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# DNA FINGERPRINTING

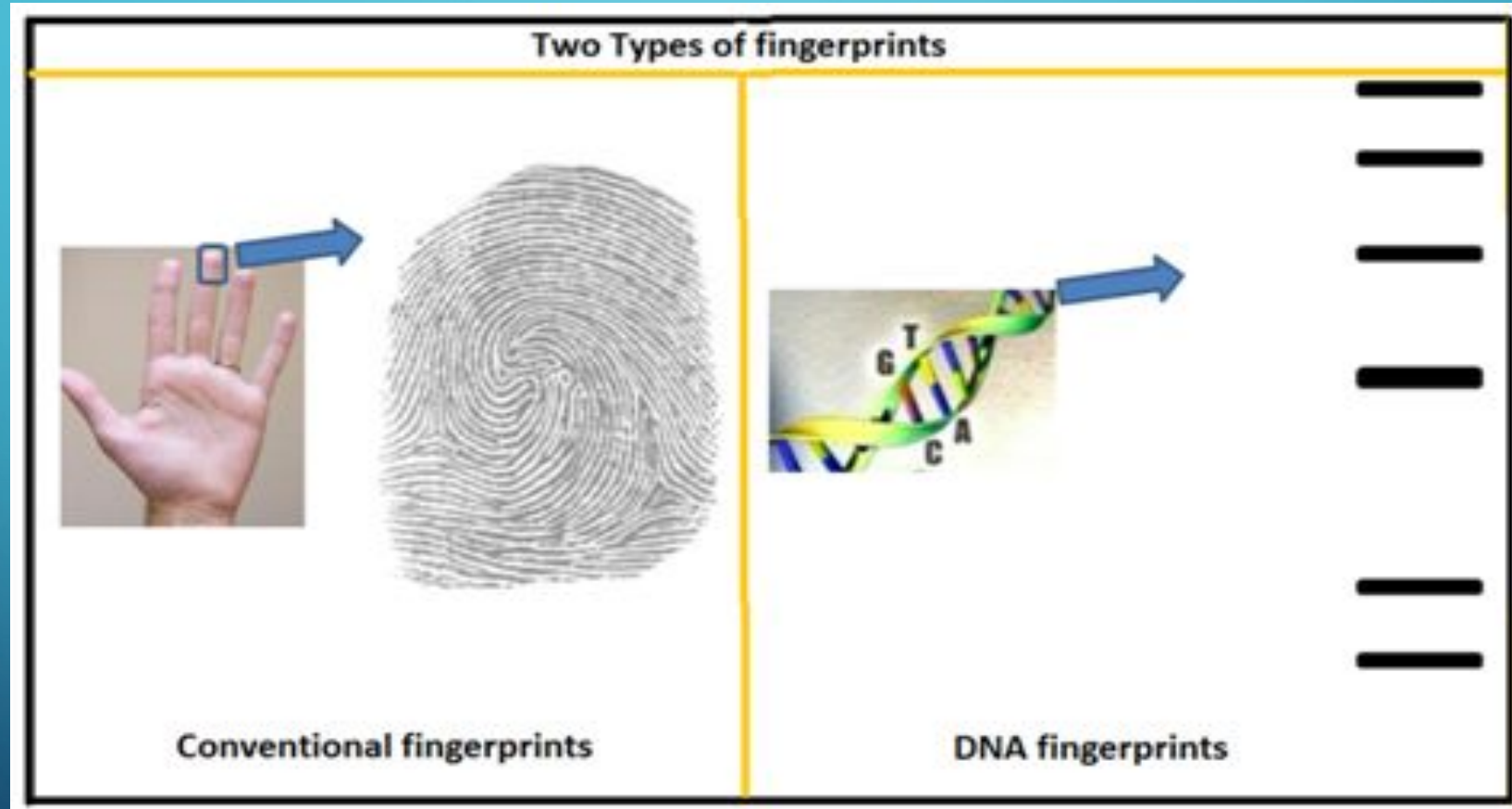


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# DNA FINGERPRINTING

- Also called as DNA Profiling, Genetic Fingerprinting or DNA Typing.
- **DNA fingerprinting** is a method used to identify an individual from a sample of **DNA** by looking at unique patterns in their **DNA**.
- This method of fingerprinting is much effective than **conventional method** because in conventional fingerprinting the finger prints can be **changed by surgery** but the genetic makeup of the individual remains same in every body part and cells.
- Thus, DNA fingerprint method is becoming primary method for identifying an individual.

