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DNA Test

The process of DNA fingerprinting to solve crimes

A look at the process of DNA fingerprinting and how it is used to solve crimes.

Last month, Delhi Police recovered bones from the Mehrauli forest area in connection with the Shraddha Walkar murder investigation. DNA testing conducted on the bones — parts of the jaw, pelvis and lower limb — has now confirmed a positive match with Shraddha's father. Further examination of the bones will be conducted to ascertain the cause of death and time period, sources say. Given that Walkar's body was allegedly dismembered and disposed of by her live-in partner Aaftab Poonawala, DNA (Deoxyribonucleic acid) evidence is crucial in this case.

The Origin Of DNA Fingerprinting

DNA fingerprinting was first developed in 1984 by Alec Jeffreys in the UK, after Jeffreys discovered that no two people could have the same DNA sequence. Within three years of the discovery, the UK achieved the world's first conviction based on DNA evidence in a case of rape and murder.

Lynda Mann, a 15-year-old girl, had been found raped and murdered in Narbourough, England. This was followed by a similar rape and murder case three years later in the same area. The police arrested one Richard Buckland, who confessed to both crimes. However, when his samples were checked against those found on the dead bodies — they didn't match. Subsequently, Buckland was exonerated and another man, Colin Pitchfork, arrested and convicted of the murders.

How is DNA fingerprinting done?

Each person's DNA, except for identical twins, is unique. By analyzing selected DNA sequences (called loci), a crime laboratory can develop a profile to be used in identifying a suspect.

DNA can be extracted from many sources, such as hair, bone, teeth, saliva, and blood. Because there is DNA in most cells in the human body, even a minuscule amount of bodily fluid or tissue can yield useful information. Samples may even be extracted from used clothes, linen, combs, or other frequently used items.

In the Walkar case, DNA from the recovered bones and that of Shraddha's father has been compared, with the similarity marking close consanguineal relations.

According to a US Congressional Research Service report, DNA evidence is used to solve crimes in two ways:

- If a suspect is known, that person's DNA sample can be compared to biological evidence found at a crime scene to establish whether the suspect was at the crime scene or whether they committed the crime.
- If a suspect is not known, biological evidence from the crime scene can be analyzed and compared to offender profiles in existing DNA databases to assist in identifying a suspect.

Beyond its accuracy, DNA fingerprinting can also sift through crime scene evidence in different ways, previously unavailable to investigators. For instance, advanced DNA fingerprinting can make separate prints of various individuals even from a sample mixture found at the crime scene — this is of help during gang rape investigations as each perpetrator can be individually identified.

DNA fingerprinting comes to India

By 1988, Lalji Singh, who had been in the UK from 1974 to 1987 on a Commonwealth Fellowship, developed DNA fingerprinting for crime investigations at the Centre for Cellular and Molecular Biology (CCMB) in Hyderabad. Today, Lalji Singh, who passed away in 2017, is known as "the father of DNA fingerprinting in India."

In 1989, DNA fingerprinting was first used in a case by the Kerala Police. By the early 1990s, the technology had begun to be used for establishing paternity, and to link criminals and identify victims in sensational crimes. From the 2000s onwards, the technology became a staple in rape cases where vaginal swab samples were matched with semen samples from suspects.

What is DNA fingerprinting?

It is a technique by which a person can be identified by examining their DNA.

DNA

- DNA, or deoxyribonucleic acid, is the basic building block of life. This component of cells contains all the information about an organism and also helps in transferring the characteristics to the next generation. Most of the DNA is found in the nucleus of the cell, hence it is called central DNA. James Watson and Francis Crick discovered that DNA is a double-helix polymer in the year 1953.
- Each individual's DNA is made up of the bases (adenine (A), thymine (T), guanine (G), and cytosine (C)), sugar, and phosphate. Two bases join each other using hydrogen bonds to form a base pair. Every human has three billion such base pairs. Although 99.7% of makeup is the same between any two people; There is a difference of 0.3% which accounts for about 10 million different base pairs. By examining this we can identify the relationship between two people. There is a 50% match between a child and its father or mother. Among siblings, it can be anywhere between 25% to 75%. Monozygotic twins show 100% matching,".

DNA fingerprinting Process

- DNA is isolated from the available sample. Each type of sample has a specific protocol for isolation. The DNA fragments are then amplified using a reaction called polymerase chain reaction (PCR).
- A small piece of DNA can turn into a thousand to millions of copies. This amplified DNA sample then undergoes a technique called gel electrophoresis, which separates it into distinct visible bands. The banding pattern formed by an individual's DNA is unique. The bands from two or more DNA samples can then be compared using software.

