An Introduction to Forensics Sciences

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Former Forensic Scientist (Forensic Biologist/DNA analyst)
Anyone have one of these?

Unusual forensics applications!
Dogs of Bruntingthorpe UK

- Small village
- 150 people
- 30 dogs
- One resident failing to clean up after their dog
Dr. Ian Eperon

- Molecular geneticist
- Compiled a database
  - All 30 dogs
  - Hair samples (roots intact)
- Next “sample” left can be linked to owner
- Nature Genetics 12;354
Crime in the United States

Crime in 2005

<table>
<thead>
<tr>
<th>State</th>
<th>Population coverage</th>
<th>Violent crime total</th>
<th>Murder and nonnegligent manslaughter</th>
<th>Forcible rape</th>
<th>Robbery</th>
<th>Aggravated assault</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States-Total</td>
<td>296,410,404</td>
<td>1,390,695</td>
<td>16,692</td>
<td>93,934</td>
<td>417,122</td>
<td>862,947</td>
</tr>
</tbody>
</table>
Agenda

- Forensic Science Specialties
- Pseudoscents
- Drug Chemistry
- Latent Fingerprint analysis
- Innocence project
- Restorase and DNA Barcodes
Agenda

• Forensic Science Specialties
  • Pseudoscents
  • Drug Chemistry
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  • Restorase and DNA Barcodes
Forensic Science

• Definition:
  – Application of science to the law

• Goal is to link
  – Suspect to a crime scene
  – Victim to a crime scene
  – Crime scene to crime scene
  – Victim to suspect
  – Suspect to victim
Forensic Science

• Common specialties
  – Microscopy (hairs and fibers)
  – Trace evidence
  – Firearms and Toolmarks
  – Forensic biology/Forensic DNA Analysis
  – Latent Fingerprint Analysis
  – Drug Chemistry

• Less common
  – Odontology / Forensic Dentistry
  – Anthropology
  – Entomology (BUGS!)
Microscopy

• Examine and compare hairs
  – Human
  – Non human
  – Can determine sex and ethnicity

• Fibers
  – Carpet
  – Other
Microscopy

- Crushed human hair

- Examine and compare hairs
  - Human
  - Non-human
  - Can determine sex and ethnicity

- Fibers
  - Carpet
  - Other
Microscopy

• Examine and compare hairs
  – Human
  – Non human
  – Can determine sex and ethnicity

• Fibers
  – Carpet
  – Other

Animal Hairs
Microscopy

• Examine and compare hairs
  – Human
  – Non human
  – Can determine sex and ethnicity

• Fibers
  – Carpet
  – Other

Cotton Fibers
Microscopy

• Examine and compare hairs
  – Human
  – Non human
  – Can determine sex and ethnicity

• Fibers
  – Carpet
  – Other
Trace Evidence
Firearms / toolmarks
Firearms / toolmarks
Firearms / toolmarks

Butt of revolver- Before
Firearms / toolmarks

Butt of revolver - After
Odontology
Odontology
Anthropology
Anthropology
Entomology
Entomology
Forensic Biology/ DNA analysis
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Drug Chemistry

• In order to use drug chemistry techniques, we must first find the drug.
Drug Chemistry

- In order to use drug chemistry techniques, we must first find the drug.
# Olfactory abilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Olfactory Membrane</th>
<th>Sense of smell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betsy</td>
<td>4 sq cm</td>
<td>ok</td>
</tr>
<tr>
<td>Bighead</td>
<td>14 sq cm</td>
<td>good</td>
</tr>
<tr>
<td>Mathilda</td>
<td>150 sq cm</td>
<td>Phenomenal!!!</td>
</tr>
</tbody>
</table>
Olfactory abilities BEEF STEW

• People Smell
Olfactory abilities BEEF STEW

• Dogs Smell
Pseudo Scents

COLUMBO HAS SUCCESSFULLY FINISHED REHAB AND WILL RETURN TO THE FORCE NEXT WEEK.

COLUMBO?
WHO'S COLUMBO?
THEIR DRUG-SNIFFING DOG.

