DNA Footprints

Since Sir Alec Jeffreys developed the concept of the DNA profile for the identification of people, this type of forensic technique has taken on significant importance. A practically unmistakable genetic footprint can be established that allows for the correlation of evidence found at the scene of a crime (hair, semen, blood samples) with a suspect. In addition, the use of this technique is a key element to determine the genetic link in kin relationships.

SWAB
For saliva samples. Then it is immersed in a solvent solution and the DNA extracted.

1 Sample Collection

Any body fluid, such as urine, blood, semen, sweat, and saliva, or fragments, such as tissues, cells, or hairs, can be analyzed to obtain a person's DNA. There is generally always something left at the scene that can be used as a sample.

Each sample is placed in separate plastic bags, sealed, and certified to avoid adulterations.

Only a very small amount of evidence is needed for sampling. For example, just a small fraction of a drop of blood or sperm is sufficient.

FACTORS THAT ALTER DNA

Moisture or water will denaturalize a sample faster.

Heat is one of the most destructive factors.

2 DNA Separation

HAIR FOLLICLE
A follicle has DNA that is easy to obtain.

TWEEZERS
must be properly sterilized.

LABELING
is absolutely necessary so that the samples are not mixed up.

1 HAIR DIGESTION
The hair is divided into sections. These are then put into a tube, and solvents are applied.

2 CENTRIFUGING
The suspended DNA must be centrifuged to separate it from the rest of the cell material.

MICROPIPETTE
Only the substance floating on the surface is extracted. This is where the DNA is.

3 PRECIPITATION
A 95 percent solution of ethanol is added; the sample is shaken and then centrifuged at a higher speed than before.

Surface-floating substance and pellet

DISPOSABLE MATERIAL
All the material that is used must be disposable to avoid contaminating the DNA.

4 SURFACE-FLOATING SUBSTANCE
A 70 percent solution of ethanol is added, and the mixture is rinsed with water. The DNA is free of impurities and ready for analysis.

DNA and pellet of leftover materials

3 DNA Magnification

The polymerase chain reaction (PCR) is carried out by a machine that, using heat, synthetic short nucleotide sequences, and enzymes, copies each fragment of DNA as many times as needed. This amplification makes it possible to conduct a large number of tests while conserving the DNA. Later the DNA fragments are separated by means of capillary electrophoresis.

Visualization of the DNA as curves on the monitor

4 Impression and Comparison

The machine presents the results as curves, where each base has a specific location according to the height of the curve in the graph sequence. It then compares the sample obtained at the crime scene with those obtained from the crime suspects. If one of them was at the scene of the crime, the curves coincide exactly in at least 13 known positions.

DNA-EVIDENCE GRAPH

The numbers represent a position in the DNA sequence.

100 105 110

CYTOSINE GUANINE THIAMINE ADENINE

DNA GRAPH FOR SUSPECT A

COINCIDENCE OF GENETIC PATTERNS

DNA GRAPH FOR SUSPECT B

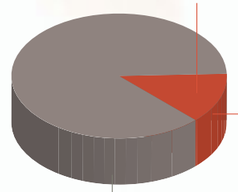
13 locations

is the minimum number of coinciding points that need to be found for a suspect to be accused of a crime in the United States.

Power of Exclusion (PE)

Overall, for a DNA test to be considered as valid criminal evidence, at least in theory, it should be able to guarantee a PE with a certainty above 99.9999999 percent. The PE is measured as a percentage but is expressed as the number of people who are excluded as possible bearers of the DNA at the crime scene. Thus, a sample is taken at random from one person, as a type of witness, and it is then compared with the DNA from the evidence and that of the suspect. The detail of the analysis must be so precise that it can, at least theoretically, be able to discriminate one person among one billion people. In practice, the test is valid if it statistically discriminates one person in one billion. All this is done to guarantee the results of the test and so that it can have validity in court. In practice, the suspects are not chosen randomly but fulfill other evidence patterns, among which DNA is used to confirm these patterns.

1 in 1,000,000,000
is the STATISTICAL GUARANTEE.



6,500,000,000
is the WORLD'S POPULATION.

GUARANTEED POWER OF EXCLUSION

Filial DNA	1:100 million
Forensic DNA	1:1 billion