DNA fingerprinting Technology for Medico-legal Purpose

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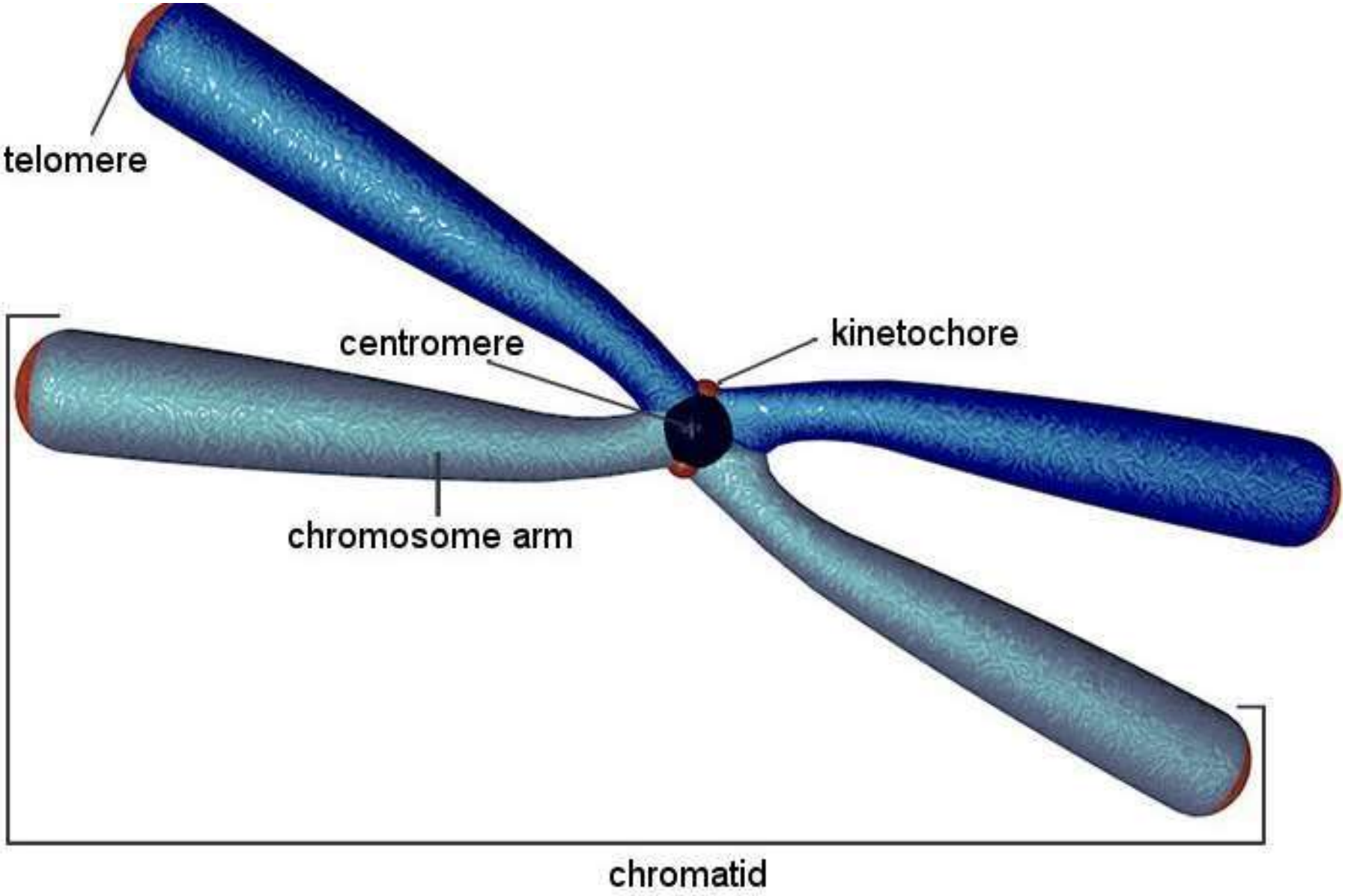
GURUGRAM

Introduction and History

- **Definition** – Chromosomes are the rod-shaped, dark-stained bodies seen during metaphase stage of mitosis.
- **Strausberger** discovered chromosome in 1875
- The term chromosome was coined by **Waldeyer** in 1888
- Term initiated as (Chroma= Colour and Soma = body)


telomere
centromere
kinetochore
chromosome arm
chromatid

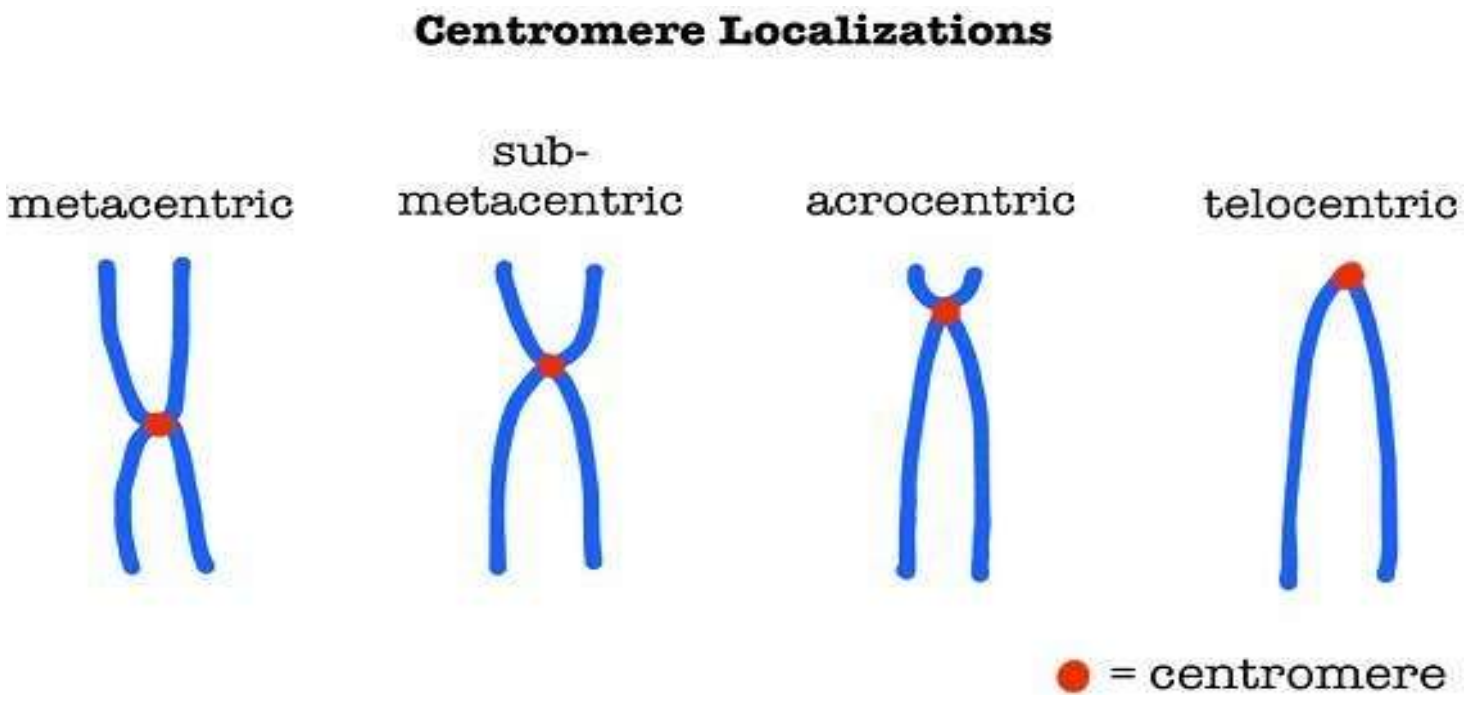
Chromosome shape

- The shape of chromosome is generally determined by the position of centromere

- Chromosomes generally exits in three different shapes, *viz., rod shape, J shape and V shape*

Types of chromosome

- According to the relative position of centromere chromosomes are divided into four types



