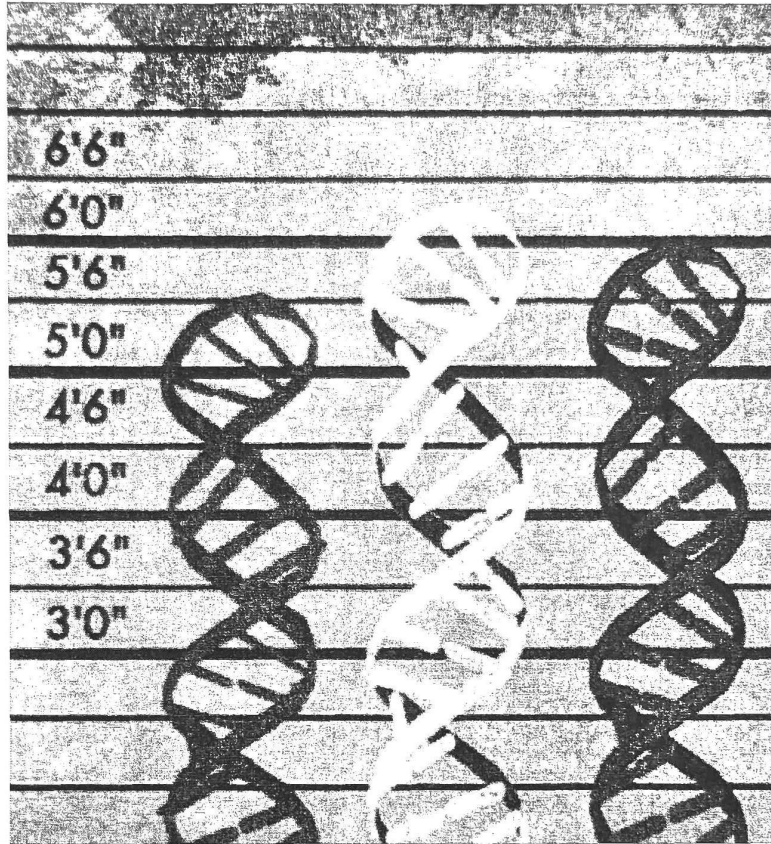


KEY

## Unit 10: DNA (Structure/Analysis)



By the end of the unit, you will be able to:

- Describe the structure of DNA, and properly match base pairs
- Describe the various techniques used to analyze DNA
- Simulate DNA analysis using gel electrophoresis
- Extract DNA from an organism using proper laboratory techniques
- Simulate a polymerase chain reaction experiment

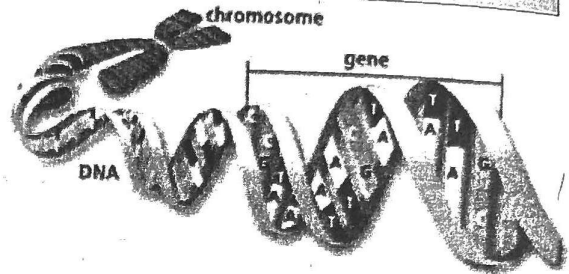
### Unit Vocabulary:

- DNA: \_\_\_\_\_
- Double helix: \_\_\_\_\_
- Nucleotides: \_\_\_\_\_
- Genetic code: \_\_\_\_\_
- RFLP: \_\_\_\_\_
- Restriction enzymes: \_\_\_\_\_
- Gel electrophoresis: \_\_\_\_\_
- Genetic fingerprint: \_\_\_\_\_
- PCR: \_\_\_\_\_
- STR: \_\_\_\_\_
- CODIS: \_\_\_\_\_
- Mitochondrial DNA: \_\_\_\_\_
- Nuclear DNA: \_\_\_\_\_

What is DNA?

