

DNA Evidence

How is DNA be used to solve crimes?

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 no body can be found.
- DNA can **link crime scenes** together by linking the same perpetrator to different scenes locally, statewide, and across the nation.
- 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 **refute a claim of self-defense** and put a weapon in the suspect's hand.
- It can change a story from an **alibi** to one of **consent**.

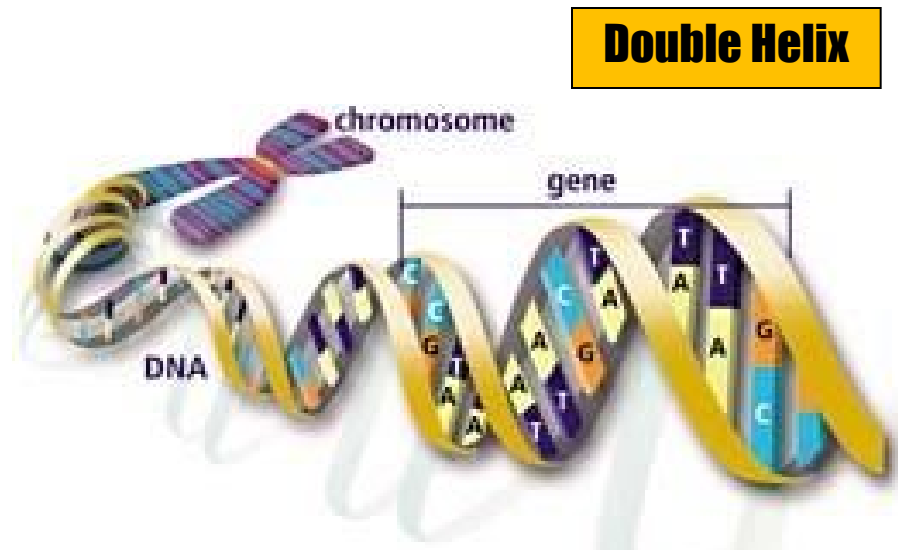


What is DNA?

DNA stands for **deoxyribonucleic acid** and contains **genetic information**. It is found on **chromosomes** located in the nucleus of our cells.

What makes up DNA?

- 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)**.
- The order of the bases determines the **genetic code**. The rungs are unique to each person.



Label the DNA molecule shown below.

Word List:

