

DNA Fingerprinting

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DNA Fingerprinting: Role in Law, Medicine, and National Security

Context:

DNA fingerprinting is a key tool in **forensic science, criminal investigations, ancestry tracing, and medical research**. It identifies individuals using **DNA polymorphisms**, aiding justice, security, and genetic studies.

What is DNA?

- **Deoxyribonucleic Acid (DNA)** is the genetic material in **skin, blood, bone, and teeth**.
 - Humans have **46 chromosomes (23 from each parent)**.
 - Chromosomes contain **genes** that determine traits like **eye color and disease susceptibility**.
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DNA Polymorphisms & Identification

- **Variations in DNA sequences** that distinguish individuals.
 - Used for **crime-solving, paternity testing, and ancestry tracing**.
 - Forms the basis of **DNA fingerprinting**.
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Short Tandem Repeats (STRs)

- **Repeated DNA sequences** (e.g., GATC-GATC-GATC).

- Unique to individuals, making them useful for:
 - **Forensic identification.**
 - **Parent-child testing.**
 - **Genetic studies.**
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Polymerase Chain Reaction (PCR)

- **Amplifies DNA** for analysis.
 - Key steps:
 1. **DNA Extraction** from blood, bones, saliva, etc.
 2. **Denaturation (95°C)** - DNA strands separate.
 3. **Annealing (60°C)** - Primers bind.
 4. **Extension (72°C)** - DNA polymerase creates new strands.
 5. **Repetition** - Multiplies DNA.
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What is a DNA Fingerprint?

- **Unique genetic profile** based on STR variations.
 - Created using **Capillary Electrophoresis.**
 - **Sources:** Teeth, bones, blood, saliva, semen, skin cells.
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Relevance to UPSC & Governance

- **Forensic Science & Justice:** Solves crimes, prevents wrongful convictions.
- **National Security:** Identifies terrorists, missing persons.
- **Medical Research:** Helps in disease studies, organ transplants.
- **Ethical Issues:** Privacy concerns over DNA databases.



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