Forensic Sciences

Specialties
Programs
Career Pathways

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The Hype... the TV version

Forensic Sciences

**Hype**

Significant progress has been made in the past 20 years in the recognition and use of physical evidence in helping to solve and resolve cases

Progress has been particularly dramatic in the development and implementation of DNA technologies

**Reality**

There are still many things we cannot do that would be helpful in resolving cases

There are huge and stubborn laboratory backlogs... in nearly all labs and in nearly all the specialties

Research indicates that forensic laboratory results and findings play a negligible role in the majority of criminal case resolutions

DNA typing is not relevant to many cases, not even all biological evidence cases

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**Forensic Sciences**

**Hype**

Besides the CODIS (DNA) database, there are important and growing electronic databases of fingerprints (AFIS), and of bullets and cartridge cases (NIBIN)

Crime scenes are carefully processed by well-trained investigators. Most relevant evidence is collected and submitted to laboratories for analysis

**Reality**

The databases have limitations. Not everything is in them. The search algorithms can impose limitations.

Research indicates that considerable evidence goes unrecognized, uncollected, unsubmitted.
The application of natural sciences and technologies to matters of law

Forensic Sciences

Forensic Sciences Biomedical Areas
- Pathology
- Medicine
- Odontology
- Dentistry
- Anthropology
- Serology
- DNA Typing
- Toxicology

CRIMINALISTICS
- Firearms
- Tool marks
- Trace Evidence
- Questioned Documents
- Serology
- DNA
- Fingerprint
Medical Examiner:

**Medical Cause of Death**

**Manner of Death**

**Cause / Manner of Death**

- **Cause of death**
  
  Heart disease; blow to the head; gunshot wound; pneumonia; etc. Sometimes may be undetermined

- **Manner of death**
  
  Homicide; Suicide; Accidental; may also sometimes be Undetermined
In some cases, human remains cannot be identified by viewing.

Dental identification (or fingerprints) are the method(s) of choice in identifying otherwise unidentifiable remains.
Forensic Toxicology

- Extraction / separation of drugs / toxins from the biological matrix
- Identification / quantitation of drugs / toxins in blood, body fluids, tissues
- Interpretation of effects of drug(s) or toxin(s) at the concentration(s) detected

Forensic Drug Chemistry

- Identification of “street” drugs and controlled substances
- Identification of “ethical” drugs at scenes or illegally possessed
- Quantitation of drugs and controlled substances

The analytical methods used in drug identification and forensic toxicology are similar or identical.

Forensic Sciences

- Reconstruction / Crime Scene
- "Trace" Microscopy
- Pattern Evidence
- Biology DNA

- Questioned Documents
- Fingerprints
- Firearms Toolmarks

TRACE / MATERIALS EVIDENCE ANALYSIS

- Hair
- Fibers
  - Glass Fragments
  - Soils
  - Paints
- Cosmetics
- Other Materials
Trace / Materials

Hairs / Fibers
Glass; Soil; Paint;
Plastics; Cosmetics;
Other materials

Individualization

• Many classes can be examined for various characteristics - and partially individualized.
• Generally, we do not have the data to determine the degree of individuality....

Trace / Materials

Hairs / Fibers
Glass; Soil; Paint;
Plastics; Cosmetics;
Other materials

Individualization

• This category of evidence is thus often said to have primarily exclusionary value
• Occasionally, an examiner might testify to an effective individualization of paint or soil when very unusual features are present

Questioned Documents Examinations

• Handwriting
• Typewriting
• Printed / Stamped Documents
• Paper
• Inks
• Photocopy / Fax
• Reconstructions of Charred Documents
• Indented Writings
Fingerprints

- Unique
- Stable
- Classification Systems

Until recently, fingerprints were taken using ink and recorded on cards ....

.... which were stored in large, manual paper files

Now, fingerprints are scanned into automated systems

North American Morpho  De La Rue

De La Rue Printrak
Automated fingerprint identification system

NEC
AFIS Technology

New Unknown Profile

? Query? for Identification

? Query? to Connect Unsolved Cases

Fingerprints in large files (offenders, arrestees, various licensees, etc)

Unidentified latents from other cases

FIREARMS TOOLMARKS

Pattern

Fingerprints
Handwriting
Firearms / Toolmarks
Other impressions
Bitemarks

Identification (Individualization)

- Handwriting, fingerprint, and firearms / toolmarks examiners generally testify following the comparison of a Questioned with a Known:
  (a) Inconclusive - Q unsuitable for comparison
  (b) Do not match. K excluded as source of Q.
  (c) Do match. K is the source of Q.
Biological Evidence

Blood / Bloodstains
Physiological Fluids / Stains
Semen
Vaginal Fluids
Saliva
Urine

Identification / Classification

• Blood generally no problem, but . . . . .

• Presumptive and confirmatory tests are commonly used, and sometimes only a presumptive test result is available

Forensic DNA Typing
**Biological**

Blood
Physiological Fluids
(saliva, semen, etc.)
Tissues

**Individualization**

- Biological evidence is individualized by DNA typing / profiling
- Most experts think that a 13-locus match essentially individualizes biological evidence (among unrelated people)

... a male DNA profile was identified in item XXYY. John Smith cannot be excluded as a depositer of the evidence in item XXYY. This profile would be expected to occur by chance in approximately one in 1.09 billion unrelated African Americans, one in 284 trillion unrelated Caucasians, and one in 305 quadrillion unrelated Hispanics.