Cytosine

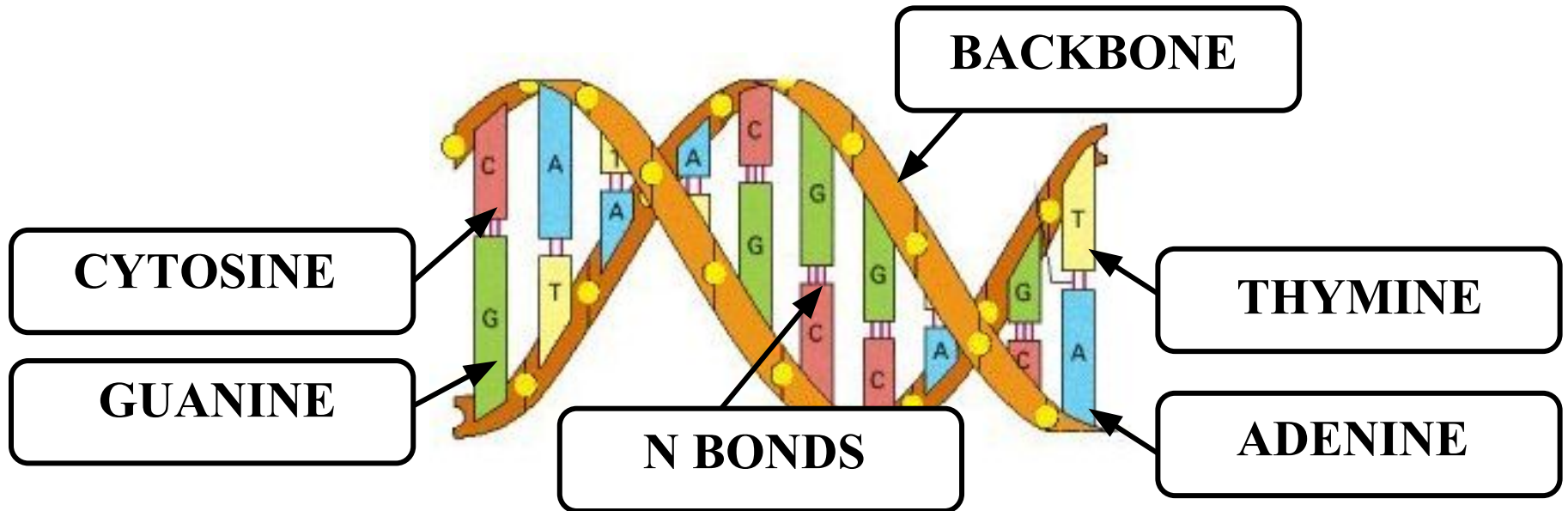
Adenine

Thymine

Guanine

Backbone

Nitrogen (N) Bonds



How does DNA work?

Your inheritable traits are controlled by DNA. DNA controls the production of proteins.

- DNA stores codes for amino acids, amino acids link together to form proteins.

- Three base pairs (a codon) will code for the 20 different amino acids that make proteins.

- C-C-T G-A-G G-A-G

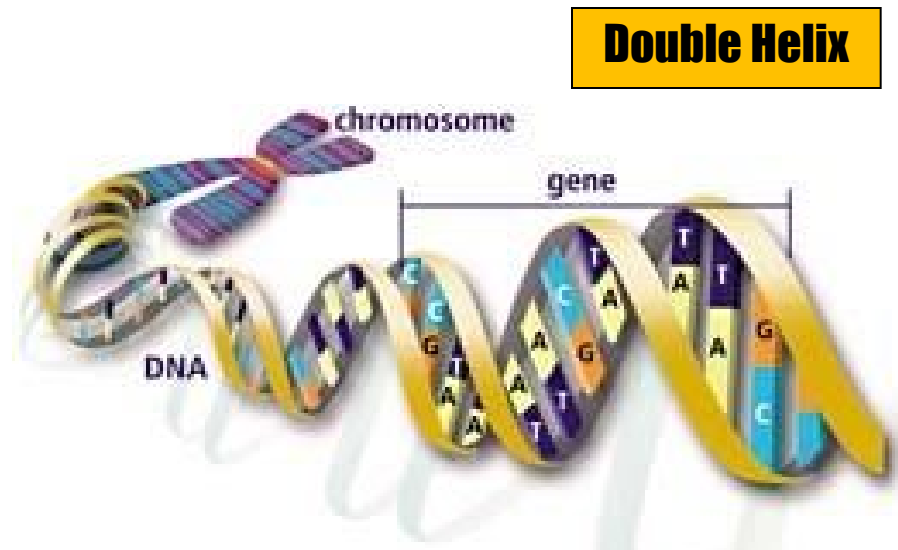
- Proline Glutamate glutamate

- C-C-T G-T-G G-A-G

- Proline valine glutamate

- Sequence one is normal hemoglobin.

- Sequence two is sickle cell hemoglobin.



DNA replication and PCR

DNA replication is the unwinding of DNA to produce a new strand. Nucleotides bind to the free edge to create two identical strands.