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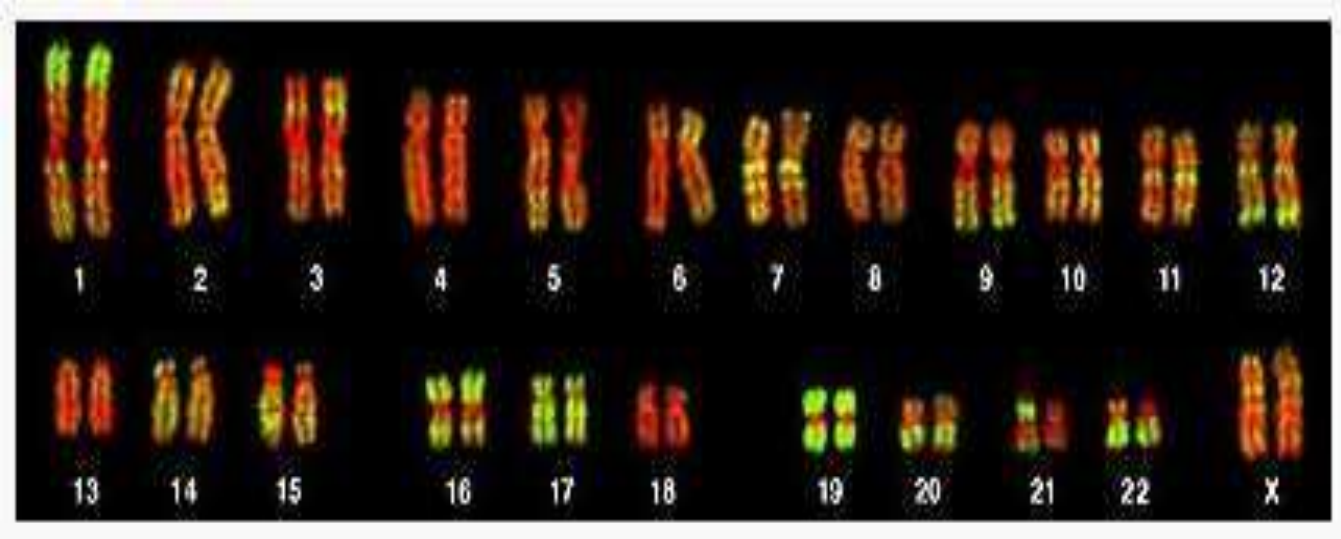

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
X

Somatic chromosome number of some common plants and animals

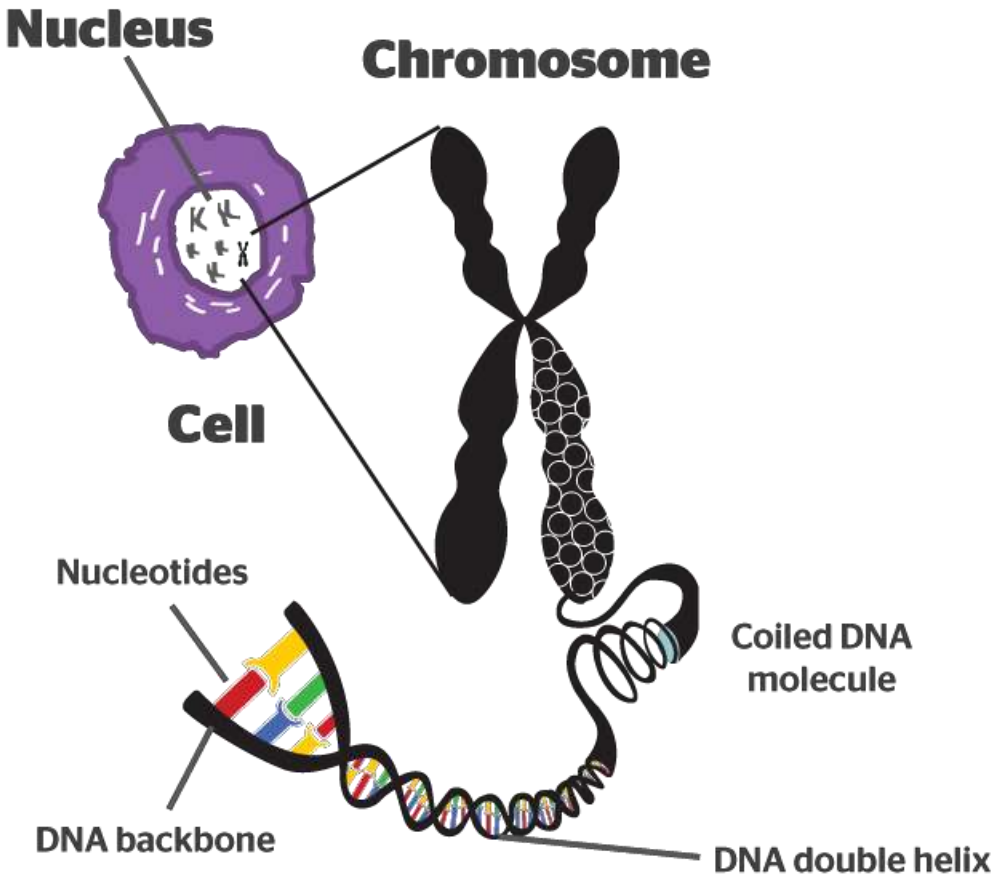
Sr. no	Scientific name	Common name	Chromosome number	
			Somatic	Gametic
1	*Homo sapiens*	Human	46	23
2	*Oryza sativa*	Rice	24	12
3	*Rattus norvegicus*	rat	42	21
4	*Pisum sativum*	Pea	14	7
5	*Daucus carota*	Carrot	20	10
6	*Allium cepa*	Onion	16	8
7	*Zea mays*	Maize	20	10
8	*Apis mellifera*	Honey bee	32	16
9	*Musca domestica*	House fly	12	6
10	*Felis domesticum*	Cat	38	19
11	*Drosophila melanogaster*	Fruit fly	8	4
12	*Neurospora Crassa*	Bread mold	14	7

Chromosome structure

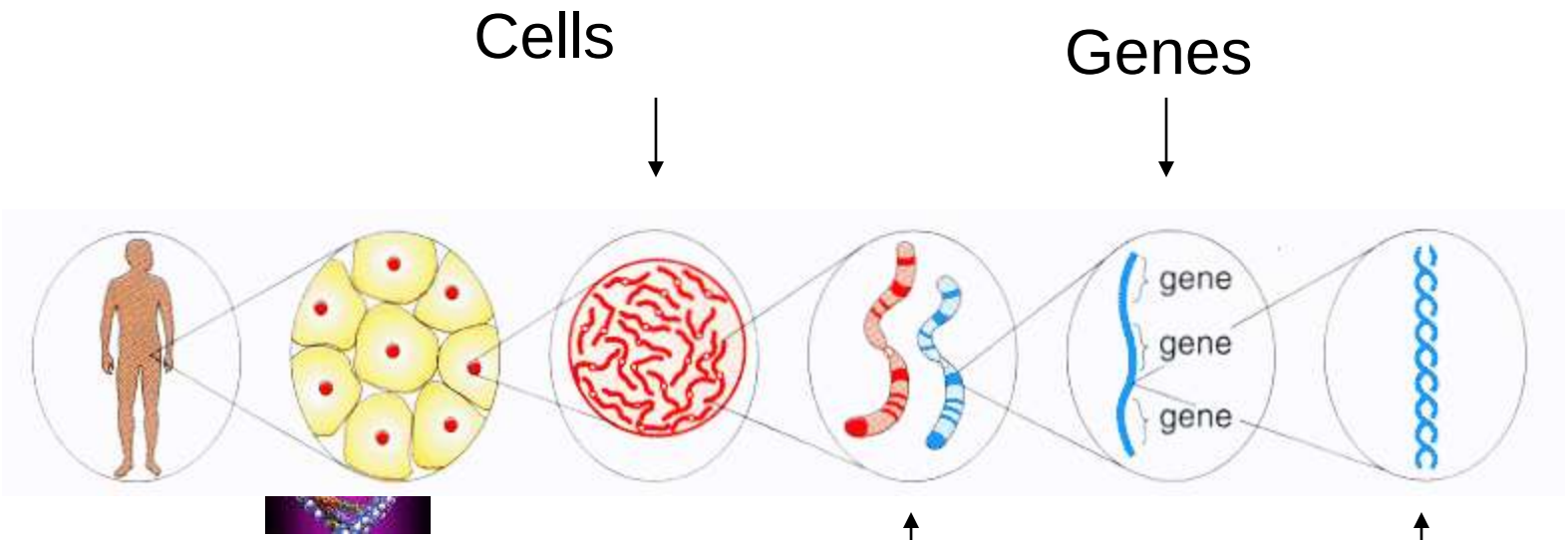
- **Structurally chromosomes consists of seven parts**

