DNA Fingerprinting & Nanotechnology

DNA fingerprinting / DNA profiling / DNA barcoding:

- DNA fingerprinting is used to establish the identity of a person or organism based on differences and similarities in DNA.
- DNA profiling was developed in 1984 by Sir Alec Jeffreys of the UK.
- In 1988, this technology was developed in CCMB Hyderabad in India. CCMB stands for Centre for Cell and Molecular Biology.
- In DNA fingerprinting, entire genomics is not used but only some sequence is used to identify a person.
  - In DNA, there are some specific sequences known as VNTR or STR- Variable Number of Tandem Repeats and Short Tandem Repeats. Based on this sequence, the DNA is identified.
  - Every human being or every organism has VNTR or STR but their number, position and size are different in every organism or human being for analysis of these VNTRs or STR. The similarity and differences in DNA are established.

Technology used in DNA Profiling

- **PCR (Polymerase Chain Reaction):** It is used to increase the quantity of the DNA; in case we get less DNA.
- **SBT (Southern Blotting Technology):** This helps to identify the specific segments of VNTR and STR of the DNA sample.
- **Electrophoresis:** Organic molecules (like DNA, and RNA protein) can be arranged based on charge and molecular weight.

Applications of DNA profiling

- **Forensic investigation**
  - For the identification of criminals.
  - For the identification of a dead body.
  - Also used for paternity tests. (Father) famous case N.D. Tiwari's case was resolved through it to identify the kid or baby.

- **Health care**
  - To identify the genetic disorder.
  - Pedigree analysis - There is a 25% chance that a particular gene or disease is carried to offspring or the next generation.

- **In the conservation of biodiversity**
  - To identify the animals and different species.
  - To stop the smuggling and hunting of animals. E.g.; To identify dead tigers in other countries.

Some Other DNA Profiling Related Technology:

- **Northern Blotting Technology:** To identify RNA segments.
- **Western Blotting Technology:** To identify the protein.

Nanotechnology

Substance at different scale changes properties. If we bring down an element or material at the nanoscale. Then the material will start showing different and new properties, which are quite different from the properties at the macro scale.

Methods of Nanotechnology

- **Top-Down Method**
  - In the top-down method, molecule at the bulk level (macro) is converted into fragments (micro) and then at nanoscale.
  - It is a time consuming and expensive method.
  - It is not suitable for large-scale production.
  - It is important for initial laboratory experimentation.

- **Bottom-Up Method**
  - In the bottom-up method, atoms (10-12) are converted into molecules and then at the nanoscale.
  - It is suitable for the mass production of complex nanostructures.
  - It takes less time as it is based on chemical synthesis or reaction.
  - This is more popular but expensive at present.

Important Instruments of Nanoscience and Technology:

- Atomic Force Microscope
- Scanning, and Tunneling Microscope

Richard Feynman in 1959, in his research paper, “There is plenty of room at the bottom”, suggested to work on nanotechnology.

Applications of Nanotechnology

- Silver can be used as medicine because it can kill bacteria at the nanoscale.
- Aluminum silicate makes glass resistant.
- Virus-killing masks can be produced.
- They find applications in cosmetics, waterproof clothing etc.

Additional Information

- Nanoscale - anything in the size range of 10–9 m.
- At milli scale, through silver, we can get coins, utensils, and jewellery.
- At the micro-scale, we realized it is the best conductor, which are used in mobile phones and laptops.
- At nano scale, Silver starts killing bacteria, which is used as a silver nanocrystal in medicine.