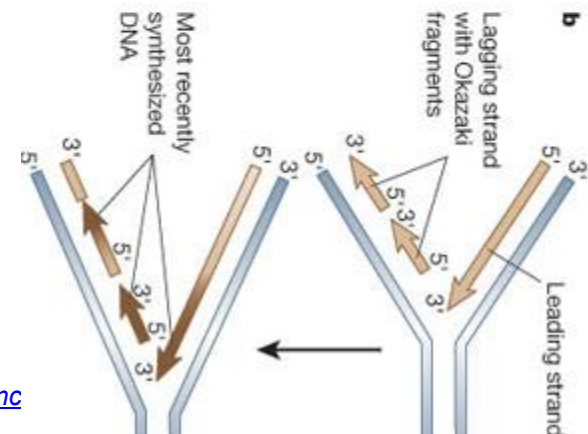
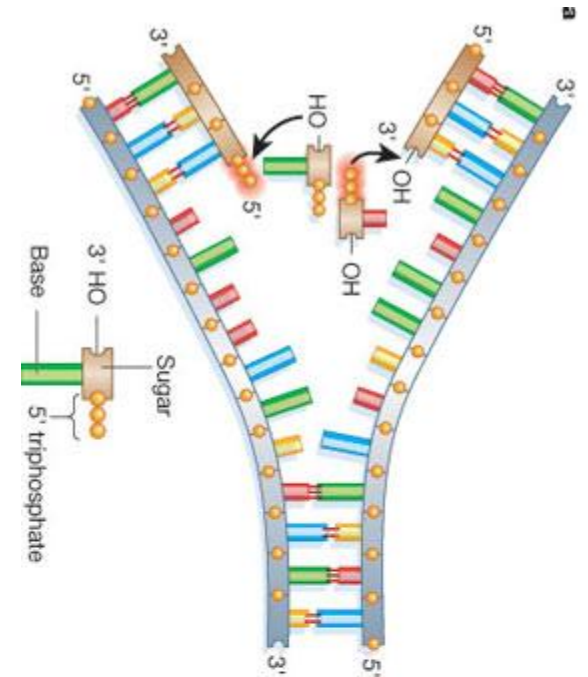
Polymerase Chain

Reaction:

The process of copying DNA strands outside of a living organism.

Can copy DNA a billionfold in a few hours.

Sample size is no longer limiting.



Development of DNA Fingerprinting

DNA profiling didn't exist until the mid-1980s, when an English scientist, Dr. Alec Jeffreys, discovered that certain areas of the DNA strand contain patterns that repeat many times.

VNTR = Variable Number Tandem Repeats.

- The number of these repetitions varies between individuals, and Dr. Jeffreys developed a test to measure the variation in length of these repetitions.

- Using this test, Dr. Jeffreys found that he was able to identify individuals by comparing samples of their DNA. This test became known as RFLP = Restriction Fragment Length Polymorphism.

- RFLP is an accurate and reliable test, but it requires a relatively large amount of DNA to work with.

Laboratories can now use tests based on the Polymerase Chain Reaction (PCR) method, which allows for testing on very small amounts of DNA from biological samples.

DNA Typing

- DNA Typing involves identifying different alleles present at loci (parts of chromosomes) for one or more of the 46 human chromosomes.
- Today we determine the DNA type at 13 specific loci. Population frequencies are known for each allele.

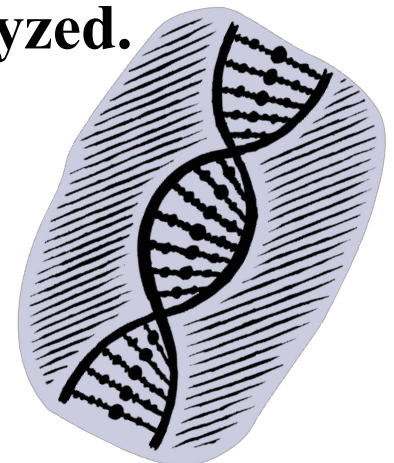
Short Tandem Repeats

Currently we use a method of DNA typing called STR, which looks for 3-7 base pairs which repeat in length in different individuals.

**DNA at the locus of interest is amplified using PCR.
The amplified segments are separated and analyzed.**

Did you know?

Each human cell contains three billion DNA base pairs. Our unique DNA amounts to 0.1% or 3 million base pairs.



What factors affect DNA evidence?