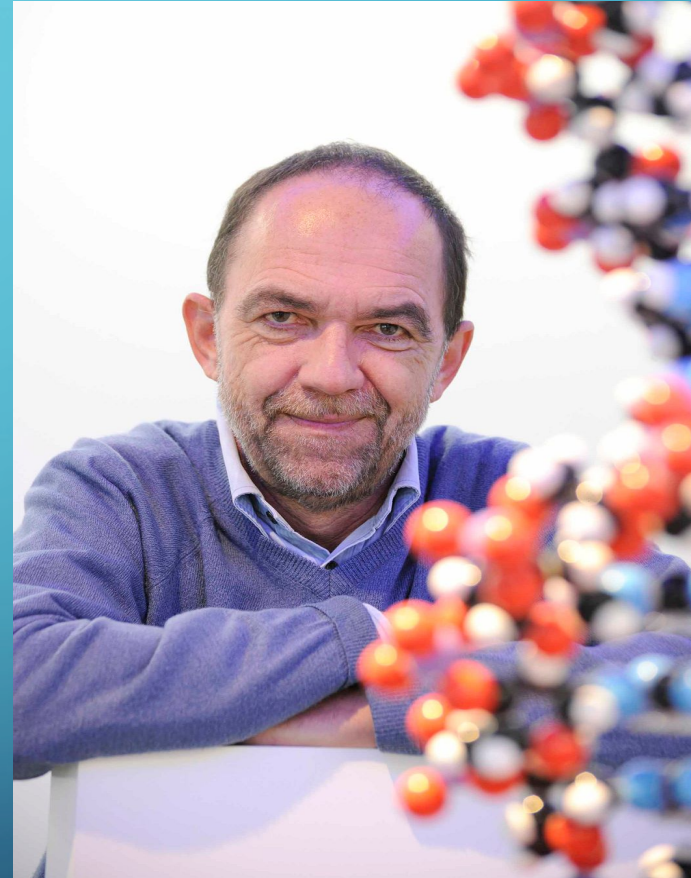
# Conventional VS DNA Fingerprinting





# HISTORICAL VIEW

- An English geneticist, **Dr. Alec J. Jeffreys** from the University of Leicester in Great Britain invented this technique in the year **1984**.
- He found that in the DNA there are DNA sequences which are repeated again and again and the number of repeated sequence is different in different people.
- By finding out the length of the DNA and the number of DNA sequences one can perform the identity test.



# "FATHER OF INDIAN DNA FINGERPRINTING"

- **Lalji Singh** (5 July 1947 – 10 December 2017) was an Indian scientist who worked in the field of DNA fingerprinting technology in India.
- In 2004, he received the Padma Shri in recognition of his contribution to Indian science and technology.
- Singh founded various institutes and laboratories in India, including the Centre for DNA Fingerprinting and Diagnostics in 1995.



# PRINCIPLE OF DNA FINGERPRINTING

- The DNA of every human being on the planet is 99.9% same. However, 0.1% of DNA is unique to the individual that makes all the difference.
- Human genome pos-sesses numerous small non-coding but inheritable sequences of bases which are repeated many times. They do not code for proteins but make-up 95% of our genetic DNA and therefore called the —**junk DNA**.
- They can be separated as the satellite from the bulk DNA and hence called **Satellite DNA**



- In satellite DNA, repetition of bases is in tandem. The **variable number of tandem repeats (VNTRs)** have repeats of 20-25 base pairs.
- Since a child receives 50% of the DNA from its father and the other 50% from his mother, so the number VNTRs at a particular area of the DNA of the child will be different may be due to insertion, deletion or mutation in the base pairs.
- As a result, every individual has a distinct composition of VNTRs, and this is the main principle of DNA fingerprinting.
- Thus, if DNA of any individual is digested with a restriction enzyme, fragments pattern (sizes) will be produced and will be different in cleavage site position. This is the basics of DNA fingerprinting.