1. Centromere
2. Chromatid
3. Secondary constriction and satellite
4. Telomere
5. Chromomere
6. Chromonema
7. Matrix

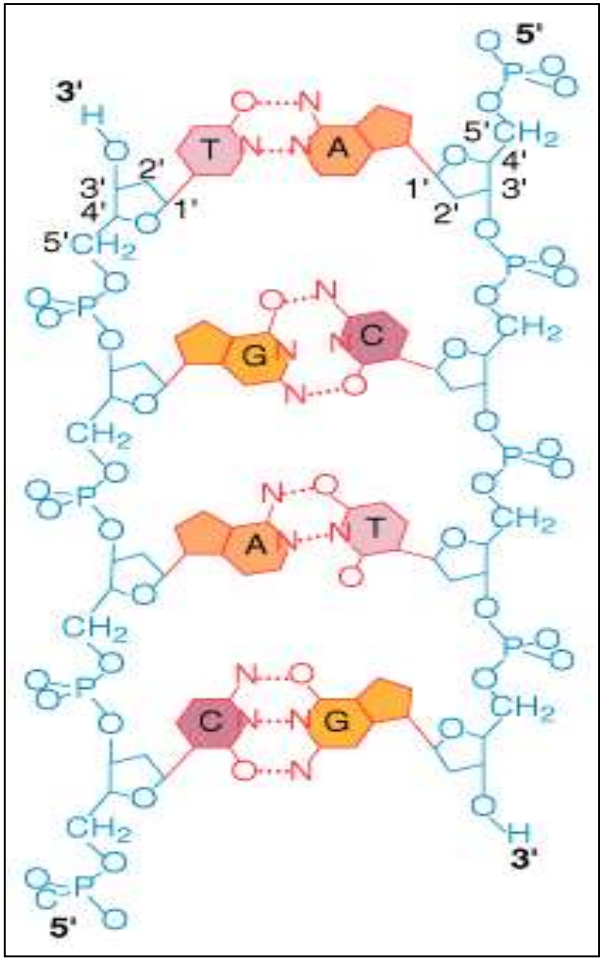
Relative position of chromosome in cell



The Human Genome



Each Chromosome has the Genetic material-DNA



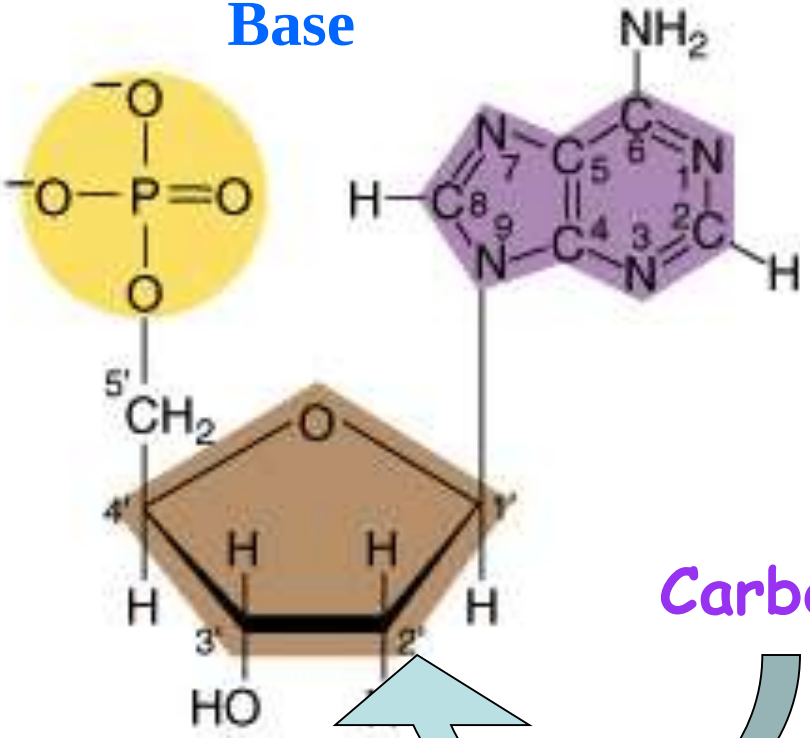
Chemical Structure of DNA

Four nitrogenous bases

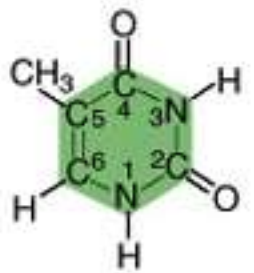
Purines

Pyrimidines

Nucleotides:
Phosphate
Sugar
Base

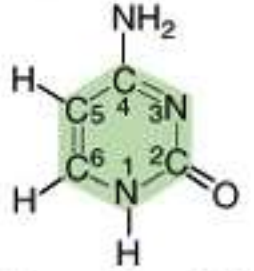


Adenine (A)



Thymine (T)

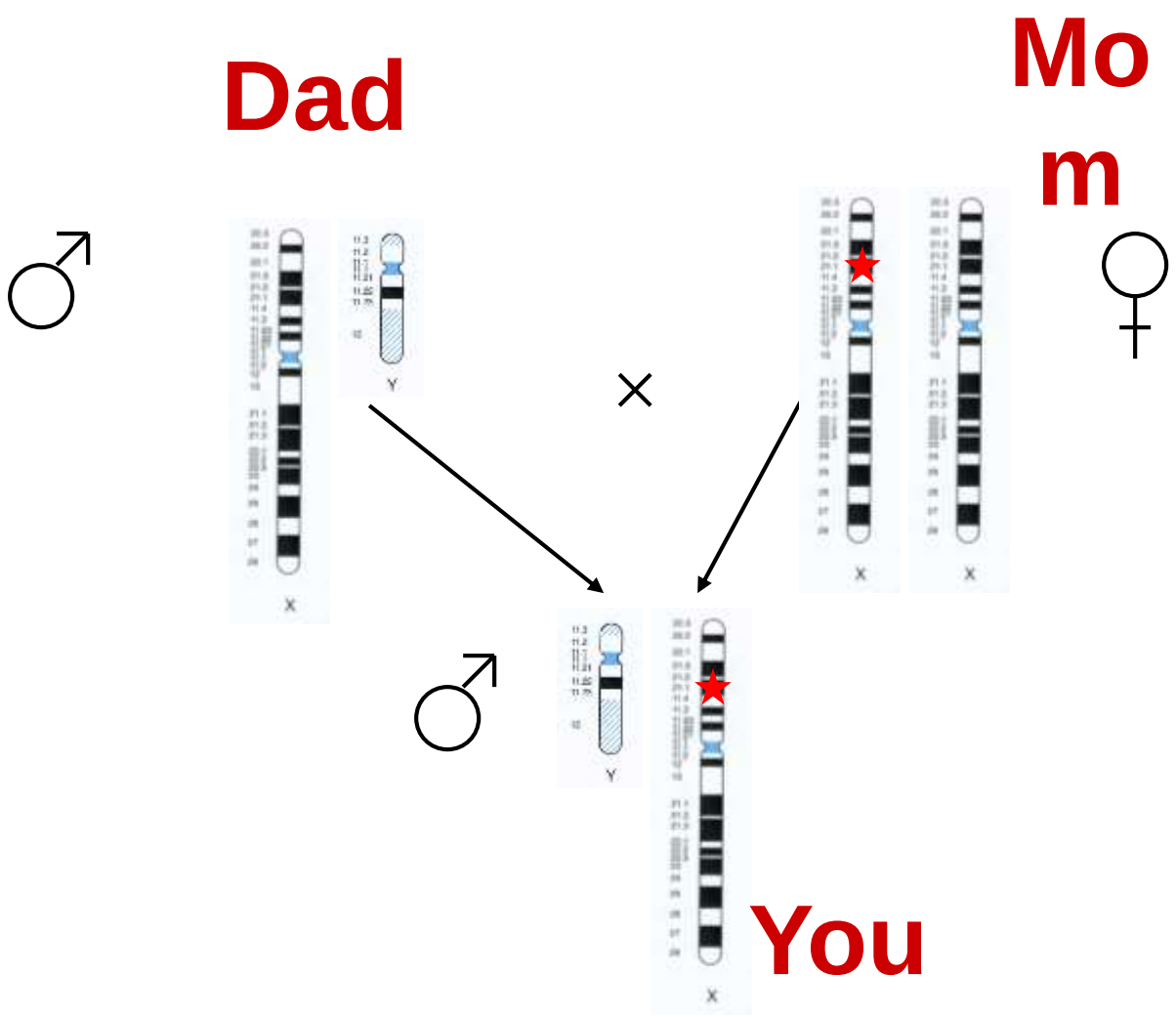
Guanine (G)



Cytosine (C)

Carbon atoms of sugar are numbered

Transmission of Genetic Material



DNA in Forensic Science

- The chemical structure of everyone's DNA is the same.
- The only difference between individuals is the order of the base pairs.
- This can give the valuable information to distinguish the individuals.
- So plays an important role in forensic investigations

The technique which promise correct identification, was established by Anupuma Raina, in 1992.

