

Brain Builders Coaching

Class - X

Genetics

1. Mendel's Laws of Inheritance

Gregor Mendel

- Known as the *Father of Genetics*.
- Conducted experiments on pea plants (*Pisum sativum*).
- Discovered fundamental laws of heredity.

Why Mendel chose pea plant?

- Short life cycle.
- Distinct contrasting traits (e.g. tall/dwarf, round/wrinkled).
- Easy to self-pollinate and cross-pollinate.

Mendel's Three Laws

i) Law of Dominance

In a pair of alleles, one (dominant) masks the expression of the other (recessive).

Example:

- T = Tall, t = Dwarf
- Cross: $TT \times tt \rightarrow \text{All } Tt$ (Tall)

ii) Law of Segregation

Each individual possesses two alleles and they separate during gamete formation, such that each gamete carries only one allele.

iii) Law of Independent Assortment

Alleles of different genes are distributed independently during gamete formation.

2. Monohybrid Cross

Cross between individuals involving **one pair of contrasting traits**.

Example:

Tall (TT) × Dwarf (tt)

TT × tt

Tt

Selfing

Tt × Tt

♂/♀	T	t
T	TT	Tt
t	Tt	tt

- Genotypic ratio = **1 TT : 2 Tt : 1 tt**
- Phenotypic ratio = **3 Tall : 1 Dwarf**

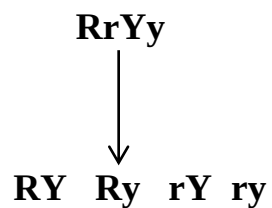
3. Dihybrid Cross

Cross between individuals involving **two pairs of contrasting traits**.

Example:

Round Yellow (RRYY) × Wrinkled Green (rryy)

RRYY × rryy



 	RY	Ry	rY	ry
RY	RRYY Round Yellow	RRYy Round Yellow	RrYY Round Yellow	RrYy Round Yellow
Ry	RRYy Round Yellow	RRyy Round Green	RrYy Round Yellow	Rryy Round Green
rY	RrYY Round Yellow	RrYy Round Yellow	rrYY Wrinkled Yellow	rrYy Wrinkled Yellow
ry	RrYy Round Yellow	Rryy Round Green	rrYy Wrinkled Yellow	rryy Wrinkled Green

- F1: All RrYy (Round Yellow)
- F2: 9:3:3:1
 - 9 Round Yellow
 - 3 Round Green
 - 3 Wrinkled Yellow
 - 1 Wrinkled Green

4. Key Genetic Terms (Detailed)

Gene

A segment of DNA that carries the instructions for a trait or protein.

Example: A gene controlling height in pea plants.

Allele

Alternate forms of a gene found at the same locus.

Example: T (tall), t (dwarf) are alleles of the same gene.

Homozygous

Having identical alleles for a trait.

Examples: TT (tall), tt (dwarf).

Heterozygous

Having different alleles for a trait.

Example: Tt (tall).

Dominant

An allele that expresses its trait even in the presence of a different allele.

Example: T in Tt (Tall plant).

Recessive

An allele whose effect is masked by a dominant allele.

Example: t in Tt (trait not shown).

Genotype

The genetic constitution or combination of alleles.

Example: TT, Tt, or tt.

Phenotype

The observable physical trait.

Example: Tall or Dwarf.

Mutation

A sudden change in a gene or DNA.

Example: Mutation in hemoglobin gene causes sickle cell anemia.

Variation

Differences in traits between individuals of the same species.

Example: Variation in human eye color.

5. Sex Determination in Humans

Chromosome Numbers

- Humans have 46 chromosomes (23 pairs).
- 22 pairs = autosomes, 1 pair = sex chromosomes.

Sex Chromosomes

- Female: XX
- Male: XY

Mechanism

- Egg contributes X chromosome.
- Sperm contributes X or Y.
- **X + X = Girl, X + Y = Boy**
Father decides the sex of the child.

6. Sex-linked Inheritance of Diseases (Criss-cross inheritance)

Inheritance of a gene located on the **X chromosome** (X-linked).

Haemophilia

- **X-linked recessive disorder**
- Blood fails to clot properly.
- Common in males; females are mostly carriers.

Colour Blindness

- Inability to distinguish red and green.
- Also X-linked and recessive.

Criss-Cross Inheritance

- A carrier mother ($X^H X^h$) may pass the trait to her son ($X^h Y$).
- Affected father ($X^h Y$) can pass the gene to daughter (carrier $X^H X^h$).

Table of Terms

Term	Definition	Example
Gene	Unit of heredity	Height gene in pea
Allele	Alternate forms of gene	T and t
Homozygous	Same alleles	TT, tt
Heterozygous	Different alleles	Tt
Dominant	Expressed allele	T in Tt
Recessive	Masked allele	t in Tt
Genotype	Gene combination	TT, Tt, tt
Phenotype	Physical appearance	Tall or Dwarf
Mutation	Sudden change in DNA	Sickle cell anemia
Variation	Differences among individuals	Height in humans