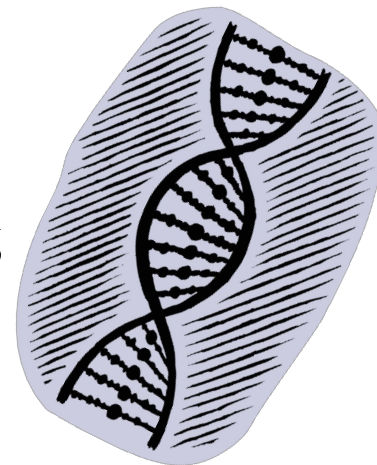
Several factors can affect the DNA left at a crime scene, such as **environmental factors** (e.g., heat, sunlight, moisture, bacteria, and mold). Therefore, not all DNA evidence will result in a usable DNA profile. Further, DNA testing cannot identify when the suspect was at the crime scene or for how long.

What is CODIS?

CODIS stands for **Combined DNA Index System**, which is an electronic database of DNA profiles that can identify suspects. DNA profiles from individuals convicted of certain crimes, such as rape, murder, and child abuse, are entered into CODIS and help officers identify possible suspects when no prior suspect existed.

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Collection of Evidence

Sources:

Blood

Hair

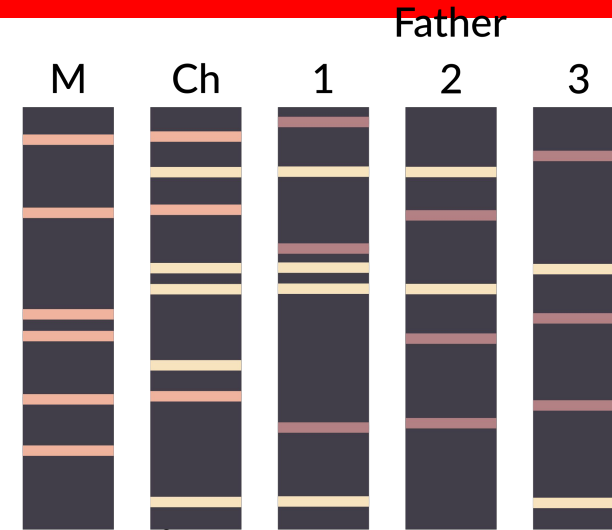
Teeth

Saliva

Semen

Bone

Tissue



1. Assume all samples are infectious and handle with care.
2. Avoid contamination, wear protection to prevent cross contamination.
3. Collect samples from people known to be at scene for elimination.
4. Do not package in airtight containers. This promotes bacterial growth.

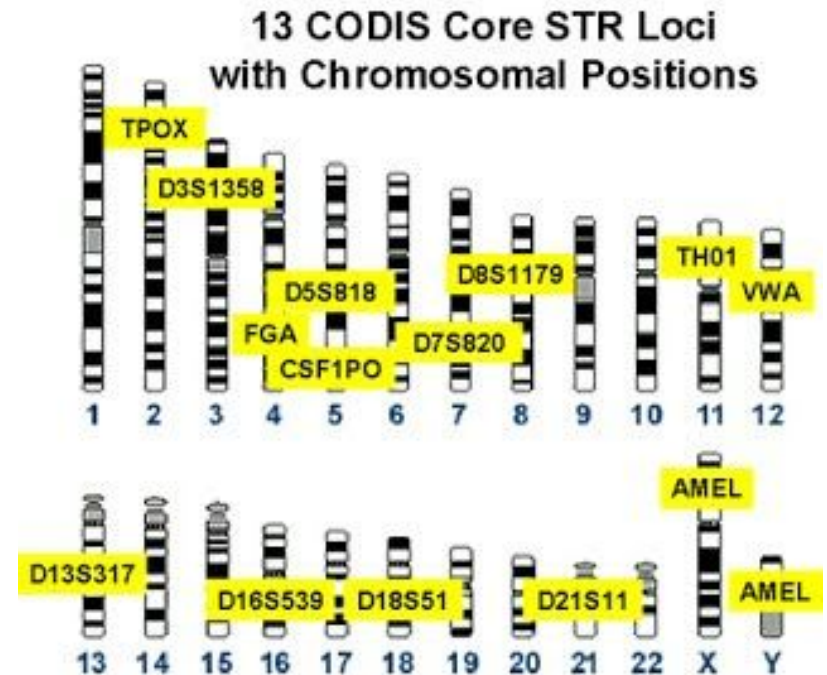
DNA PROFILING USING STR

1. DNA is Extracted
2. PCR amplifies DNA
3. DNA is spliced using restriction enzymes.
4. Gel Electrophoresis



CODIS

- Combined DNA Index System
- Computer database of DNA from convicted offenders, unsolved crime evidence and missing persons.
- Uses STR from 13 Loci for analysis