DNA FINGERPRINTING

DNA Fingerprinting

DNA fingerprinting was established by Prof. Alec. J. Jeffrey (1984) while studying the gene of myoglobin at the University of Leicester

Techniques That revolutionized the field of DNA fingerprinting

- Polymerase Chain Reaction

- Capillary Electrophoresis

Markers for DNA Fingerprinting

- VNTR(Variable number tandem repeat)
- RFLP (Restriction Fragment Length Polymorphism)
- Microsatellites

a) STRs(Short tandem repeats)

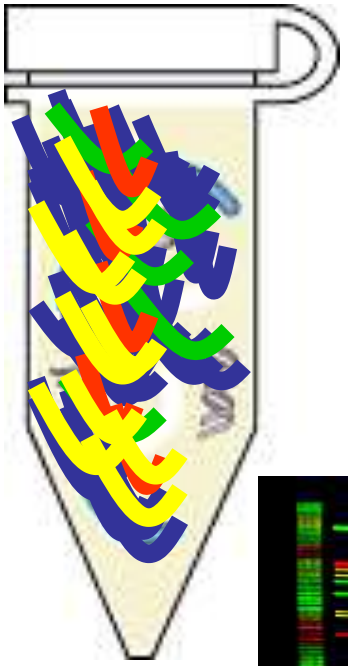
i) Autosomal

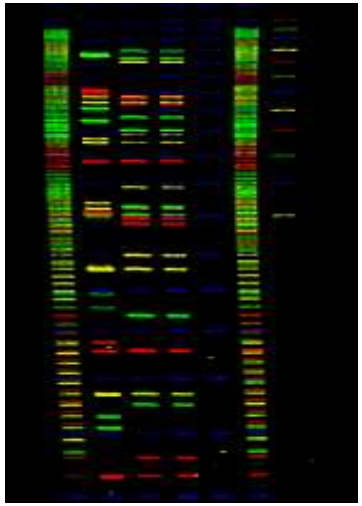
ii) YSTR

iii) Mt DNA

b) SNPs (single nucleotide polymorphisms)

Multiplex PCR

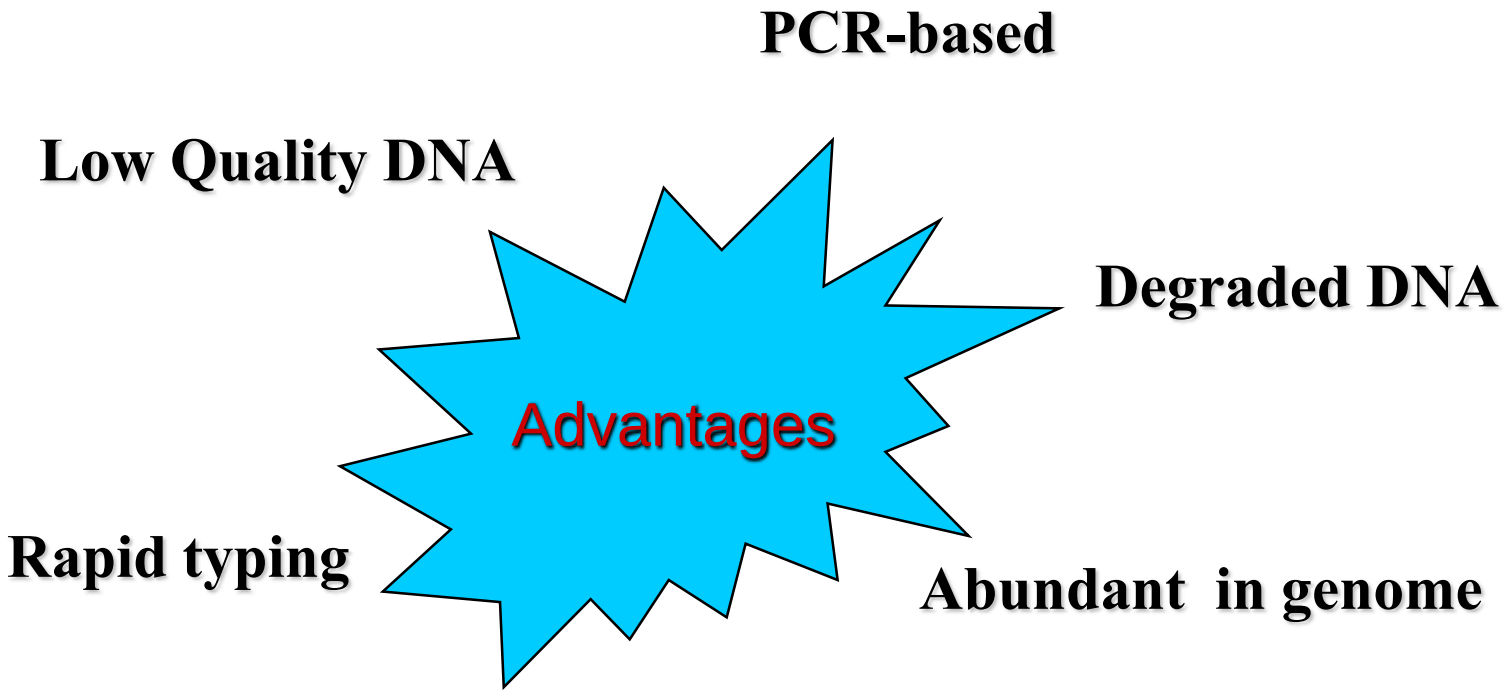




Scanned Gel Image

- Over 10 Markers Can Be Copied at Once
- Sensitivities to levels less than 1 ng of DNA
- Ability to Handle Mixtures and Degraded Samples
- Different Fluorescent Dyes Used to Distinguish STR Alleles with Overlapping Size Ranges

Advantages of Short Tandem Repeats

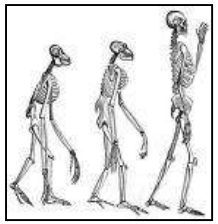


Sources of Biological Evidence

- Blood
- Semen
- Saliva
- Hair
- Skin cells
- Bone
- Teeth
- Tissue
- Vomit

Condoms
Envelopes
Cigarette Butts
Chewing gum
Drinking Cups
Under victim's fingernails