... a male DNA profile was identified in item XXYY. John Smith cannot be excluded as a depositer of the evidence in item XXYY.

To a reasonable degree of scientific certainty, this profile originated from John Smith.
The 13 “CODIS Core” STR Loci

- D3S1358
- VWA
- FGA
- D8S1179
- D21S11
- D18S51
- D5S818
- D13S317
- D7S820
- CSF1PO
- TPOX
- THO1
- D16S539
- Amelogenin

DNA Databases / CODIS

New Unknown Profile

- Query for identification
- Query to connect unsolved cases

Offender Database  Forensic File

Profiles of Unknown Origin from Casework

Newer Developments

Daubert

NAS / NRC Report
**Careers in Forensic Sciences**

**Formal Education for Criminalistics Work**

**Minimum:**
- B.S. Hard Science
  - (B.S. Forensic Science)

**Useful:**
- M.S. Forensic Science
  - (M.S. Hard Science)

**Ph.D.:**
- Rarely Required for Criminalistics
- Usually in a Hard Science Discipline

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**Forensic Science Academic Programs**

**Undergraduate Program / Concentration**

**Graduate Program / Concentration**

- Science - Research Based / Oriented
- Investigation Based / Oriented

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**Degree Requirements for Forensic Science Employment**

- **Do I Need a “Forensic Science” Degree?**  No
- **Do I Need a Master’s Degree?**  No
## How do I become a ...

<table>
<thead>
<tr>
<th>Role</th>
<th>Education Required</th>
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</thead>
<tbody>
<tr>
<td><strong>Criminalist or toxicologist</strong></td>
<td>Education in the sciences</td>
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<td>- working in a forensic science laboratory</td>
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<td><strong>Crime scene investigator</strong></td>
<td>Become a law enforcement officer - little or no higher education required</td>
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<td><strong>Federal agent</strong></td>
<td>Bachelor’s degree is minimum. Major probably doesn’t matter.</td>
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<td><strong>Forensic Pathologist</strong></td>
<td>College: “Pre-medical” Medical School (M.D.) Internship .. Residency</td>
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<tr>
<td><strong>Medical Examiner</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Forensic Toxicologist</strong></td>
<td>College: B.S. Degree .. then Ph.D. in toxicology, anthropology, entomology</td>
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<tr>
<td><strong>Anthropologist</strong></td>
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<td><strong>Entomologist</strong></td>
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<tr>
<td><strong>Forensic Dentist</strong></td>
<td>College: “Pre-dental” Dental School “On the job” training</td>
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<tr>
<td><strong>Forensic Psychiatrist</strong></td>
<td>College: “Pre-medical” Medical School Internship .. Residency</td>
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<td><strong>Criminalist - working in a forensic science lab</strong></td>
<td>B.S. in science (chemistry or biochemistry best) Possibly M.S.; rarely Ph.D.</td>
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### The Job Picture

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<th>Role/Field</th>
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| Criminalists / Forensic Labs                    | • Several thousand in US  
                                          • Few hundred new hires per year                                           |
| Toxicology                                      | • Several thousand in US  
                                          • Opportunities in public forensic labs, and in private testing labs        |
| Law Enforcement                                 | Almost unlimited opportunity                                                |
| Pathology                                       | • Several hundred in U.S.  
                                          • There are opportunities, but the training is long and arduous            |
| Anthropology, Entomology, Odontology, Psychology / Profiling | • Almost no opportunities  
                                          • Most practitioners are academics who do forensic cases on consulting basis |

### Other Important Considerations for Law Enforcement Employment

- Any significant drug use history
- An arrest or conviction for any significant offense
  
  ....... will exclude you from employment

All agencies do backgrounds and drug tests.

Many agencies do polygraphs.

### The UIC M.S. Program

- Receives about 75 - 100 applications per cycle
- The top 20 – 25 applicants could be (in some cases have been) admitted to PhD programs or to medical school
- Admission is offered to about 15 students; typically, 8 -14 attend the program
- Over 180 alumni(-ae) of the program (since 1977);  
  > 140 since 1996
The UIC M.S. Program

Core:
- Toxicology / Drug Chemistry
- Biological Evidence Analysis
- Trace and Materials Evidence Analysis / Microscopy
- Pattern Evidence Analysis (Documents, Fingerprints, Firearms, Toolmarks, Other Patterns)
- Expert Witness Testimony / Courtroom Demeanor
- Research

Forensic Science Related Electives:
- Forensic Microscopy Topics
- Law and Science
- Special Topics
- Any graduate basic science course on campus

http://www.uic.edu/pharmacy/depts/Forensic_Science

- You can get a job in a forensic science lab with a B.S. degree
  You do not need a Master’s degree

- Most of the other Master’s programs have requirements similar to UIC

Forensic Science Programs in the U.S.

AAFS web site http://www.aafs.org
  > Resources > Colleges and Universities

Caution: do your homework when looking at programs

THE END

Questions

Thank You
Contact information

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Welcome . . . .

University of Illinois at Chicago
College of Pharmacy

Graduate Programs
• M.S. Forensic Science
• Ph.D.
  • Biopharmaceutical Sciences
  • Medicinal Chemistry
  • Pharmacognosy