  – Trace evidence
  – Can be used as a link between crime scene, victim and suspect
  – Remember Locard’s principle

“When two objects come into contact, there will be an exchange of materials.”
Forensic Science

• Hairs and Fibers
  – Many cases potentially could have hair and fiber evidence
    • Sexual assault
    • Hit and run
    • Murder
    • Burglary
Sample collection

Avoid:

1. Loss
2. Contamination
3. Deleterious Change
Forensic Science

• Paint analysis
  – Hit and run
  – Burglary
Forensic Science

- Paint analysis
  - Color Sequence
  - Solubility
  - Instrumental
Forensic Science

- Arson and Explosives
  - Was the Fire Set Deliberately (Arson)
- Electrical
- Accelerants
Forensic Science

- Arson and Explosives
  - Detection of accelerant residues
    - Color tests
    - Flame Ionization Detectors (Sniffers)
    - Portable Gas Chromatographs
    - Portable IR spectrophotometers
    - Dogs
Forensic Science

• Explosions and Explosives
  – Violent outburst
  – Often a shock wave much heat and noise
  – Most of sample destroyed or deposited over a large area
  – Collection and isolation of sample is the problem
Forensic Science

• Testing of explosives and residues
  – Spot tests
  – Chromatography
    • Thin Later
    • Liquid
  – X-ray Diffraction
  – Infrared Spectrophotometry
  – Mass Spectrometry
Forensic Science

- Identification and Classification of body fluids
  - Blood
  - Seminal fluid
  - Vaginal fluid
  - Saliva
  - Urine
  - Fecal material
  - Gastric contents
Forensic Science

• Subsequent DNA analysis of stains
• Much advancement in the last 25 years
  • RFLP (1980’s) – 2 months for analysis, lots of DNA needed (a stain about the size of a quarter), odds in the $10^7$ range
  • PCR (1990’s) – 2-3 weeks for analysis, stain about the size of a dime (cloning technology used), odds in the $10^6$ range
Forensic Science

- Much advancement in the last 25 years
  - STR analysis (late 1990s) – 2 days for analysis, small amount of sample needed (about the size of a pin head), odds in the $10^{15}$ range or greater (remember, the world population is only about $7 \times 10^9$)
  - Mitochondrial DNA
  - Y-STR analysis
Forensic Science

- DNA Analysis
  - Capillary Electrophoresis with fluorescence detection
  - Isolation and amplification of 13 loci for detection
  - CoDIS for possible identification of an unknown offender
Possible variants for nine genetic markers
Variants from victim

Variants from gum at crime scene

Variants from suspect
Forensic Science

- Combined DNA Indexing System (CoDIS)
  - Computerized searches for genetic profiles
  - All sex offenders on file
  - Now more convicted of crimes as well
  - Allows analysis of “no suspect” cases
Forensic Science

• DNA Analysis
  • Remember – no matter what, identical twins still give the same profile

• However, their fingerprints are different
Forensic Science

- Fingerprints
  - Principles of Fingerprints
    - No two people have been found with identical fingerprints
    - Fingerprints are permanent
    - Fingerprints easily classified
Forensic Science

1. Bifurcation
2. Ridge ending
3. Enclosure
4. Ridge ending
5. Bifurcation
6. Bifurcation
7. Bifurcation
8. Ridge ending
9. Ridge ending
10. Short ridge
11. Bifurcation
12. Ridge ending
FIGURE 14–4  The right index finger impression of John Dillinger, before scarification on the left and afterward on the right. Comparison is proved by the 14 matching ridge characteristics. Courtesy Institute of Applied Science, Youngsville, N.C.
Forensic Science

- **Automated Fingerprint Identification System (AFIS)**
  - Computerized search for suspects to match to crime scene print
  - Comparison of 5,000,000 prints per second
  - Gives up to 10 possible “matches”
Drugs – any compound which can cause a physical or psychological effect in higher order animals
Drug Analysis

(Left) Original Rohypnol pills and packaging (Above) The new Rohypnol tablet includes a dye that makes the drug visible if slipped into a drink.
Drug Analysis

- Drugs of Importance (Controlled)
  - Cocaine
  - Cannabis
  - Methamphetamine
  - Heroin
  - Hallucinogens
  - Designer Drugs
Toxicology

The only difference between a drug and a poison is the dose
Toxicology

- Similar to drug chemistry, except
  - More drugs seen
  - Metabolites sometimes the only means of determination of a drug
  - Matrix is not as neat and clean
  - Concentration of drug much less (mg/L and less)
Forensic Science