Applications of DNA Fingerprinting



Diversity

Mass Disaster

Crime Investigation

Identification

Paternity

Migration

Baby Exchange

Family tree

DNA FP

Wildlife Genomics

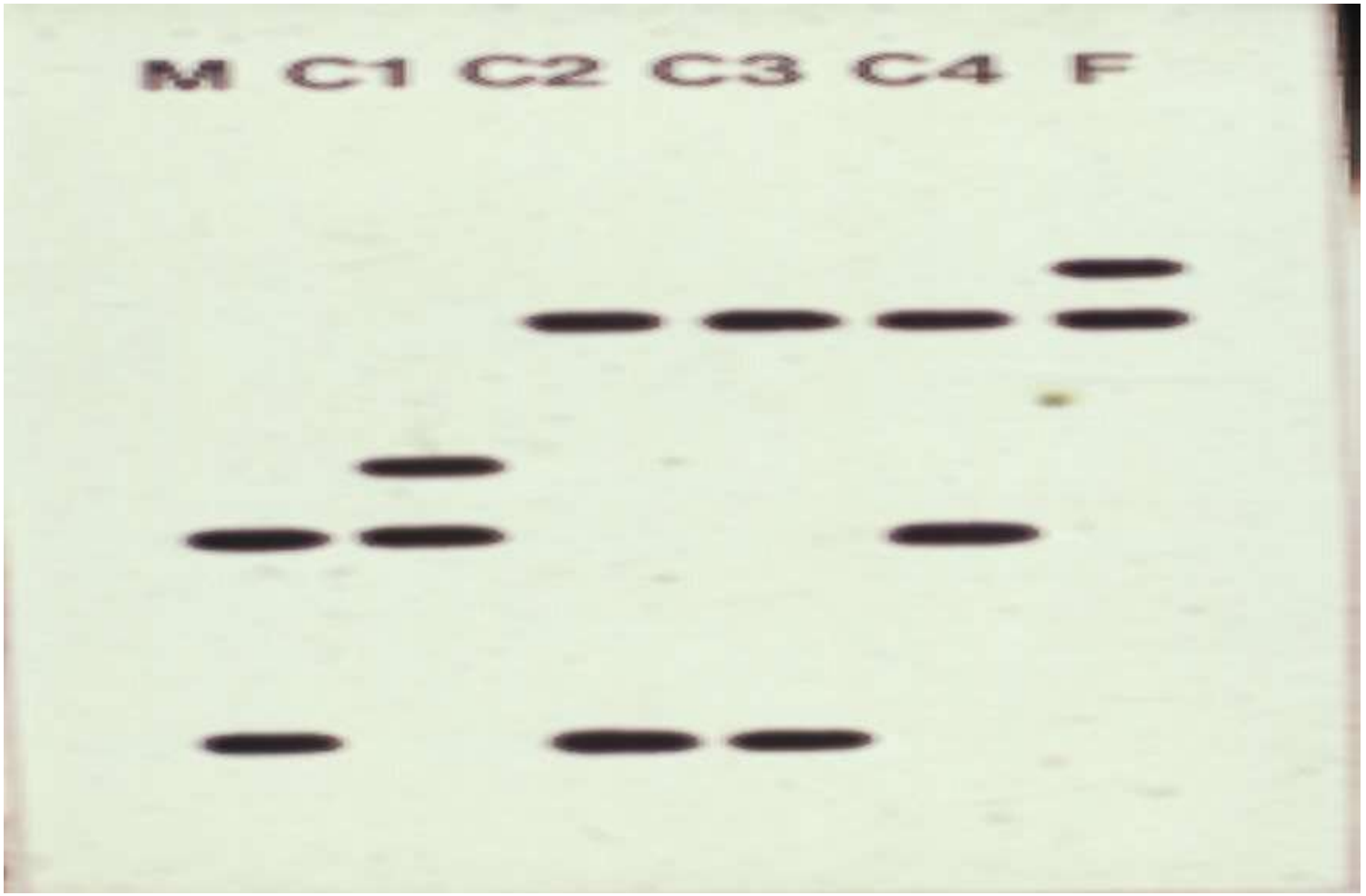
Rape

Application- Identification

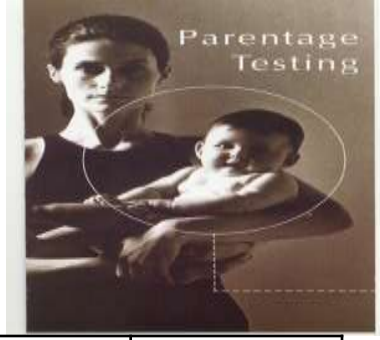
Identification of the victims of

- Mass disaster
- Serial killing
- Natural Disasters (Tsunami)