# VNTR- VARIABLE NUMBER OF TANDEM REPEATS

Genomic DNA

Coding (very few)

Non- Coding (maximum)

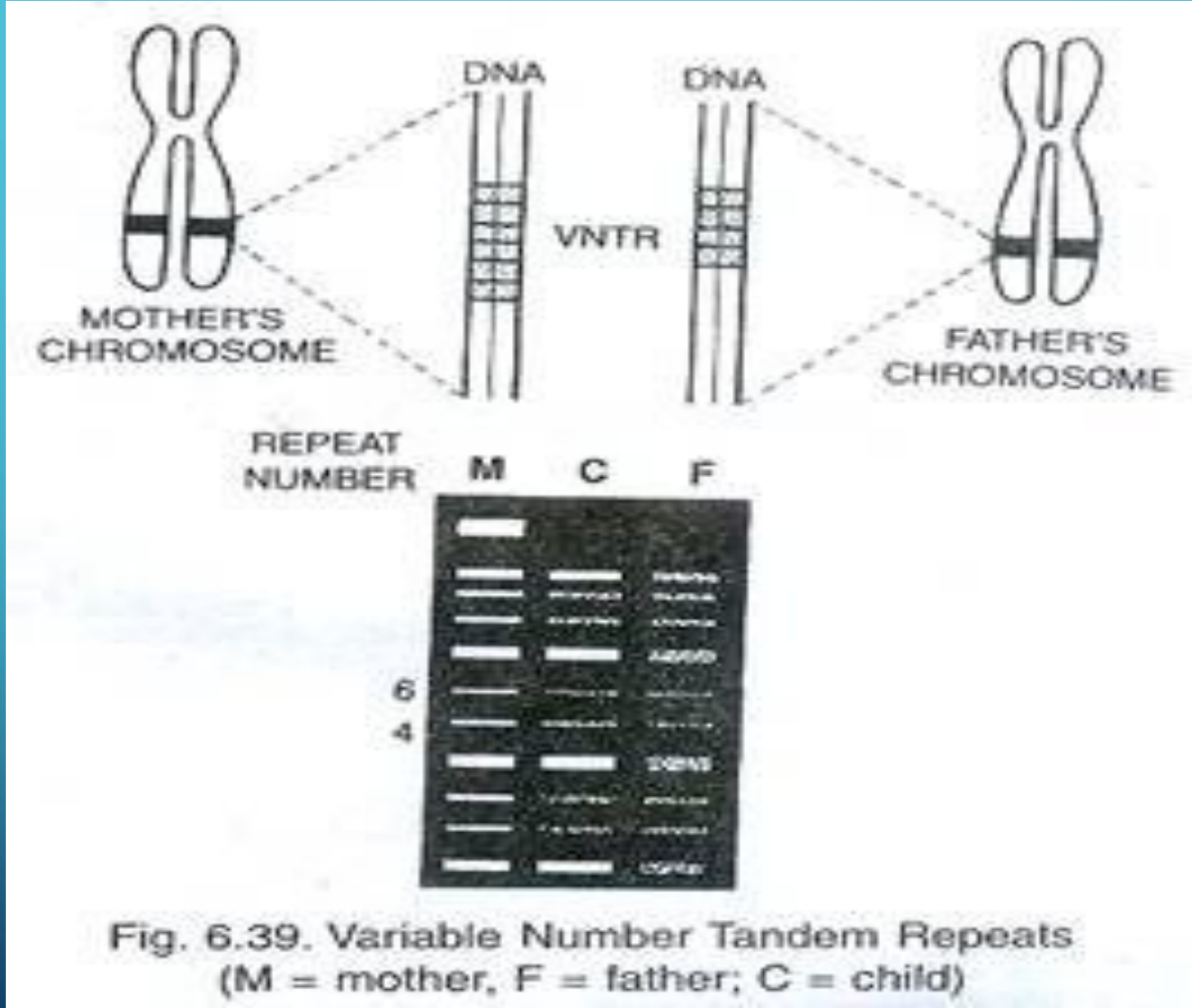
Satellite DNA (found in eukaryotes)—short segments of DNA sequences

Sequence repeats (vary from person to person)

Example 1: CACACACACA-2bp/nucleotides

Example2: ACGGCTAACGGCTA -6bp/nucleotides

- ❖ 2-4bp long Microsatellite DNA
- ❖ 20-25 bp long Minisatellite DNA or VNTR



# Biological samples used for DNA fingerprinting

- Blood
- Hair
- Saliva
- Semen
- Body tissue cells
- DNA samples have been obtained from vaginal cells transferred to the outside of a condom during sexual intercourse.