- VOLATILES
  - Ethanol
  - Methanol
  - Iso-propanol
  - Acetone
  - Toluene
  - Ethylene Glycol
Forensic Science

Tests Done on Samples From

- Drivers for DUI/DUID
- Drivers for Reckless Homicide
- Deceased Persons
- Some Sexual Assault Victims
Forensic Science

➤ Analytical Techniques in Drugs and Toxicology
  ➤ Preliminary tests
    ➤ Tell there might be a drug present
  ➤ Confirmatory tests
    ➤ Tells exactly what the drug is
Forensic Science

➤ Reporting

● Volatiles
  ● Identity of substance
  ● Concentration (g/dL)

● Drugs and other compounds
  ● Identity
  ● Quantitation when necessary
Forensic Science

- **Firearms and Tool Marks**
  - Rifling put into barrel to make the bullet spin and have a truer course to the target
  - This also put striations on the bullet which could be traced back to a particular gun
Forensic Science

• Comparison Microscope used to make the comparison between evidence bullet and test fired bullet
Forensic Science

Comparisons of bullets and cartridge casings
Forensic Science

Serial Number Restoration
Forensic Science

- IBIS – Computerized searches for firearms analysis
  - Scan fired evidence into data base
  - Compare to data base
  - Firearms examiner must observe evidence and test to make call – computer does not
  - Can link cases together, fired evidence, firearms to fired evidence
Forensic Science

• All Sections
  – After analysis, results reported to submitting agency
  – Results will be used during trial
  – Analyst may or may not have to testify
    • Testimony as expert witness
    • Trials are mostly criminal, but can be civil
Careers in Forensic Science

• Requirements for employment
  – At least a Bachelor’s degree in a natural Science

• Careers, Chemistry, Biochemistry and Biology are best

• Other natural sciences include
  – Zoology - Pre-med
  – Physics - Med-tech
  – Botany - Agricultural Science
  – Geology - Animal Science
Careers in Forensic Science

- Requirements for employment
  - Option A
  - Comparative Sciences (Firearms, Questioned Documents, Fingerprints)
  - Bachelor’s degree in natural science or forensic science
Careers in Forensic Science

• Firearms
  – Evaluation of fired evidence and toolmarks in evidence
  – Training is approximately two years
  – Sections located in the Chicago, Joliet, Springfield, Rockford, Morton and Fairview Heights area laboratories
Careers in Forensic Science

• Fingerprints
  – Evaluation of evidence for the presence of fingerprint evidence and comparison of found fingerprints
  – Training is approximately two years
  – Sections located in the Chicago, Joliet, Springfield, Rockford, Morton and Fairview Heights area laboratories
Careers in Forensic Science

• Questioned Documents
  – Evaluation of document evidence for authenticity of the document or author of the document
  – Training is approximately three years
  – Sections located only in the Springfield area laboratory
Careers in Forensic Science

- Requirements for employment
  - Option B
    - Chemistry related sections (Drugs, Tox, Trace)
      - At least 60 hours of science
      - At least 20 hours of chemistry
Careers in Forensic Science

• Drug Chemists
  – Analysis of plants, tablets, powders and capsules for the presence or absence of controlled substances
  – Training is approximately 9 months
  – Drug sections in all laboratories
Careers in Forensic Science

• Trace and Microscopy Chemists
  – Analysis of accelerant residues, explosives and explosive residues, glass, hairs and fibers, gun shot residues, unknown chemicals and paints
  – Training is variable depending upon the types of analysis in which the analyst receives training
  – Trace and/or Microscopy sections in Chicago, Joliet, Springfield, Fairview Heights and Carbondale area laboratories
Careers in Forensic Science

- **Toxicologists**
  - Analysis of body fluids for the presence or absence of drugs and alcohol
  - Training is approximately 1 year
  - Toxicology sections only in Chicago and Springfield area laboratories
Careers in Forensic Science

• Requirements for employment
  – Option C
  – Biology/DNA
    • At least 60 hours of science
    • Careers including
      – Molecular Careers
      – Genetics
      – Biochemistry
Careers in Forensic Science

• Forensic Biology/DNA
  – Analysis of evidence for the presence of body fluids and the subsequent identification of the individual who contributed the fluids
  – Training is approximately two years long
  – Sections located in the Chicago, Joliet, Springfield, Rockford, Morton, Carbondale and Fairview Heights area laboratories
Careers in Forensic Science