Application-Immigration

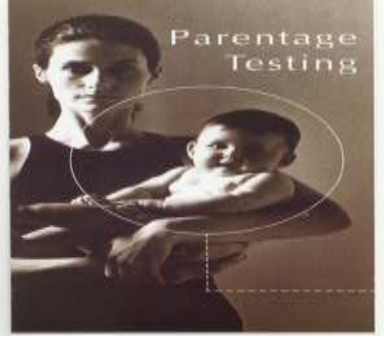


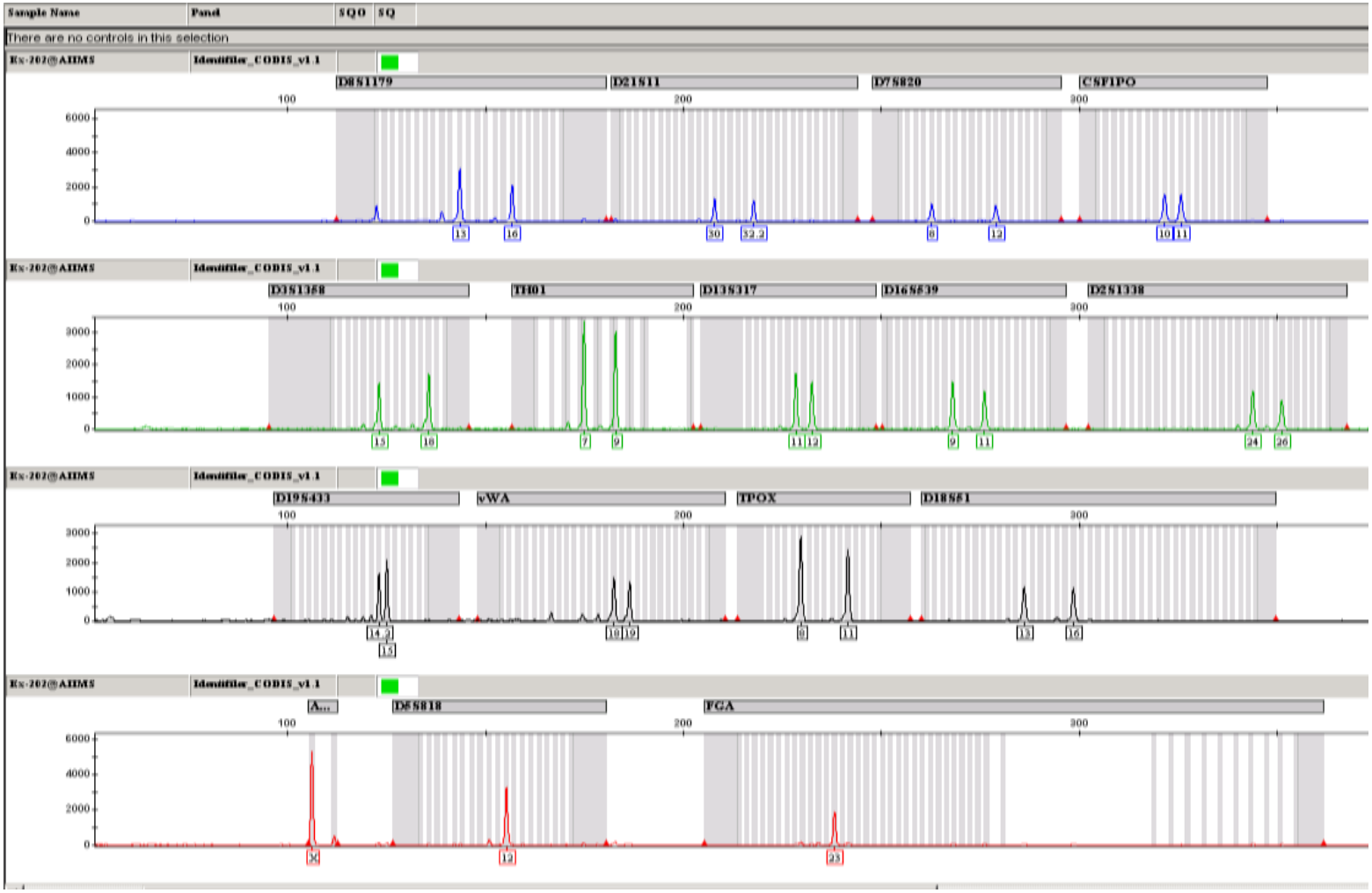
Paternity



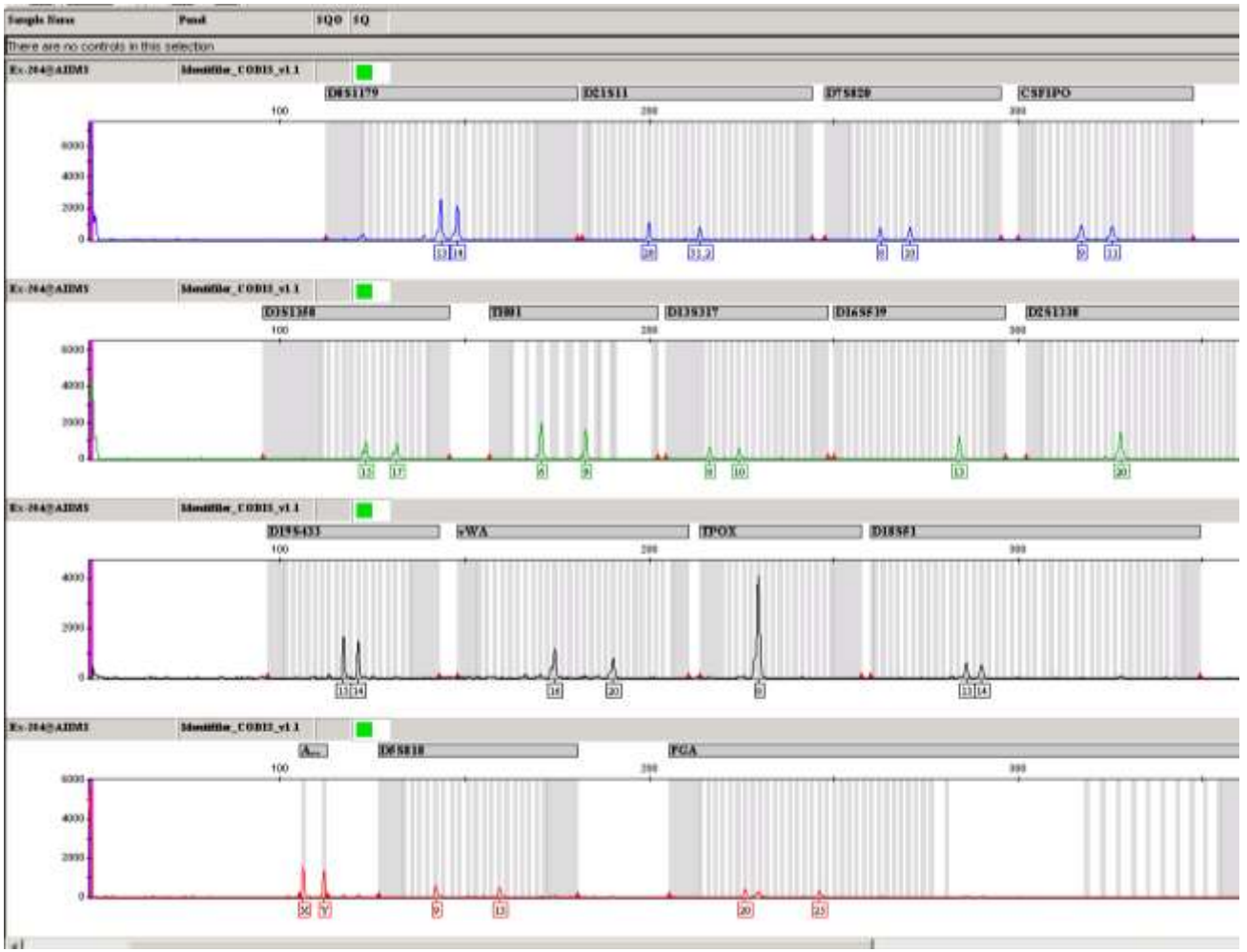
Locus	Exhibit M	Exhibit F	Exhibit Suspected F	Exhibit C	Exhibit JS 2 (PC)	Exhibit NC
D8S1179	13,16	14, 15	13,14	13,13	10, 13	-
D21S11	30, 32.2	29, 33.2	28, 31.2	30, 31.2	29,31	-
D7S820	8, 12	8,10	8, 10	8, 10	8,11	-
CSF1PO	10,11	9,13	9, 11	10,11	10,12	-
D3S1358	15,18	17,18	15, 17	15,17	17	-
THO1	7, 9	9.3	6, 9	7, 9	8, 9.3	-
D13S317	11, 12	10	8,10	10,12	11,14	-
D16S539	9,11	13	13	9, 13	10,11	-
D2S1338	24, 26	19, 20	20	20,26	19	-
D19S433	14.2,15	14	13, 14	13, 15	14, 15	-
vWA	18, 19	16	16, 20	16,19	14, 17	-
TPOX	8, 11	8, 9	8	8, 11	8,11	-
D18S51	13, 16	14, 19	13, 14	13,16	14,20	-
Amleogenin	X	XY	XY	XY	XY	-
D5S818	12	11, 13	9, 13	9, 12	11,12	-

Paternity (Contd.)