# Methodology

Steps involved :-

1. DNA Extraction
2. DNA Cutting
3. Gel Electrophoresis
4. Southern Hybridization
5. Autoradiography



# 1. DNA EXTRACTION



- Cells are broken down to release DNA.
- Sample Collect from:-
  - ✓ Blood
  - ✓ Hair
  - ✓ Saliva
  - ✓ Semen
  - ✓ Body tissue cells

## 2. DNA CUTTING

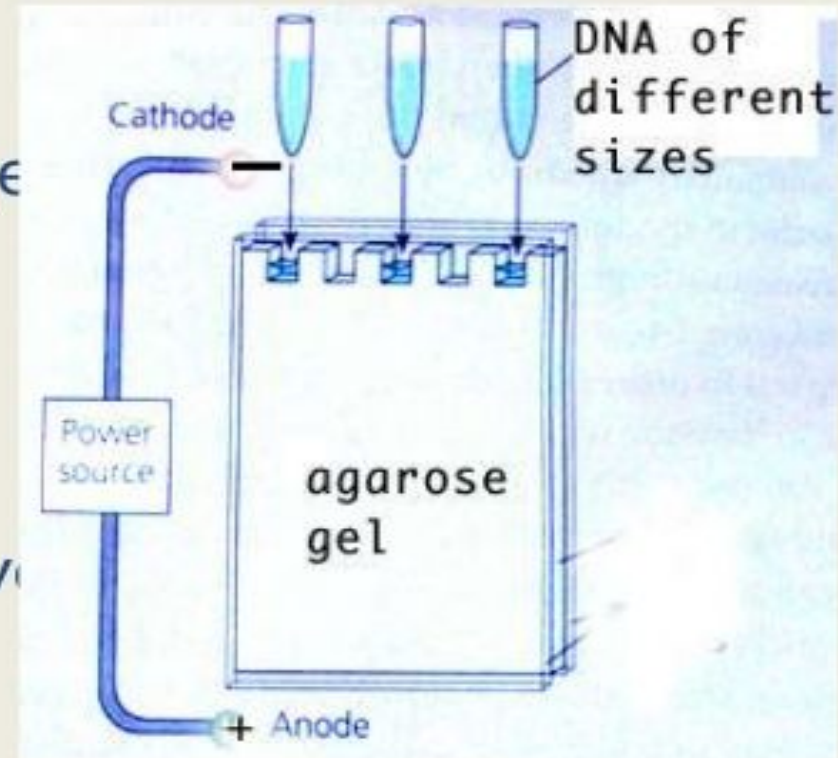
- The DNA is cut into fragments using **restriction enzymes**.
- Each restriction enzyme cuts DNA at a specific base sequence.



