18/MHS07/044

PHA 210

Assignment: Explain the applications of DNA fingerprinting in Medical Biotechnology.

Answer:

DNA fingerprinting is based on the distribution of small repetitive elements called "minisatellites" that are contained in the cellular DNA, or deoxyribonucleic acid, of an organism. The technique is also known as DNA profiling, DNA typing or genetic fingerprinting. Since each cell of an organism contains the same DNA, the technique can be used to identify individuals. Several techniques are available to visualize the distribution pattern of mini-satellites with applications in genetic research, paternity testing, family genealogy, agriculture and forensic genetics for crime investigation.

1. Identification of diseases passed through family
2. Helps in finding cure for genetic diseases
3. Matches tissues of organ donors to people who need transplant
4. Genetic Research

[DNA](https://www.webmd.com/a-to-z-guides/dna-fingerprinting) fingerprinting is a chemical test that shows the genetic makeup of a person or other living things. It’s used as evidence in courts, to identify bodies, track down [blood](https://www.webmd.com/heart/anatomy-picture-of-blood) relatives, and to look for cures for disease.

**Your Genetic Map**

DNA is short for deoxyribonucleic acid, which is inside of every cell in your body. It’s a chain of chemical compounds that join together to form permanent blueprints for life.

These compounds are called bases, and there are 4 of them. They pair up with another to form what are called base pairs. Your DNA has about 3 billion of these couples. The way they’re strung together tells your cells how to make copies of each other.

The complete set of your compounds is known as a genome. More than 99.9 % of everyone’s genome is exactly alike (100% if you are identical twins). But the tiny bit that’s not is what makes you physically and mentally different from someone else.

DNA fingerprinting uses chemicals to separate strands of DNA and reveal the unique parts of your genome. The results show up as a pattern of stripes that can be matched against other samples.

Since it was invented in 1984, DNA fingerprinting most often has been used in court cases and legal matters. It can:

• Physically connect a piece of evidence to a person or rule out someone as a suspect.

• Show who your parents, siblings, and other relatives may be.

• Identify a dead body that’s too old or damaged to be recognizable.

DNA fingerprinting is extremely accurate. Most countries now keep DNA records on file in much the same way police keep copies of actual fingerprints.

It also has medical uses. It can:

• Match tissues of organ donors with those of people who need transplants.

• Identify diseases that are passed down through your family.

• Help find cures for those diseases, called hereditary conditions.

**Fingerprint Test**

To get your DNA fingerprint, you would give a sample of cells from your body. This can come from a swab inside your [mouth](https://www.webmd.com/oral-health/anatomy-of-the-mouth), from your [skin](https://www.webmd.com/skin-problems-and-treatments/picture-of-the-skin), the roots of your [hair](https://www.webmd.com/skin-problems-and-treatments/picture-of-the-hair), or your [saliva](https://www.webmd.com/oral-health/what-is-saliva), sweat, or other body fluids. [Blood](https://www.webmd.com/a-to-z-guides/rm-quiz-blood-basics) is usually the easiest way. Lab workers treat the sample with chemicals to separate the DNA, which is then dissolved in water.

Your DNA is cut into smaller segments with another chemical process to get sections of 5 to10 base pairs that repeat themselves. Technicians copy those tiny sections millions of times to make the samples longer for easier study.

Lab workers take those strips of DNA and mix them into a gel. Then they run an electric current through the gel, which separates smaller strands of DNA from the larger ones. A dye added to the gel makes the DNA strips stand out when they’re placed against an ultraviolet light or lit up with a laser.

The more these short segments are tested, the more accurate the DNA profile will be. The strips will show a barcode-like pattern that can then be compared to the results from another sample of DNA to find a match.

In 1984, Alec Jeffreys, a British geneticist, identified the presence of minisatellites within the boundaries of genes. These minisatellites do not contribute to the functioning of genes and are distributed throughout the cellular DNA of an organism in a unique and inheritable pattern. The DNA fingerprint can be revealed by processing cells collected from individuals through one of several different techniques. These different techniques for genetic fingerprinting have been applied to identify and isolate disease genes, develop cures for diseased genes, and diagnose genetic diseases.

