

CHAPTER 9

Heredity

9.1 Accumulation of Variation During Reproduction.

- DNA copying mechanism is not absolutely accurate.
- Due to errors in DNA copying, Variations accumulate in an organism.
- Variations also accumulate due to sexual reproduction.
- These variations accumulate and are passed on from one generation to another. This is essential for the survival of organisms.

9.2 Heredity

- A process by which particular characteristics (biological) are passed from one generation to another.

<u>Trait</u>	<u>characteristic</u>
• Refers to a distinct variant of a characteristic.	• It is a broader term which encompass a particular character.
Eg:- Blue eyes.	Eg- Eye colour.

Types of Traits.

• Inherited traits.

Traits which are passed from parents to offsprings

Eg:- Genetic disease, physical characteristics like eye color, skin color etc.

- Acquired traits.

Traits that an organism develops during its lifetime, resulting from environmental influences or experiences.

Eg: Skills such as singing, Dancing, Injuries etc.

9.2.2 Rules for the Inheritance of Traits - Mendel's Contribution

- In Humans, both parents - mother and father contribute equal amounts of genetic material to the child.
- Gregor Johann Mendel (22 July 1822) worked out on the main rules of such inheritance pattern.

- Mendel's Experiments.

- Mendel used a number of contrasting/opposite visible traits of garden peas such as:-

- Round/wrinkled seeds.
- Tall/short plants.
- White/violet flowers
- Green pod/yellow pod.

- He crossed tall pea plant with short pea plant.

Tall plant X Short plant

TT X tt

	t	t
T	Tt	Tt
T	Tt	Tt

Phenotypic ratio = 1:0

Genotypic ratio = 1:1

F₁ generation = Tt, Tt, Tt, Tt
(Filial) All Tall plants

- He then self-pollinated the plants obtained in F_1 generation.

$Tt \times Tt$

	T	t
T	TT	Tt
t	Tt	tt

Monohybrid cross: A hybrid cross in which only one trait is studied.

Eg: Height, color etc.

F_2 generation: TT, Tt, Tt, tt

Tall = 3

Short = 1

- From his experiment, Mendel concluded that:
 - Both - Tallness and shortness traits were inherited in F_1 generation, but only the tallness trait was expressed.
 - Two copies of genes controlling traits are present in sexually reproducing organism.
 - A single copy of 'T' is enough to make the plant tall, but both copies of 't' are required to make the plant short.

Dominant Trait - A trait that is expressed even when only one copy of the gene is present.

It is indicated by capital letter.

Eg: Tall (T), Round (R)

Recessive Trait - A trait that is expressed only when two copies of a gene are present.

It is indicated by small letter.

Eg: Short (t), Wrinkled (r).

- Mendel performed another experiment in which he crossed round and green seeds with wrinkled and yellow seeds.

Dihybrid cross: A hybrid cross in which two characters are simultaneously studied.

Eg: Round and green seed
Yellow and wrinkled seed

- Mendel's dihybrid cross experiment.

- He crossed Round, green seeds with wrinkled, yellow seeds.

Here, $RRyy \times rrYY$.

R = Round (Dominant) (round, green) (wrinkled, yellow).

r = wrinkled (Recessive)

Y = Yellow (Dominant)

y = green (Recessive)

$Ry \times rY$ [Formation of gametes]

[F₁] $RrYy$ [Fertilisation]
(Round, Yellow seeds)

$RrYy \times RrYy$ [Self-cross]

$RrYy \times RrYy$

	Y	y	
R	RY	Ry	Formation of gametes
r	rY	ry	

 F_2 generation

	RY	Ry	rY	ry	
RY	RRYY	RRYy	RrYY	RrYy	
Ry	RRYy	RRyy	RrYy	Rryy	
rY	RrYY	RrYy	rrYY	rrYy	
ry	RrYy	Rryy	rrYy	rryy	

Summary:

315 round, yellow	9
108 round, green	3
101 wrinkled, yellow	3
32 wrinkled, green	1
556	16

Phenotypic ratio (F_2) = 9:3:3:1

23. How do these traits get expressed?

- All the information of a living organism is present in DNA (Deoxyribonucleic acid).
- DNA contains small segments - known as genes.
- The genes in DNA control the expression of proteins.

Example:

- In plants - the height of plants is controlled by hormones.

→ More hormone - More height --- Tall plant.

→ Less hormone - Less height --- Dwarf plant

- The amount of hormone in turn is controlled by an enzyme which is synthesized from a gene.

- If a gene synthesizes - More efficient enzyme.



More hormone



Plant - tall.

- If the gene synthesizes - Less efficient enzyme



Less hormone



Plant - Dwarf.