GAATTC  
CTTAAG

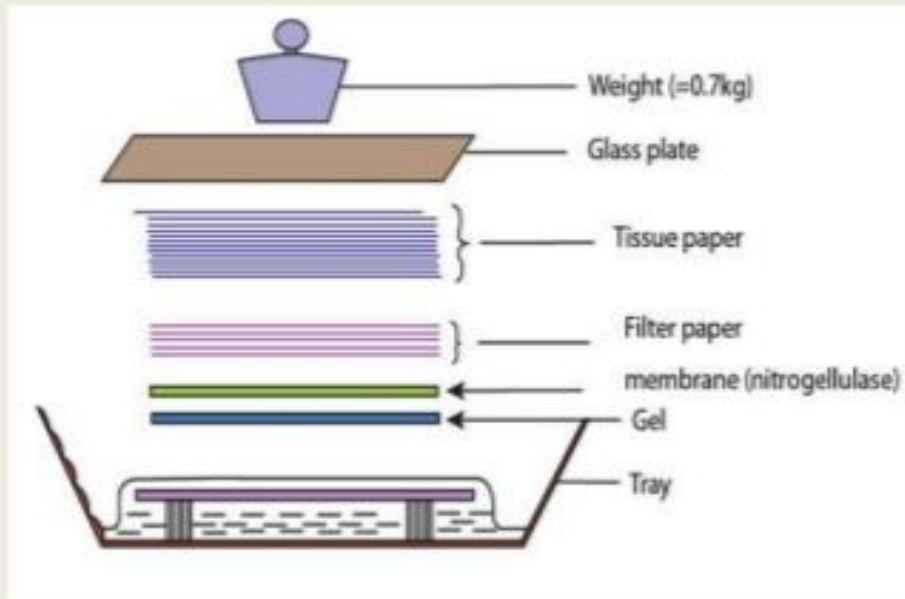
### 3. Gel Electrophoresis

- Fragments separated by length
- DNA (negatively charged)
- Moves towards +ve terminal
- Shorter fragments move faster



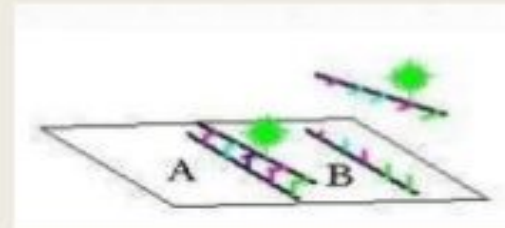


## 4. Southern Hybridization



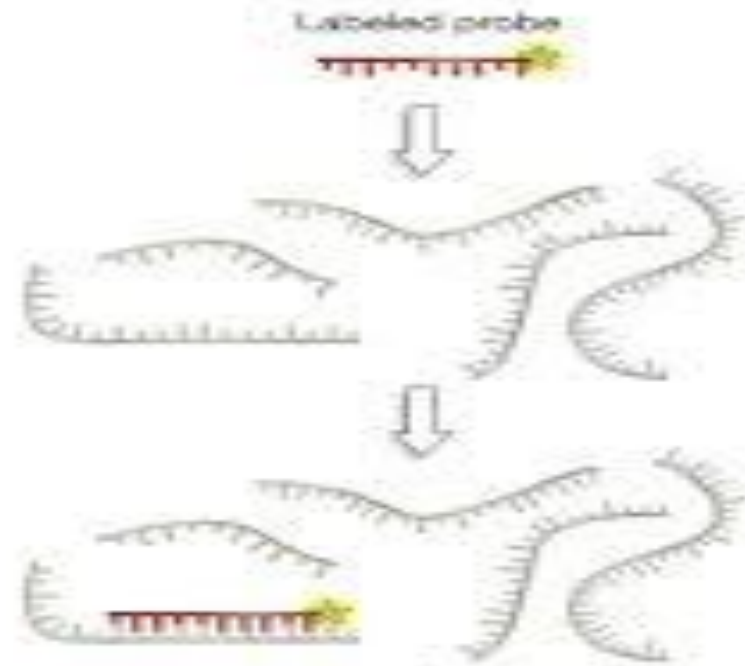
- DNA fragments transferred from gel to filter paper or nylon membrane
- DNA is split into single strands using an alkaline solution