- DNA stands for deoxyribonucleic acid and contains all of our genetic information
- It is found on chromosomes located in the nucleus of our cells
- DNA shape: double helix

**Double Helix**

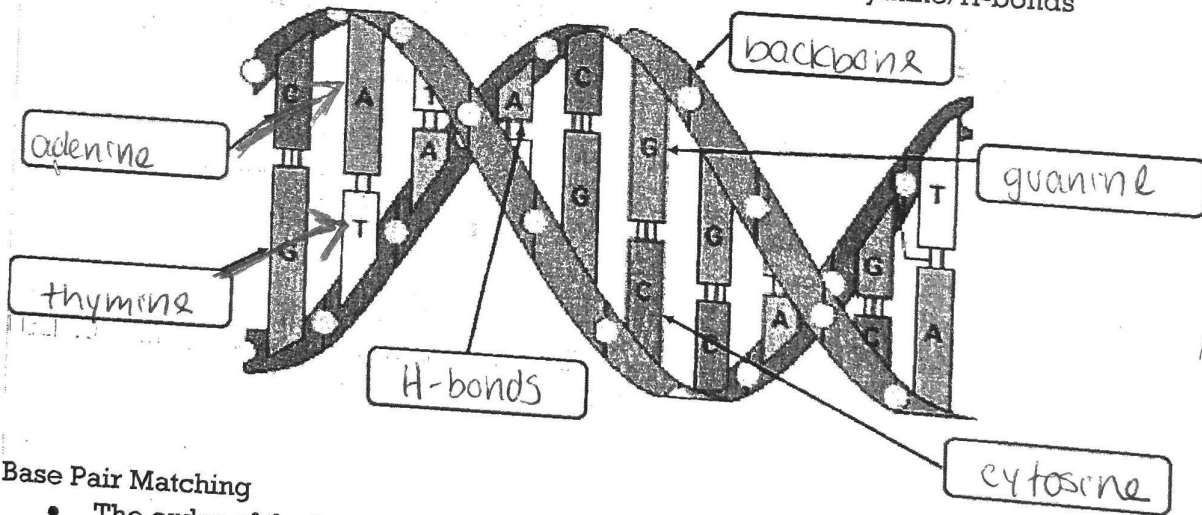


What is DNA made of?

- The sides or backbone of the DNA molecule are made up of sugar (deoxyribose) and phosphate molecules
- The rungs that form the middle of the molecule are made up of pairs of nucleotides or nitrogen bases. Adenine (A) pairs with thymine (T), while guanine (G) always pairs with cytosine (C).

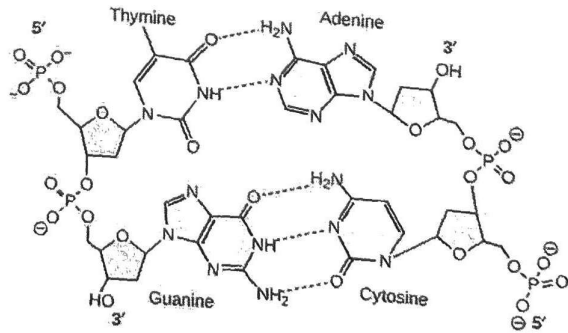
Label the DNA molecule

**Word Bank:** cytosine/backbone/guanine/adenine/thymine/H-bonds



Base Pair Matching

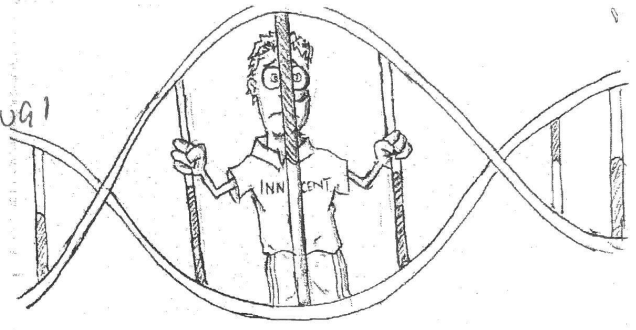
- The order of the base determines the genetic code
- DNA is made up of 2 strands that are complementary to each other
- Each base has a specific partner to match with
  - Adenine-Thymine
    - A-T
    - T-A
  - Cytosine-Guanine
    - C-G
    - G-C



Name: \_\_\_\_\_ Per: \_\_\_\_\_ Date: \_\_\_\_\_

How is DNA used as evidence?

- Each person's DNA is different from other people (except identical twins).
- DNA collected from a crime scene can either link a suspect to the evidence or eliminate a suspect, similar to the use of fingerprints.
- DNA can identify a victim through DNA from relatives, even when nobody can be found.
- DNA can place an individual at a crime scene, in a home, or in a room where the suspect claimed not to have been.
- DNA can link crime scenes together by linking the same perpetrator to different scenes locally, statewide, and across the nation.

