CHAPTER – 9
Heredity and Evolution

Genetics : Branch of science that deals with Heredity and variation.

Heredity : It means the transmission of features/ characters/ traits from one generation to the next generation.

Variation : The differences among the individuals of a species/ population are called variations.

MENDEL AND HIS WORK ON INHERITANCE

Gregor Johann Mendel (1822&1884) : Started his experiments on plant breeding and hybridisation

Mendel was known as Father of Genetics

Plant selected by Mendel : Pisum sativum (garden pea). Mendel used a number of contrasting characters for garden pea.

TABLE OF CONTRASTING CHARACTERS. (SEVEN PARTS)		
CHARACTER	**DOMINANT TRAIT**	**RECESSIVE TRAIT**
Flower colour	Purple	White
Flower position	Axial	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf

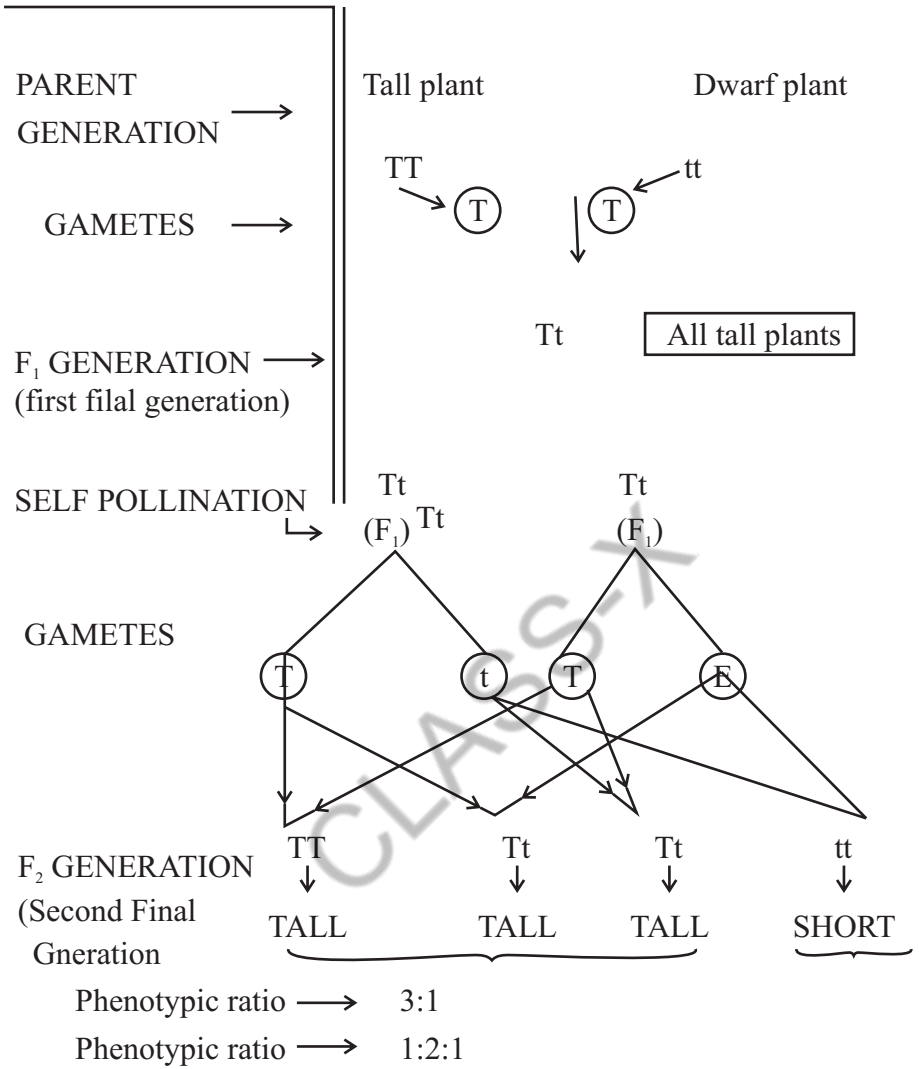
Seven pairs of contrasting characters in $\frac{\text{Garden}}{\text{Pea}}$

Mendels Experiments : Mendel conducted a series of experiments in which he crossed the pollinated plants to study one character (at a time)

Monohybrid Cross :

Cross between two pea plants with one pair (monohybrid cross) contrasting characters

Example : Tall / Short Plants.


PARENT GENERATION
Tall plant
Dwarf plant
GAMETES
TT
T
tt
T
Tt
All tall plants
F1 GENERATION
(first filal generation)
SELF POLLINATION
Tt
(F1)
Tt
Tt
(F1)
GAMETES
T
t
T
t
F2 GENERATION
(Second Final
Gneration
TT
Tt
Tt
tt
TALL
TALL
TALL
SHORT
Phenotypic ratio ⟶ 3:1
Phenotypic ratio ⟶ 1:2:1

CHARACTER	DOMINANT TRAIT	RECESSIVE TRAIT
Seed shape	 Round	 Wrinkled
Seed colour	 Yellow	 Green
Flower colour	 Violet	 White
Pod shape	 Full	 Constricted
Pod colour	 Green	 Yellow
Flower position	 Axial	 Terminal
Stem height	 Tall	 Dwarf

Fig. Mendel's seven different unit characters

TT] Both dominant gene] Pure or conditon — homozygous
tt] Both recessive gene]

Tt] ⟶ One dominant, one recessive gene] — Hetrozygous condition. [Hybrid]

Phenotypic ratio : 3:1

Genotypic ratio : 1:2:1

Phenotype Physical appearance [Tall or Short]
Genotype Genetic make up [TT, Tt or tt]

Observations :
1. All F_1 progeny were tall (no medium height plant (half way characteristic)
2. F_2 progeny ¼ were short
3. Phenotypic ratio F_2 – 3:1
   Genotypic ratio F_2 – 1:2:1

Conclusions :
1. TT and Tt both are tall plants while tt is a short plant.
2. A single copy of T is enough to make the plant tall, while both copies have to be 't' for the plant to be short.
3. Characters/Traits like 'T' are called dominant trait (because it express itself) 't' are recessive trait (because it remains supressed)

Dihybrid Cross : A cross macle between two plants having two pairs of contrasting characters is called dihybrid cross.