- Radioactive probe in solution binds to DNA



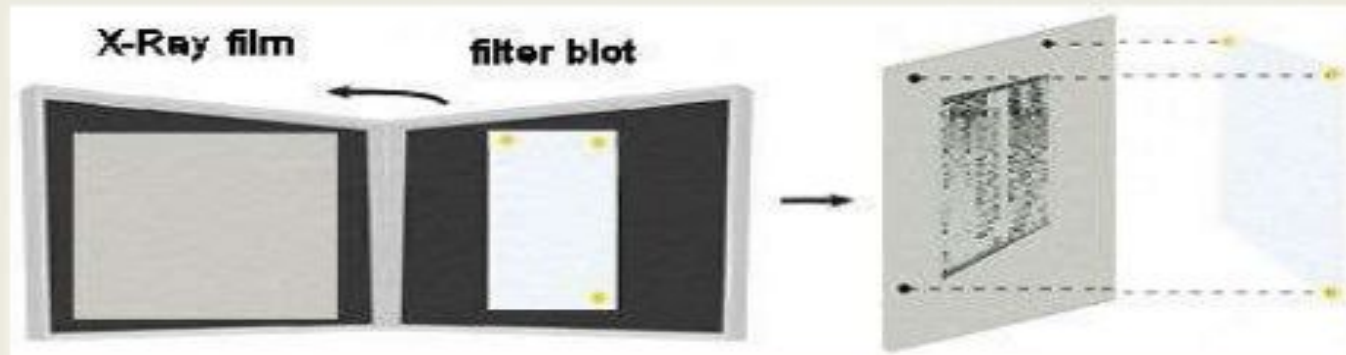


## Hybridization of a labeled probe to DNA



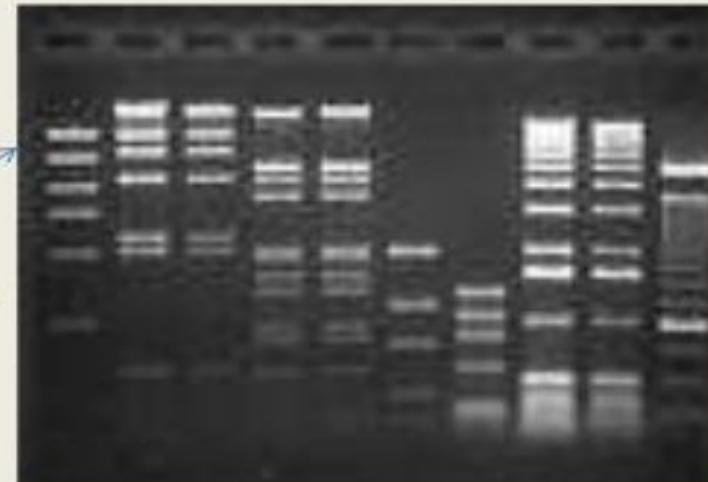
VNTR	Probe
It is a class of satellite DNA, where a small sequence is arranged tandemly in many copy numbers.	It is a radioactivity labelled VNTR, used for hybridization with DNA segments.

## 5. Autoradiography



- X-ray film placed over filter paper.
- Radioactivity probes makes dark spots on film.

DNA Fingerprinting patterns



# SOME METHODS TO DETECT DNA POLYMORPHISM

- **SNP analysis**: by chip analysis or PCR
- **RFLP**: sickle cell globin, sometimes no hybridization necessary e.g. mitochondrial DNA
- **PCR** e.g. followed by sequence analysis
- **PCR-RFLP**: PCR followed by restriction digest
- **STR**: Short Tandem Repeats or microsatellites, usually detected by PCR
- **RAPD**: Random PCR
- **AFLP**: PCR of selected restriction fragments

# Famous Cases

- Colin Pitchfork was the first criminal caught based on DNA fingerprinting evidence.
- He was arrested in 1986 for the rape and murder of two girls and was sentenced in 1988.





AN INDIVIDUAL NAMED **ROHIT SHEKHAR TIWARI** HAD FILED A PATERNITY SUIT AGAINST THREE TIMES CHIEF MINISTER OF THE STATE OF UTTAR PRADESH, **SHRI NARAYAN DUTT TIWARI**, AFTER DNA MAPPING TEST CONFIRMED HIS FATHERHOOD.

MR. TIWARI FINALLY ACCEPTED ROHIT AS HIS SON AND MARRIED HIS MOTHER, UJJWALA TIWARI.