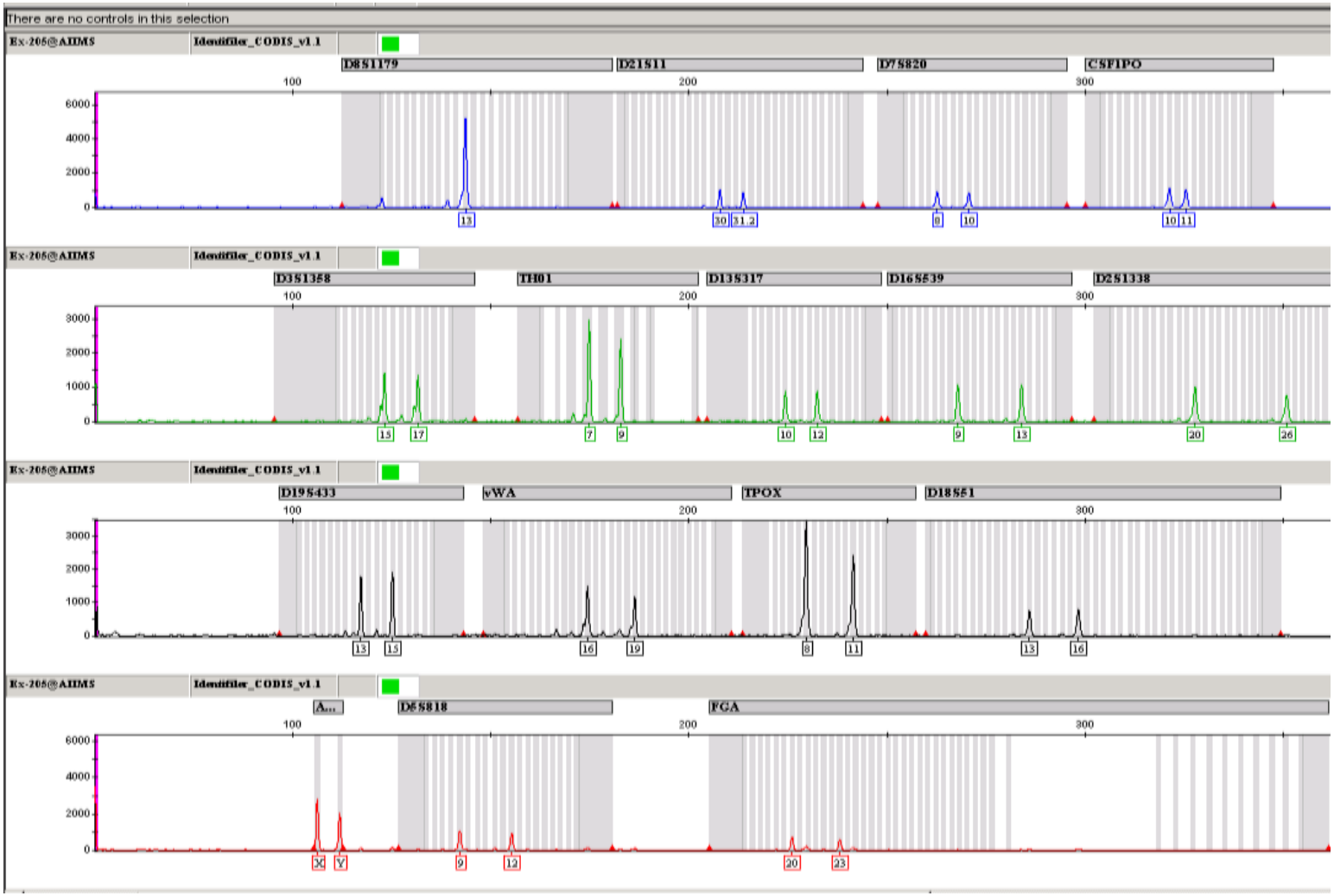




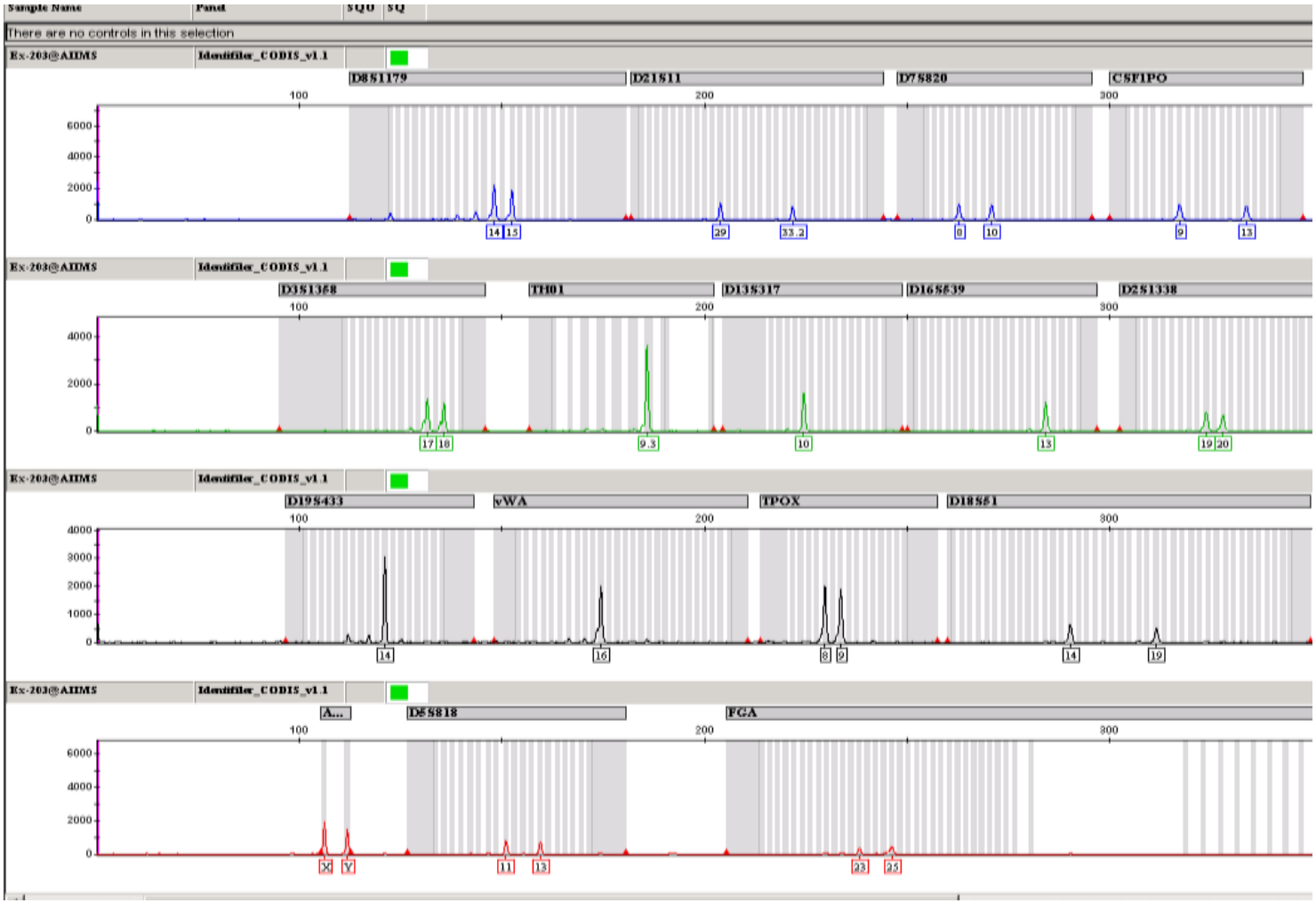
Paternity (Contd.)



Paternity (Contd.)



Paternity (Contd.)

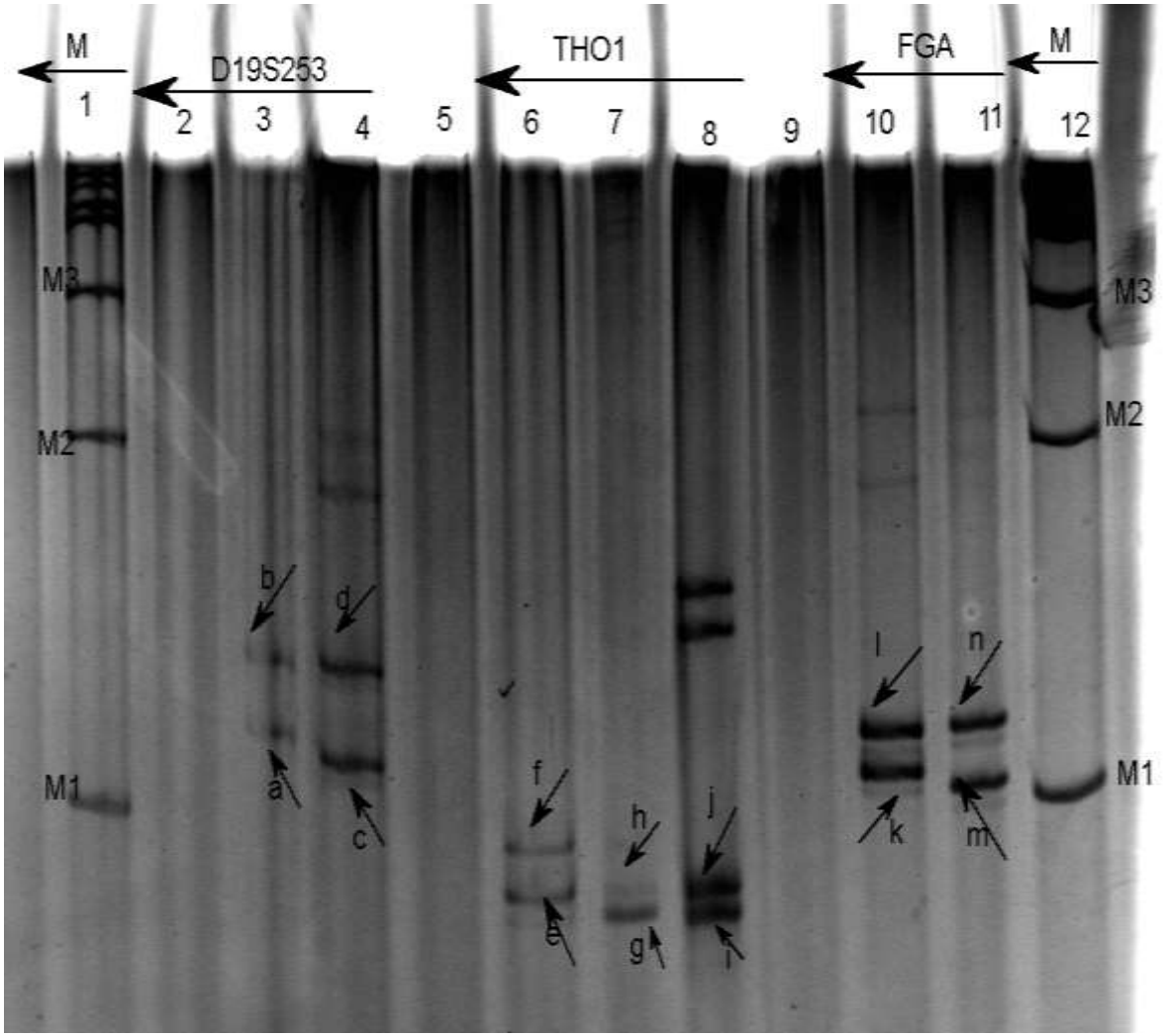


Baby exchange

Locus	Exhibit M	Exhibit C	Exhibit F	Exhibit PC	Exhibit NC
D8S1179	10, 11	10, 11	11, 13	16	-
D21S11	32.2, 33.2	30, 32.2	29, 30	29, 31	-
D7S820	10, 12	11, 12	8, 11	10	-
CSF1PO	11	10, 11	10 , 12	9,12	-
D3S1358	16	16, 17	14, 17	14, 18	-
THO1	6.3, 7.3	7.3, 8.3	8.3	7.3, 8.3	-
D13S317	11, 12	11, 12	11	12, 13	
D16S539	8, 9	8, 9	9, 11	9, 11	-
D2S1338	19, 20	20, 22	18, 22	19, 20	-
D19S433	12.2, 14	14, 14	14, 16.2	13, 15	-
vWA	16, 19	16, 16	16, 17	16, 17	-
TPOX	8, 11	8, 9	9, 11	8, 9	-
D18S51	14	13, 14	13	14, 15	-
Amleogenin	XX	XX	XY	XY	--
D5S818	11	11, 11	11	11	-

Murder Investigations

Murder Investigations



Murder Investigations

CENTRE FOR DNA FINGERPRINTING AND DIAGNOSTICS

TABLE-I

GENOTYPE ANALYSIS FOR ESTABLISHING IDENTITY USING MICROSATELLITES i) D8S1179 ii) D21S11 iii) D18S51 iv) D3S1358 v) vWA vi) FGA vii) D5S818 viii) D13S317 ix) D7S1358 and x) Amelogenin

Locus	5935 Exhibit A		5938 Exhibit D		5937 Exhibit C		5936 Exhibit B		5939 Exhibit E	
D8S1179	15	16	13	16	14	16	16	16	16	16
D21S11	30	32.2	32.2	32.2	30.2	31	31	32.2	31	32.2
D18S51	12	14	14	16	12	15	14	15	12	12
D3S1358	17	17	17	17	15	16	15	17	15	17
vWA	16	17	15	17	17	17	17	17	17	17
FGA	23	25	25	25	21	23	23	25	23	23
D5S818	10	13	10	13	11	12	10	11	10	12
D13S317	12	13	11	13	11	11	11	12	11	12
D7S820	10	12	8	10	10	11	11	12	10	11
Amelogenin (Gender Marker)	X	Y	X	X	X	X	X	X	X	X

Exhibit No. 5935 : Allele data of the source of exhibit A
Exhibit No. 5936 : Allele data of the source of exhibit B
Exhibit No. 5937 : Allele data of the source of exhibit C
Exhibit No. 5938 : Allele data of the source of exhibit D
Exhibit No. 5939 : Allele data of the source of exhibit E

The alleles shown by blue colour in the source of the exhibit A are accounted for being present in the sources of exhibits B, D and E.