PARENT GENERATION ⟶ ROUND GREEN SEEDS — WRINKLED YELLOW SEEDS

RRYY — rryy

GAMETES ⟶ RY — ry

F_1 ⟶

RrYy
[round, yellow]

Selfing F_1

F_1 Rr Yy → RY, Ry, rY, ry

F_1 Rr Yy → RY, Ry, rY, ry } GAMETES

F_2

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

PHENOTYPIC RATIO : Round, yellow : 9
Round, green : 3
Wrinkled, yellow : 3
Wrinkled, green : 1

GENOTYPIC RATIO :
RRYY ; 1
RRYy : 2
RrYY : 2
RRyy : 1
RrYy : 4
Rryy : 2
rrYY : 1
rrYy : 2
rryy : 1

RATIO : 1 : 2 : 2 : 1 : 4 : 2 : 1 : 2 : 1

Observations :
1. When **RRYY** was crossed with **rryy** in F_1 generation all were Rr Yy round and yellow seeds.
2. Self pollination of F_1 plants gave parental phenotype + two mixtures (recombinants) Round wrinkled, green yellow : seeds plants appeared in the ratio of 9:3:3:1

Conclussions :
1. Round and yellow seeds are **DOMINANT** characters
2. Occurence of new phenotypic combinations show that genes for round and yellow seeds are **inherited independently** of each other.

Sex Determination

Phenomenon of decision or determination of sex of an offspring

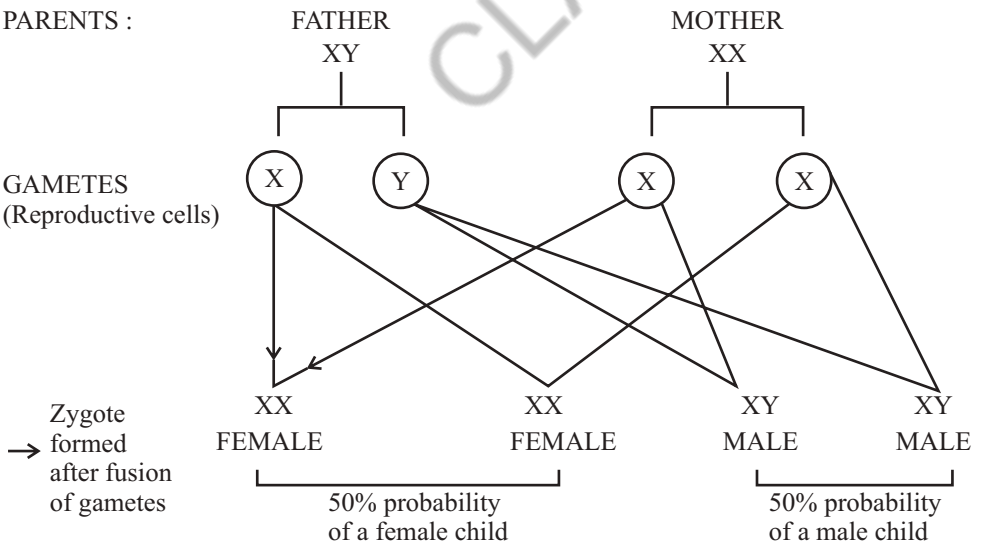
FACTORS
Responsible for Sex Determination

Environmental	**Genetic**
In some animals the temperature at which the fertilised eggs are kept decides the gender.	In some animals like humans gender or individual is determined by a pair of chromosome called sex chromosome
eg. in Turtle	XX – Female XY – Male

Sex Chromosomes : In human beings there are 23 pairs of chromosome. Out of these 22 chromosomes pairs are called autosomes and the last pair of chromosomes that help in deciding gender of that individual are called sex chromosome.

XX – female
XY – male

Sex determination in Human beings



This shows that half the children will be boys and half will be girls. All children will in herit an X chromosome from their mother regardless whether they are boys or girls. Thus sex of children will be determined by what they inherit from their father, and not from their mother.

EXERCISE

(Question Bank)

Very Short Answers (1 Mark)

1. Define variation
2. What is monohybird cross?
3. What is dominant trait.
4. What are genes?
5. Define Homologous organs
6. If an individual has XX chromosome [22+XX] will that individual be male or female.
7. Which plant Mendel had choosen for his experiments.
8. How do Mendel's experiment show that traits may be dominant or recessive?
9. Define analogous organs? Give example.

Short Answers (2 Marks)

1. Differentiate between acquired and Inherited traits? Give example of each.
2. Explain what are fossils? How the age of fossils be determined
3. What is speciation? What factors lead to formation of a new species.
4. Explain the mechanism of sex determination in humans.
5. Differentiate between homologous and analogous organs. by giving examples.
6. Define inheritance. What are the units of inheritance
7. What is genetic drift? How it contributes to the formation of new species
8. Explain monohydrid cross by taking tall and dwarf plants. Mention the phenotypic and genotypic ratio of F_1 and F_2 off springs.

Long Answer (5 Marks each)

1. Explain the process of artificial selection by taking the example of wild cabbage plant.
2. Explain about the human evolution.