**Paternity Testing**

Testing paternity samples requires the collection of cells and comparison of DNA fingerprints from and between children and potential parents. Children will have a mix of DNA fingerprints inherited from each parent. When a child is conceived, each parent provides half of the genetic information. Most often the test is performed when the mother of the child is known but the father is in question. Since it is highly unlikely that any two people will have the same genetic fingerprint, paternity testing using DNA fingerprints is a reliable way to determine the parentage of a child. Paternity testing can be especially important when the rights and duties of the father are in issue and a child's [paternity](https://en.wikipedia.org/wiki/Father) is in doubt. Tests can also determine the likelihood of someone being a biological grandparent. Though [genetic](https://en.wikipedia.org/wiki/Genetics) testing is the most reliable standard, older methods also exist, including [ABO blood group typing](https://en.wikipedia.org/wiki/Blood_type), analysis of various other [proteins](https://en.wikipedia.org/wiki/Protein) and [enzymes](https://en.wikipedia.org/wiki/Enzyme), or using [human leukocyte antigen](https://en.wikipedia.org/wiki/Human_leukocyte_antigen) [antigens](https://en.wikipedia.org/wiki/Antigen). The current techniques for paternity testing are using [polymerase chain reaction](https://en.wikipedia.org/wiki/Polymerase_chain_reaction) (PCR) and [restriction fragment length polymorphism](https://en.wikipedia.org/wiki/Restriction_fragment_length_polymorphism) (RFLP). Paternity testing can now also be performed while the woman is still pregnant from a blood draw.

**Genetic Forensics for autopsy**

A crime scene can contain biological samples, including blood, semen, saliva, skin, urine and hair, from perpetrators, victims and bystanders that can be processed to provide DNA fingerprints. The DNA fingerprints obtained are used to search existing databases for matches and to identify victims or suspects. The biological evidence and the DNA fingerprints can be used in trials to help prove guilt or innocence. The United States military has been storing DNA fingerprints of all military personnel for identification of casualties and those missing in action. The military has found the technology to be superior to identification methods used previously.

**DNA profiling**

The [DNA](https://en.wikipedia.org/wiki/DNA) of an individual is the same in every somatic (nonreproductive) [cell](https://en.wikipedia.org/wiki/Cell_(biology)). [Sexual reproduction](https://en.wikipedia.org/wiki/Sexual_reproduction) brings the DNA of both parents together to create a unique combination of genetic material in a new cell, so the genetic material of an individual is derived from the genetic material of each parent in equal amounts; this genetic material is known as the nuclear [genome](https://en.wikipedia.org/wiki/Genome) of the individual, because it is found in the [nucleus](https://en.wikipedia.org/wiki/Cell_nucleus).

Comparing the DNA sequence of one person to that of another can prove if one of them was derived from the other, but DNA paternity tests are not currently 100% accurate. Specific sequences are examined to see if they were copied verbatim from one individual's genome; if so, then the genetic material of one individual could have been derived from that of the other (i.e. one is the parent of the other). Besides nuclear DNA, [mitochondria](https://en.wikipedia.org/wiki/Mitochondrion) also have their own genetic material called [mitochondrial DNA](https://en.wikipedia.org/wiki/Mitochondrial_DNA). Mitochondrial DNA comes only from the mother, without any shuffling.

Proving a relationship based on comparison of the mitochondrial genome is much easier than that based on the nuclear genome. However, testing the mitochondrial genome can prove only if two individuals are related by [common descent](https://en.wikipedia.org/wiki/Common_descent) through maternal lines only from a common ancestor and is, thus, of limited value (i.e., it could not be used to test for paternity).

In testing the paternity of a male child, comparison of the [Y chromosome](https://en.wikipedia.org/wiki/Y_chromosome) can be used, since it is passed directly from father to son.

In the US, the [AABB](https://en.wikipedia.org/wiki/AABB) has regulations for DNA paternity and family relationship testing, but AABB accreditation is not required. DNA test results are legally admissible if the collection and the processing follows a chain of custody. Similarly in Canada, the SCC has regulations on DNA paternity and relationship testing, but this accreditation, while recommended, is not required.

The Paternity Testing Commission of the [International Society for Forensic Genetics](https://en.wikipedia.org/wiki/International_Society_for_Forensic_Genetics) has taken up the task of establishing the biostatistical recommendations in accordance with the [ISO/IEC 17025](https://en.wikipedia.org/wiki/ISO/IEC_17025) standards.[7] Bio-statistical evaluations of paternity should be based on a likelihood ratio principle - yielding the [Paternity Index](https://en.wikipedia.org/wiki/Paternity_Index), PI. The recommendations provide guidance on concepts of genetic hypotheses and calculation concerns needed to produce valid PIs, as well as on specific issues related to [population genetics](https://en.wikipedia.org/wiki/Population_genetics).