Rape cases

History of Case No.1

Rape case

A female of 20 yrs age raped at her residence

IO submitted :

1.Vaginal swab

2. Vaginal smear

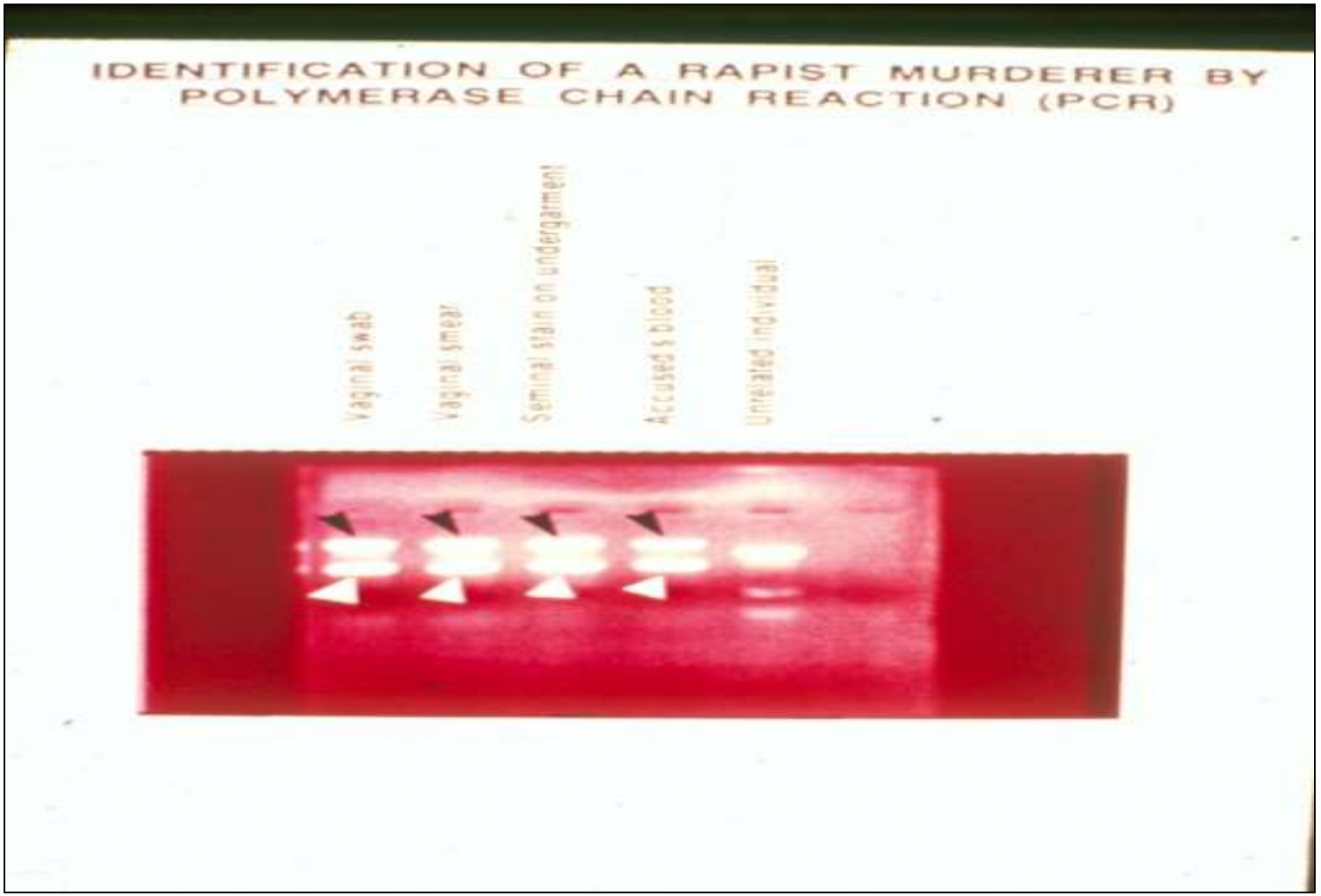
3. Vaginal stains on undergarments

4. Blood sample of the accused was collected personally in the DNA Lab

Rape cases

- **Primer Used**:
- **Bpf 3.8, D1S80, D2S44 and**
- **PYNZ22**
- Probability of observing identical patterns:
- 0.2**33** or 1 in **1023**

Rape cases

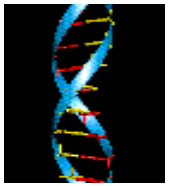

IDENTIFICATION OF A RAPIST MURDERER BY POLYMERASE CHAIN REACTION (PCR)
Vaginal swab
Vaginal smear
Semina stain on undergarment
Accused's blood
Unrelated individual

Case No. 2

- 16 years old female raped at her residence
- Rape followed by subsequent conception
- Aborted on the Hon'ble court's order

Exhibits received:

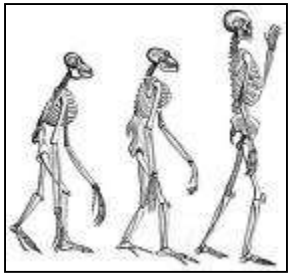
- Fresh blood sample of victim and suspect
- Product of conception



GENOTYPE ANALYSIS FOR ESTABLISHING PATERNITY USING IDENTIFILER KIT

Sl. No.	Locus	Exhibit (Accused)	Exhibit (Mother)	Exhibit (Product of conception)	Exhibit A (Positive control)	Exhibit B (Negative control)
1	D3S1358	17	15,18	15, 18	14,15	
2	THO1	7, 9.3/10	9, 12	9	8, 9.3	
3	D13S317	8.5, 12.5	9, 13	9	11	
4	D16S539	9.5 11.5	9, 11	9, 11	11, 12	
5	D2S1338	18.5, 23.5	18, 23	18, 23	19, 23	
6	Amleogenin	XY	X	X	X	
7	D5S818	9, 12	12	12	11	
8	FGA	23.8, 24.8	23.2, 26.1	23.2, 26.1	23, 24	
9	D8S1179	14, 15	13, 15	13, 15	13	
10	D21S11	33	28, 32.2	28, 32.2	30	
11	D7S820	11.5, 12.5	11.5, 12	11, 12	10,11	
12	CSF1PO	11.5, 12.5	11, 12	11, 12	10, 12	
13	D19S433	13, 15	9.5, 13	13	13.2, 15	
14	vWA	16, 17	14, 24.5	14	17, 18	
15	TPOX	8.5, 11.5	8, 10	8,10	8	
16	D18S51	12.2, 16.2	16, 20.3	16, 20	15, 19	

Diversity



DNA markers are used to study:

i) The Human Diversity
ii) Molecular relatedness amongst the individuals
iii) Differentiation between the population subgroups

Migration Pattern

DNA markers are very useful to:

1. Trace the origin of human being
2. Study migration pattern
3. Mutation analysis
4. Study the selection of the characters

Pedigree Analysis

To create the maternal and Paternal family trees

To trace out the ancestry

Wildlife Genetics

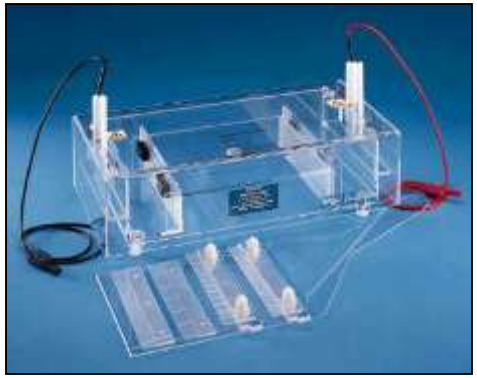
Black Buck case

Identification of animal, plant species

Identification of microbial stains

Instrumentation

Thermal Cycler



Electrophoresis

Genetic Analyzer

DNA Extraction Machine

Picodrop

RT PCR