Challenges With DNA Fingerprinting In India

It is vital to ensure that the DNA of the investigators does not get mixed with that of the victims or the suspects. Thus, picking up samples from a crime scene with sterile tools and storing samples in a proper manner are crucial for the evidence to stand a judicial test.

While India has rules and guidelines regarding this, India's police forces have a lot of catching up to do with counterparts overseas. While central agencies such as CBI have the expertise to ensure that crime scenes are protected and correct procedure is followed, state police forces are inadequately trained or fully equipped.

"The Aarushi Talwar murder case of 2008 is a prime example. Because the crime scene was not made out of bounds, both police and media trampled all over it. Now the case has no evidence to conclusively establish who killed the 14-year-old girl."

The problem, however, is not limited to the police. The capacity for DNA fingerprinting in the country itself is lacking. DNA fingerprinting is available only at a few places — Maharashtra, West Bengal, Delhi, Hyderabad and Chandigarh. Advanced practices in the technology are limited to the Centre For DNA Fingerprinting and Diagnostics (CDFD) in Hyderabad.

Why Concern ?

- The Supreme Court has expressed concern over the increasing use of deoxyribonucleic acid (DNA) test in court cases. Because DNA test has been demanded in a large number of complaints made. According to the government laboratory, such demands are increasing by about 20% annually.
- Although the 3,000-odd DNA tests performed annually by Indian laboratories are insignificant compared to the 70 other countries that rely on DNA technology, the increase in demand raises concerns regarding privacy and potential data abuse.
- DNA testing in the realm of justice has always been under suspicion, it remains a popular requirement to uncover the truth whether as evidence in a criminal case, a claim of marital infidelity or to prove paternity. and be at risk of self-crime and invasion of personal privacy.
- It focuses on the expansion of technology to improve the process of justice but it also violates the privacy of people. At the same time, as part of the right to life under Article 21, the Supreme Court accepted that bodily autonomy and privacy are part of the fundamental right.

Ethical principles and guidelines for medical research involving human subjects in the world:

- universal declaration of human rights 1948
- Declaration of Helsinki, 1964,
- International Covenant on Civil and Political Rights, 1966 (ICCPR)
- The Belmont Report (1976)
- Broad ethical guidelines for biomedical research on human subjects were finalized by the Indian Council of Medical Research (ICMR) in the year 2000.
- Drugs and Cosmetics Act, 1940 and Medical Council of India Act, 1956 (amended in 2002)

Some famous investigations where DNA fingerprinting was used in india

- **Shiney Ahuja Rape Case :** Despite his maid's statement denying that she was raped, in March 2011, Bollywood actor Shiney Ahuja was convicted and sentenced to seven years of rigorous imprisonment. The fast-track court delivering the verdict relied heavily on DNA evidence, in which semen samples from the vaginal swab of the victim matched with the samples obtained from the accused.
- **Establishing the identity of suicide bomber who killed Rajiv Gandhi :** It was DNA evidence that established the identity of Thenmozhi Rajaratnam who had detonated the bomb that killed ex-PM Rajiv Gandhi and 15 others in 1991. Evidence was gathered from charred flesh and bones found at the site of the explosion.
- **Sheena Bora Murder Case :** DNA from some charred bones were discovered in a forest in Raigad, Maharashtra, in August 2015, and matched with the DNA of media entrepreneur Indrani Mukherjea. Until then, she had maintained that her daughter Sheena Bora was away in the USA.

Expected Questions

Que. Consider the following statements-

1. A small piece of DNA can turn into a thousand to millions of copies.
2. The banding pattern formed by an individual's DNA is unique.
3. The bands from two or more DNA samples can then be compared using software.

Which of the followings statements is/are true?

A. Only 1 B. Only 2

C. 2 and 3 only D. All of the above

Answer : D

Expected Questions & Format

Que.: What is DNA fingerprinting and how it is used to solve crimes. Write about challenges with DNA fingerprinting in india. What are the ethical principles and guidelines for medical research involving human subjects in the world.

Answer Format :

- ❖ Write about DNA fingerprinting and It's uses to solve crimes.
- ❖ Write about challenges with DNA fingerprinting in india.
- ❖ Write about ethical principles and guidelines for medical research involving human subjects in the world.

Note: - The question of the main examination given for practice is designed keeping in mind the upcoming UPSC main examination. Therefore, to get an answer to this question, you can take the help of this source as well as other sources related to this topic.