• Requirements for employment
  – Additionally

• Must be willing to relocate (training can be in any ISP laboratory) for training (1-3 yrs.)
• People of high moral character
  – Polygraph test
  – Background check
  – Drug screen
  – Random drug testing
Careers in Forensic Science

• Requirements for employment
  – Additionally
  • People who won’t let outside factors influence their decision making processes
  • People who can defend their position under intense challenge (cross examination in court) yet remain impartial and truthful
  • People who can work well under pressure and don’t mind being over-worked, under appreciated and under paid
Careers in Forensic Science

• Progression of Career
  – Forensic Scientist Trainee – for 1 year
  – Forensic Scientist I – for 2 years
  – Forensic Scientist II – for 2 years
  – Forensic Scientist III – top grade for analysts
  – Public Service Administrator – line managers (Group Supervisors, Assistant Laboratory Directors)
  – Senior Public Service Administrators – Upper managers (Laboratory Directors and above)
Careers in Forensic Science

- Benefits of employment
  - Starting Salary (ISP) $3801-$5109 per month
  - Top salary (for analyst) $7588 per month
  - Health, vision and dental insurance contribution which continues with 20 years of service
  - At present, there is a pension (1.67% per year) calculated on the average of the last four years of service
  - I have not seen any lay-offs in my time
Careers in Forensic Science

• Benefits of employment
  – Rewarding experience in a field which continually changes
  – Continually growing, though slowly
  – Positions available almost every year
  – Applications and additional information at

www.isp.state.il.us/Forensics/ISPHTML/forensics.htm
Careers in Forensic Science

• Application Procedure
  – Fill out CMS 100 for each option sought
  – Remember – County of preference – read instructions here carefully
  – Take test for each option sought (must get an “A”)
  – Wait for interviews
  – Interviews are in Springfield
  – After interview – polygraph and drug test
Careers in Forensic Science

• State Police Evidence Technician
  – Requires equivalent of
    • 2 years college for SPET I
    • 4 years of college for SPET II
  – Natural science or law enforcement majors preferred
  – Salary
    • SPET I - $3379-$4404
    • SPET II - $3506-$4621
Careers in Forensic Science

• State Police Evidence Technician
  – Duties include
    • Receive evidence
    • Assist with records processing
    • Testify in court
    • Assist with communications between analysts and officers
    • Return Evidence to agencies
Careers in Forensic Science

- State Police Evidence Technician
  - Application
    - CMS-100
    - Interview at laboratory with opening
    - Polygraph
    - Drug Test
    - Background check

www.isp.state.il.us/Forensics/ISPHTML/forensics.htm
Careers in Forensic Science

• Are there any questions?

• Remember, all information here can be gained at: www.isp.state.il.us/Forensics/ISPHTML/forensics.htm
Forensic Science

- MS in Forensic Science at UIC
  - Approximately 1.5 to 2 year program
  - Starting Fall of 2014, thesis is required
  - FEPAC Accredited program (only 14 graduate programs are accredited)
  - Class size is small – we try for a maximum of eight (8) students per class – usually 5-6
  - Many courses are taught using practicing forensic scientists who work at the ISP lab at Damen and Roosevelt in Chicago (about 4 blocks from COP)
Forensic Science

• **MS in Forensic Science at UIC**
  - Laboratory exercises in the major forensic disciplines
  - Training in courtroom techniques
  - Internships are available with several local forensic laboratories
  - Employment record for previous students is over 60% in forensic science laboratories
Forensic Science

• MS in Forensic Science at UIC
  – Requirements
    • At least 3.25 out of 4.0 GPA
    • Bachelors in Chemistry, Biology, Biochemistry
    • GRE scores exceeding 310 out of 340 (new scale)
    • Three letters of recommendation
    • Personal statement
    • Ability to become a forensic scientist
  – Applications due by February 1
  – If attempting to get a University Fellowship, deadline is January 1
Forensic Science

• MS in Forensic Science at UIC
  – Contact information
  – Dr. Karl Larsen
    – larsena@uic.edu
    – 312 – 996 – 2250
Careers in Forensic Science

Questions?
Forensic Science
Forensic Science

Checking for suitable prints
Forensic Science

STAGES OF INTOXICATION (in g/dL BAC)

Sobriety: < 0.05
Euphoria: 0.03 to 0.12
Excitement: 0.09 to 0.25
Confusion: 0.18 to 0.30

Stupor: 0.27 to 0.40
Coma: 0.35 to 0.50
Death: = and > 0.45