

Deoxyribonucleic Acid (DNA)

Forensic Science



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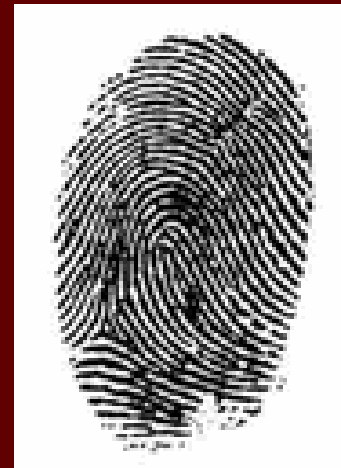
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Introduction to DNA

- **Like fingerprints, DNA is unique to each individual**
- **The primary unit is called a gene**
- **Each gene contains DNA that controls our genetic traits**



Structure of DNA

- **DNA is a molecule comprised of repeating units called nucleotides**
 - **A nucleotide consists of**
 - **Deoxyribose sugar**
 - **Phosphate**
 - **Nitrogen base (adenine, guanine, cytosine, thymine)**



Structure of DNA (continued)

- **DNA is a double helix with sides consisting of alternating sugars and phosphates and the rungs representing the nitrogen bases**
- **Nitrogen bases**
 - **Adenine bonds only to thymine, and guanine bonds only to cytosine**
 - **Base pairing is when two DNA strands are joined by the bonding of the corresponding base pairs**
 - **The order of the bases determines the genetic code**

DNA Typing

- **The process of DNA typing converts DNA into a series of bands that can distinguish an individual**
- **Only a small percentage of DNA differs from one person to the next**
- **These parts of one's DNA are used to create a DNA profile**
- **The majority of DNA does not code for specific proteins and is repetitive, repeating the same sequence over and over**

Polymerase Chain Reaction (PCR)

- **A technique for making many copies of a specific piece of DNA**
- **Can amplify very minute quantities of DNA millions of times**
- **The steps of PCR**
 - **DNA is heated to separate and “unzip” it**
 - **Primers are added to combine with DNA strands**
 - **DNA polymerase (enzymes) and free nucleotides are added to rebuild separated strands**
 - **The DNA is cooled**
 - **The process is repeated several times**

Short Tandem Repeats (STR)

- **The latest method of DNA typing**
- **There are locations (loci) on a chromosome that contain short segments of 3 – 7 bases that repeat themselves**
- **STR's are less susceptible to degradation and can be recovered from bodies or stains that have been subject to extreme decomposition**
- **With the technology of PCR, one can extract and amplify a combination of different STR's**

Mitochondrial DNA

- **Another method of typing used for individual characterization**
- **Located outside a cell's nucleus and inherited only from the mother**
- **Not as useful as STR and is more costly than other DNA testing**

Visualizing DNA through Electrophoresis

- **In the lab, DNA molecules are cut by restriction enzymes into fragments of various sizes**
- **With electrophoresis, the resulting fragments are forced to move along a gel-coated plate under the influence of an electrical potential**
- **After the fragments have “migrated” across the gel, the gel can be stained to show the bands or fragments easily**
- **Comparisons can then be made, such as comparing a suspect’s DNA to the DNA found on a crime scene**

Combined DNA Information System (CODIS)

- **CODIS maintains a database of DNA profiles from convicted offenders, unsolved crime scene evidence, and profiles of missing persons**



Sources of DNA

- **Skin**
- **Sweat**
- **Blood**
- **Mucus**
- **Saliva**
- **Tissue**
- **Semen**
- **Urine**
- **Hair**
- **Ear Wax**
- **Vaginal or rectal cells**



Collecting and Packaging Biological Evidence

- **Photograph evidence first**
- **Wear gloves at all times**
- **Package each stained article separately in paper or a well-ventilated box**
- **Avoid using plastic or airtight containers because moisture could contribute to harmful bacteria and fungi growth**
- **Remove dried blood using a sterile swab moistened with distilled water**
- **Store biological evidence in the refrigerator or a cool location until it is delivered to the lab**



Resources

- Saferstein, Richard. *Forensic Science: An Introduction*. New Jersey: Pearson Prentice Hall, 2008
- Saferstein, Richard. *Forensic Science: An Introduction*. 2nd ed. New Jersey: Pearson Prentice Hall, 2011
- Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science*. 8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004
- <http://law2.umkc.edu/faculty/projects/ftrials/clinton/lewiniskydress.html>
- Do an Internet search for the following: The Murder Trial of O.J. Simpson by Thomas L. Jones