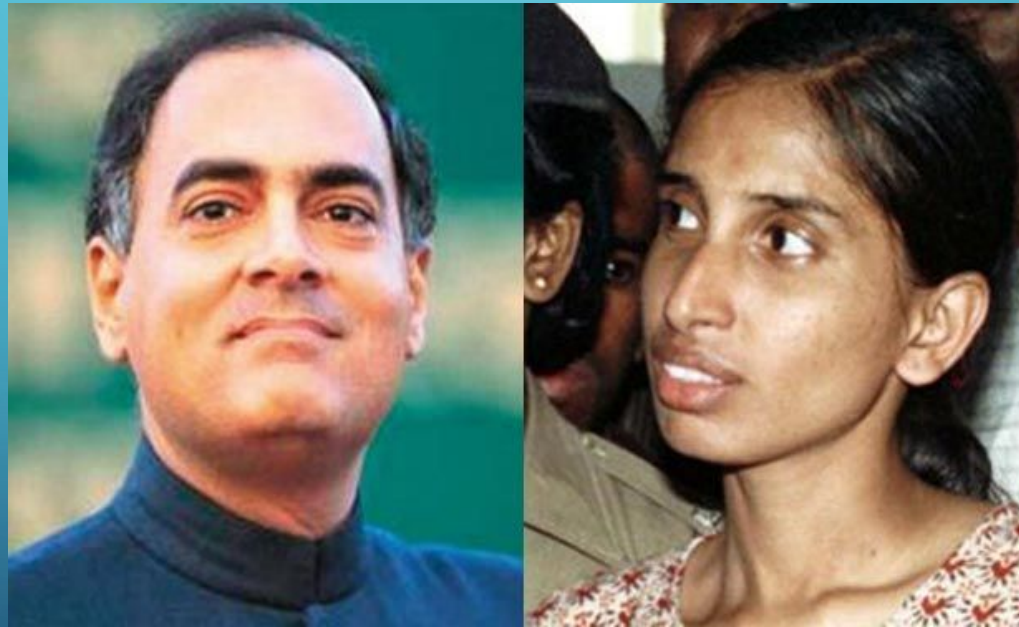


*PRIYADARSHINI MATTOO (SANTOSH KUMAR SINGH V. STATE THR. CBI),*  
SHE WAS A 25-YEAR-OLD LAW STUDENT WHO WAS FOUND RAPED AND  
MURDERED AT HER HOUSE IN NEW DELHI IN 1996.

IN THE YEAR 2006, THE DELHI HIGH COURT FOUND SANTOSH KUMAR  
SINGH GUILTY ON BOTH COUNTS OF RAPE AND MURDER



*RAJIV GANDHI ASSASSINATION (STATE THROUGH  
SUPERINTENDENT OF POLICE CBI/SIT VS. NALINI AND ORS.)*  
THE INFAMOUS RAJIV GANDHI ASSASSINATION CASE OF 1992  
USING DNA FINGERPRINTING TECHNOLOGY