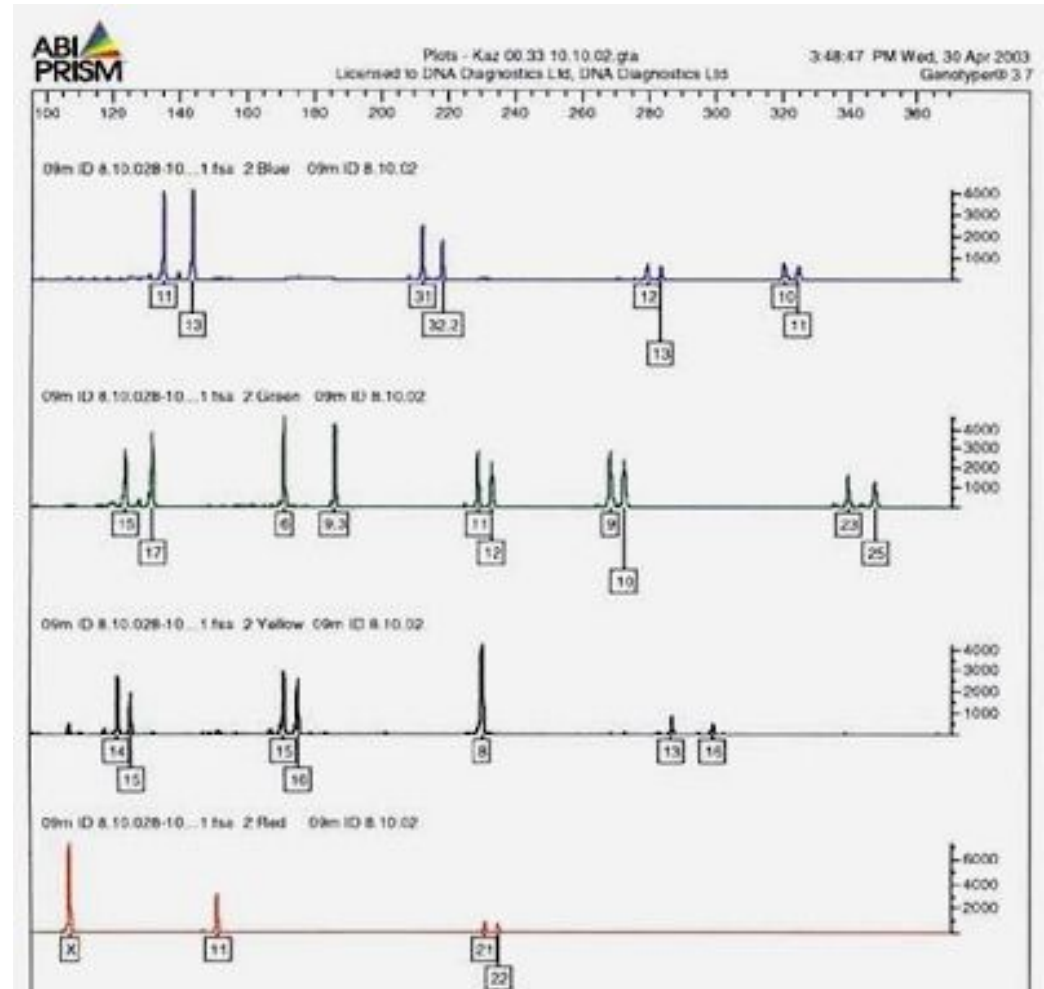


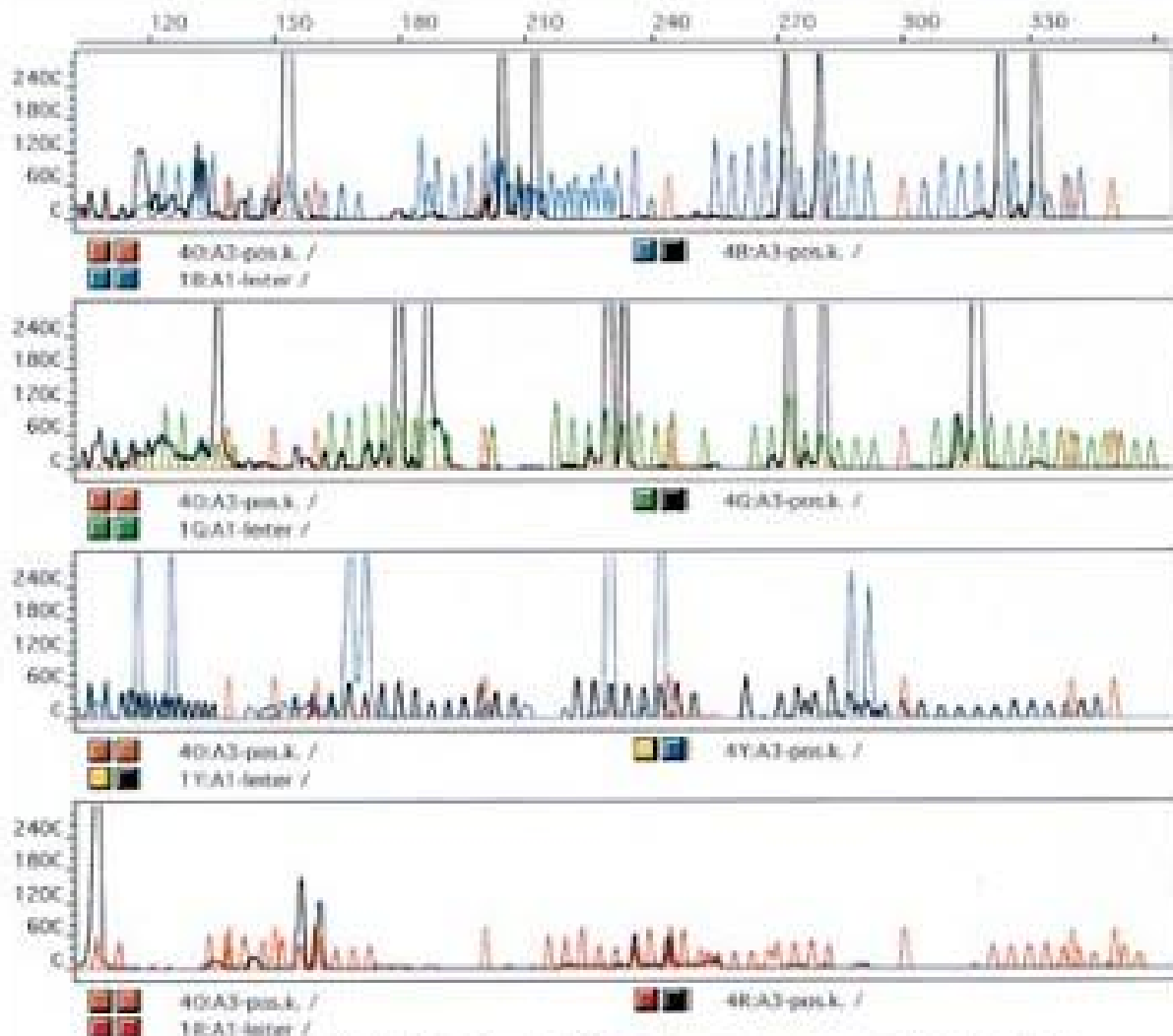
STR profile

The peaks in an STR profile show the alleles that an individual possess.

Two peaks = heterozygous

Numbers = number of repeats





<https://writersforensicsblog.wordpress.com/category/blood-analysis/>