Fri May 25, 12:00 AM ET
Pseudo Scents

- 1989
- Thomas Juehne
- John Revell
Pseudo Scents

• Cocaine
• Heroin
• Marijuana
Pseudo Scents

- Pseudo Corpse
  - I and II

- Pseudo Distress
Drug Detection

• Once alerted to the presence of drugs, the drug must be identified.

• This can be done in the field or in the lab.
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• What is a fingerprint?
  – complex mixture of natural secretions
  – contaminations from the environment

• Primarily made of secretions
  – From palms (ridges) of hands and soles of the feet

• Ridges are genetically defined – don’t change
Latent Print Analysis – Super Glue Fuming

• How does it work?
  – The main ingredient in super glue is cyanoacrylate (C$_5$H$_5$NO$_2$)
  – Instantly form bonds with hydroxyl ions in water
How Superglue works!

Superglue + HEAT → methyl 2-cyanoacrylate fumes + Water (humidity from air) + Components left behind by pores on our fingertips
Latent Print Analysis – Super Glue Fuming DIY

• Items needed:
  – Super Glue
  – Aluminum Foil or ½ of an Aluminum Can
  – Cup of Hot Water
  – Heat Source (60 watt bulb)
  – Fuming Chamber (cardboard box size of bread box)
  – Items suspected of having fingerprints

• Note: Cyanoacrylates can cause extreme eye and nose irritation. Fuming should be done in well-ventilated areas
Latent Print Analysis – Super Glue Fuming
DIY – one set up
Latent Print Analysis – Super Glue Fuming
DIY – Results (from a different set up)
Latent Print Analysis

• Unknown print from a crime can be photographed and scanned into a computer.

• Compared to known fingerprints in Automated Fingerprint Identification System (AFIS)
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The Innocence Project - 266 free
Antonio Beaver - Local St. Louis case

- 1997 conviction
- Carjacking
- Eyewitness testimony
  - 75% of time is WRONG
- Exonerated March 2007
  - Innocence Project
    - 266 people so far exonerated (Feb 2011)
    - Antonio Beaver was number 197
ST. LOUIS: Man freed from prison will get $181,250

05/25/2007

A man released from prison after 10 years when DNA tests indicated that he was wrongfully convicted of robbery will receive $181,250 as compensation for the mistake, a judge ordered Thursday.

Antonio Beaver, 41, was convicted in 1997 in the carjacking of a woman near the Arch the year before. The robber, wielding a screwdriver, was stabbed during a struggle with the victim.

Blood inside her car was not Beaver’s, according to recent DNA test results. Prosecutors said the sample had not been tested before trial because it was too small for the technology of the day.

A St. Louis judge ordered him released from prison on March 29. Circuit Attorney Jennifer Joyce apologized to Beaver and vowed to help him receive compensation from the state that he deserved.

In 2001, Beaver filed a motion under a new Missouri law allowing convicts to file for post-conviction DNA testing. St. Louis Circuit Judge John J. Riley granted a hearing and appointed a public defender in 2005. Then he ordered a test in October.
Possible Future Trends: Restorase

• What is Restorase?
  – Enzyme blend that makes copies of and repairs damaged DNA.
    • 2003

• Possible forensic uses
  – Used to analyze ancient/damaged DNA
    • Peruvian Mummy Identification (solve ancient crimes?)
    • 9/11 victims
    • Museum specimens
Possible Future Trends: Restorase

- **DNA Barcoding**
  - Short DNA sequence that can characterize every form of life on the planet.
  - Mitochondrial DNA
  - Sequence recorded in a giant database for future use

- **41,155 species categorized to date**

- **Projects in Process:**
  - Birds
  - Fish
  - Mammals
  - Insects
  - And more....
Possible Future Trends: Restorase – DNA Barcodes

- **Applications - Fraud:**
  - Red Snapper – rare and $$$
  - 2004 Study
    - 9 vendors in 8 states
    - 77% (17/22) fish labeled as Red Snapper, were vermilion or lane snapper
  - Chicago Study - 2007
    - 14 sushi restaurants
    - 64% (9/14) were tilapia
Thank You!