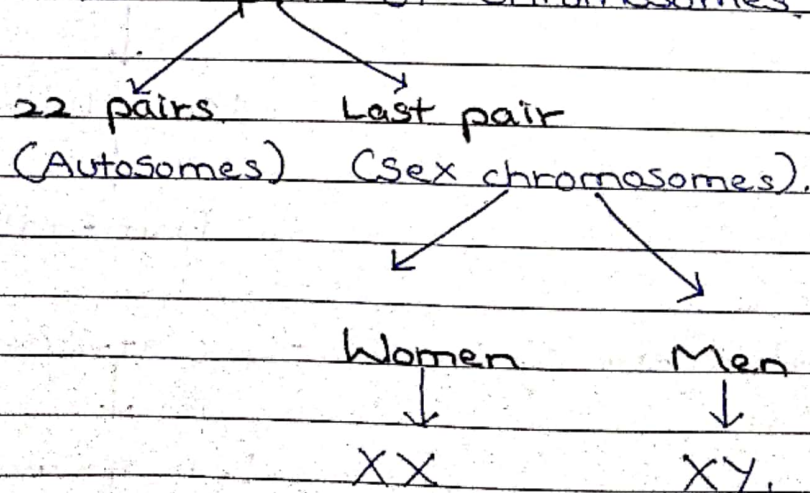
- The offsprings inherit one set of DNA from each parent.
- The DNA is present as small pieces in the form of chromosomes.

9.2.4 Sex Determination

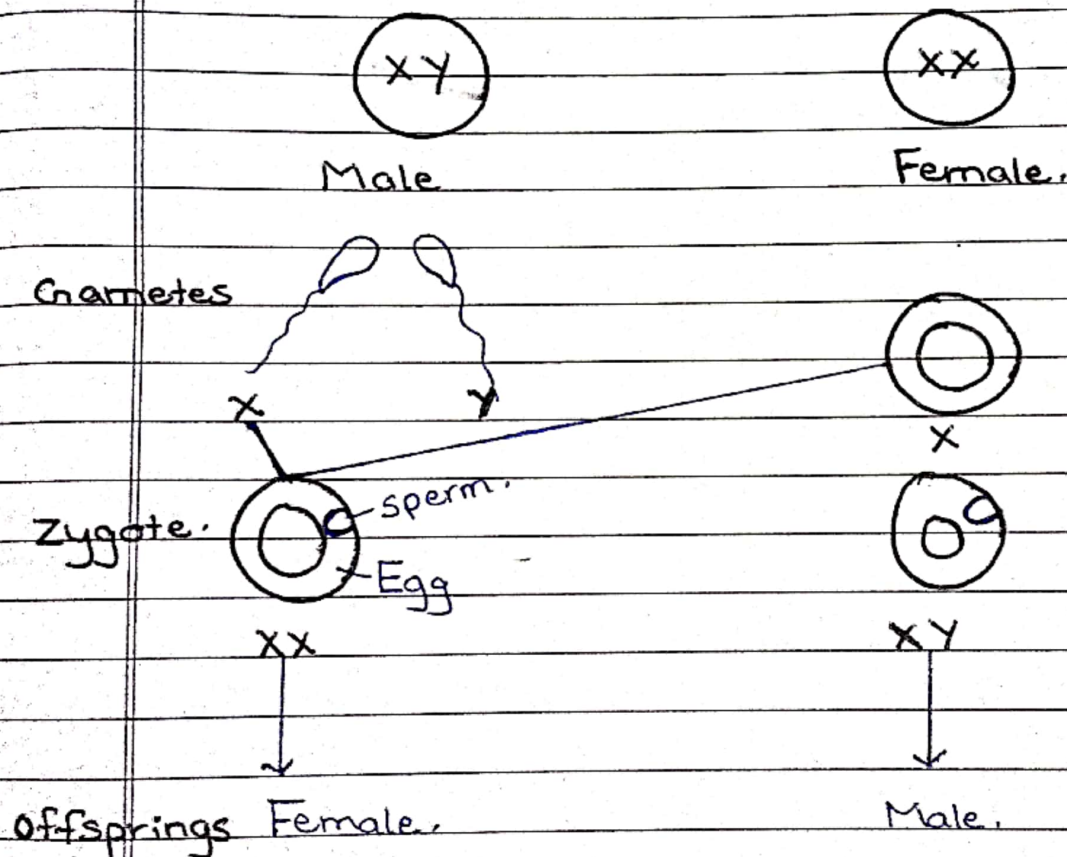
- The sex of offsprings in different organisms is determined in various ways.
- For eg:- In few reptiles - Temperature at which the egg is fertilised determines the sex.

In-snails - It can change sex, hence the sex is not genetically determined.

- In Humans.
- Sex of offsprings is genetically determined.
- Humans have 23 pairs of chromosomes.



- The Eggs of females contain X chromosomes while in case of males - some sperm cells contain X chromosome while others contain Y chromosome.
- If X chromosome carrying sperm fertilizes the egg - XX - Female.
- If Y chromosome carrying sperm fertilizes the egg - XY - Male.



- As males have two different chromosomes - the sex of a child is determined by Father.