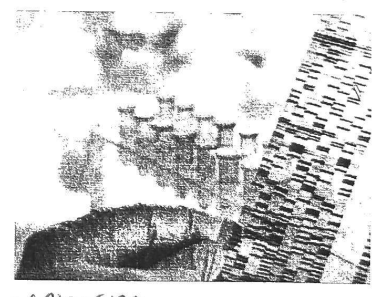


Where does the DNA evidence come from?

- Saliva
- Blood
- Hair strands (the root)
- SKIN
- Finger or toe nails
- Tooth with root material

How is DNA analyzed?

- There are various techniques that are used to analyze DNA
  - RFLP
  - PCR
  - STR
  - mitochondrial DNA analysis



What is RFLP?

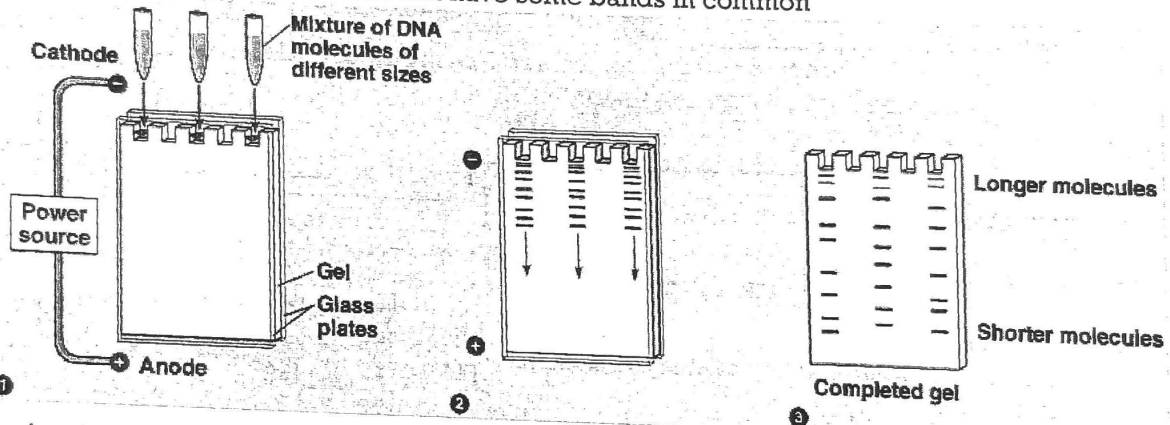
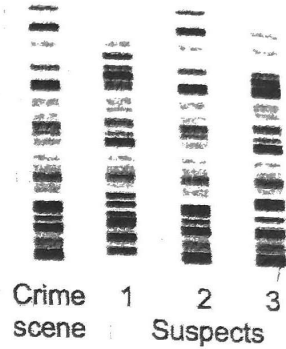
- RFLP = restriction fragment length polymorphism
- Analyzes variable lengths of DNA
- Original DNA is cut with restriction enzymes into smaller pieces based on the presence of a specific sequence
- The DNA samples are run through a test called gel electrophoresis, then are compared

What are restriction enzymes?

- Restriction enzymes are enzymes that cut DNA at specific sequences
- For example, the restriction enzyme EcoRI cuts at the sequence "GAATTC" in between the G and the A
  - Original Sequence: CCGATCTTCTAGGAATTCGTAGCCGTA
  - Digested Sequence: CCGATCTTCTAGG AATTCGTAGCCGTA
- Because different people have different DNA sequences, the number of fragments and the size of each fragments will differ

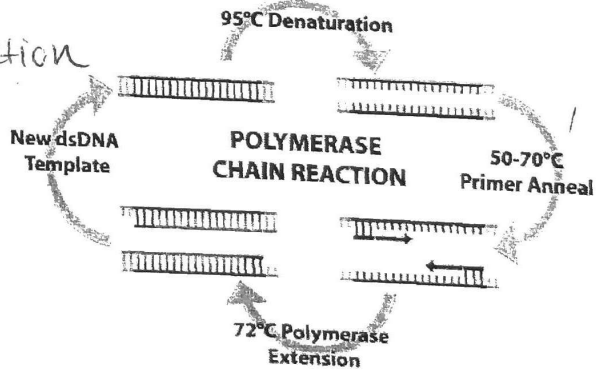
What is gel electrophoresis?