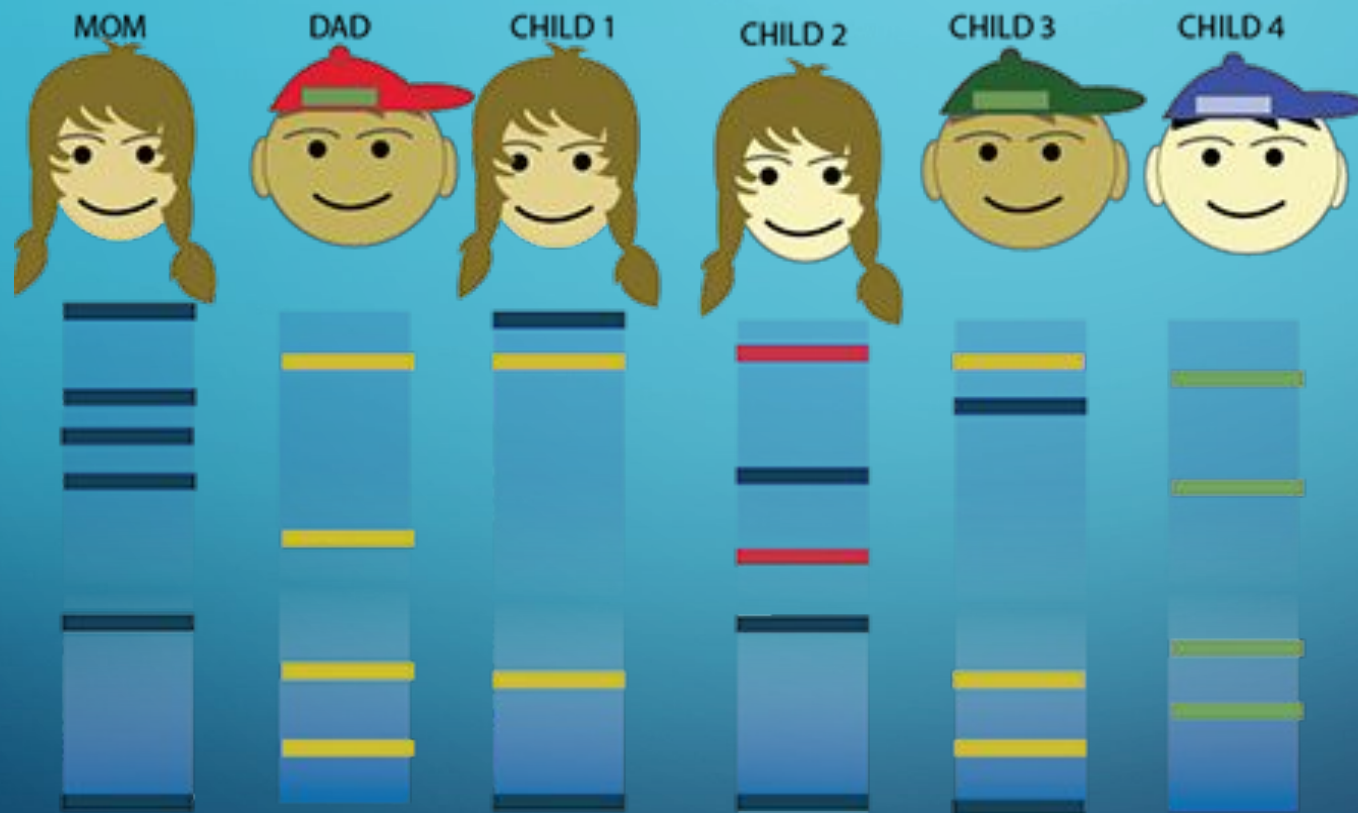


# NAINA SAHNI MURDER CASE





# DNA FINGERPRINTING



When a child is born, they inherit 23 chromosomes from the mother and 23 chromosomes from the father.

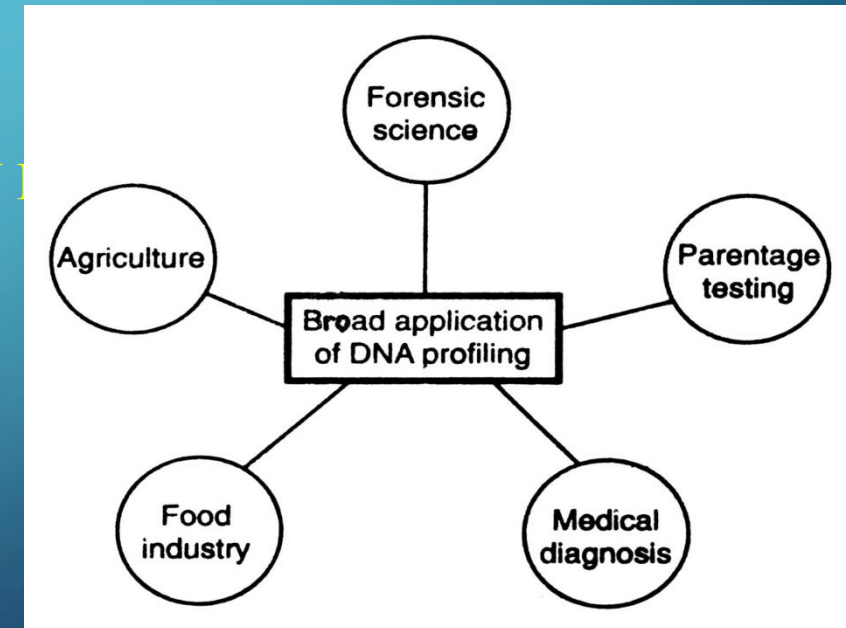
Child 1 and 3 are the children of both Mom and Dad.

Child 2 is the child of Mom, but not Dad.

Child 4 is not the child of Mom or Dad.

# APPLICATIONS OF DNA FINGERPRINTING

- INDIVIDUALITY
- PATERNITY TESTING: PATERNITY/MATERNITY
- HEREDITARY DISEASES
- CRIMINAL CASES: ELIMINATING SUSPECTS
- IDENTIFYING A CORPSE
- FOOD TESTING ( I.E. MEAT OF HORSE)



# Advantages?



Accurate

Easy-to-read



# Disadvantages?



Time-consuming

Expensive





# LIST OF FAMOUS INSTITUTES OF DNA FINGERPRINTING IN INDIA

- ❖ Centre for **DNA Fingerprinting** and Diagnostics (CDFD), Hyderabad
- ❖ Centre for Cellular and Molecular Biology (CCMB), Hyderabad

# DNA Fingerprinting Technique HD Animation

<https://youtu.be/AkBUriMK9u8>

Thank You!

