DNA Identification Techniques

Prelims: Current events of National Importance

Why in News?

After the Air India Boeing 787 Dreamliner crash in Ahmedabad, authorities are using DNA analysis to identify the remains of those killed in the accident.

- **DNA Identification -** Every person ***has a unique DNA*** that is present in nearly every cell of their body except identical twins.
- DNA identification is the gold standard for identifying human remains, especially after mass fatality events in which bodies might not be easy to identify otherwise.
- As soon as an individual dies, their DNA begins to degrade.
- Over time, this degradation can make it difficult, even impossible, for the DNA to be analysed.
- The extent of degradation depends on the kind of tissue DNA is extracted from and the conditions in which the body is kept, among other factors.
- **Sample Collection & Storage** - DNA survives much better in cold and dry conditions than in hot and humid conditions.
- So, samples must be collected as soon as possible, and once collected, stored in as cool and dry an environment as possible.
- They should ideally be ***frozen at minus 20 degrees Celsius***, or, in the case of soft tissues (skin, muscles, etc.), they may be stored in 95% ethanol.
- DNA from soft tissues degrades much faster than that from hard tissues (bones and teeth).
- This is because cells in hard tissues are largely protected from the effects of putrefaction and decomposition, forensic investigators usually collect DNA from hard tissue.
- **Reference Matching** - To identify who the collected DNA belongs to, reference samples are collected from biological relatives.
- Parents and children of the victim are ideal candidates for providing these samples, given that they share 50% of each other's' DNA.
- **Analysis Methods -** After the samples are collected, the next step is to extract DNA from them.
- Subsequently, depending on the quality of the collected DNA, scientists can choose between a number of different methods of analysis.
- **Short tandem repeat (STR) analysis** - The method evaluates short tandem repeats, which are essentially short repeating sequences of DNA.
- STRs are used for DNA identification as they widely vary between individuals.
- **Mitochondrial DNA (mtDNA) analysis -** This method is used when nuclear DNA is degraded or unavailable.

- Mitochondrial DNA is found within the cell's energy-producing organelles known as mitochondria.
- As mtDNA is present in multiple copies within the cell, it is easier to recover from human remains that are not well preserved.
- **Y chromosome analysis -** Humans have two types of sex chromosomes, X and Y - biological males typically have one X and one Y chromosome, and biological females typically have two X chromosomes.
- **Single nucleotide polymorphisms (SNPs) analysis** - The method is typically used when the DNA to be analysed is highly degraded.
- A SNP is a variation in the DNA sequence where a single base — A, C, G, or T — at a specific location differs among people.
- Given that SNPs are unique to each person, they can be used for identification purposes with the help of reference samples taken from the victim's personal belongings such as a toothbrush and hairbrush.

Reference

[The Indian Express | How DNA identification works]