- A technique used to separate digested DNA based on size
- The gel is a matrix made up of a sugar called agarose
- An electric current is run through the gel pulling the negatively charged DNA molecules to the positive end
- The larger pieces stay closer to the wells, and the smaller pieces travel faster and farther
  - Think of traffic on a major highway. Which would you rather be in, a motorcycle or an 18-wheeler? Why?
- The DNA fragments form bands, or patterns in the gel creating a genetic fingerprint
- Banding patterns are compared to match DNA at a crime and to determine familial relations
  - Familial relations will have some bands in common



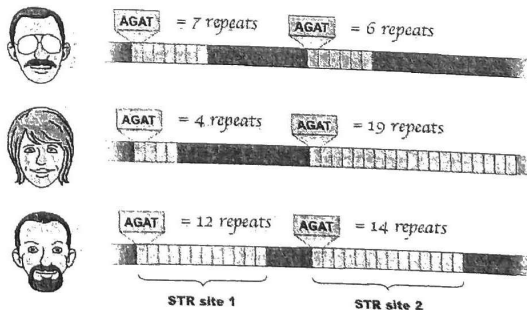
What is PCR?

- PCR = Polymerase chain reaction
- It is used to make millions of exact copies of a specific portion of the DNA
- Allows very small samples to be analyzed, such as a sample of a few skin cells



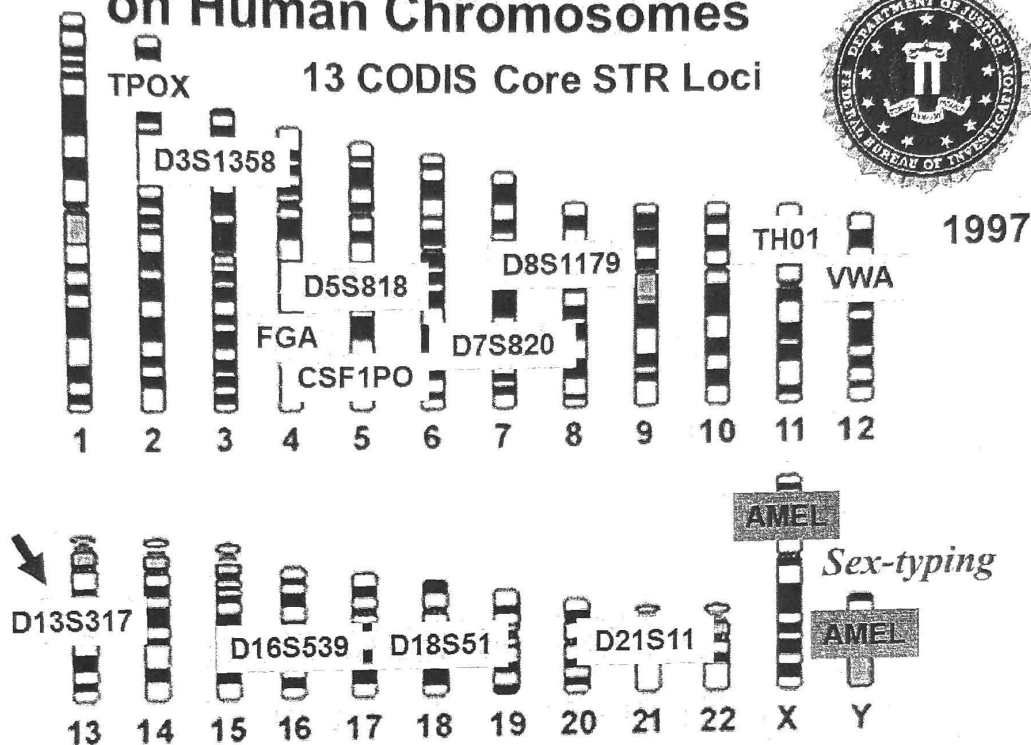
What is STR?

- STR = short tandem repeats
- Locations on the chromosomes that contain short sequences (3-7 bases) that repeat themselves in nuclear DNA
- FBI uses 13 standard specific STR regions for CODIS



# Position of Forensic STR Markers on Human Chromosomes

Core STR Loci for the United States



What is CODIS?

- CODIS = Combined DNA Index System
- National network that helps identify leads for crimes with no suspects
- Uses 13 DNA regions that vary from person to person
- Looks for matches at more than one location on a genome for more accurate results

What is mitochondrial DNA analysis?

- Used for samples that cannot be analyzed using RFLP or STR
- Uses DNA extracted from mitochondrion rather than nuclear DNA
- Especially useful in old cases and old samples

