CHAPTER 8 : HEREDITY

Introduction

Living organisms show similarities with their parents, but they are not exactly identical. This is because during reproduction, variations are introduced along with inheritance.

Heredity deals with the **transmission of traits from parents to offspring**, while variation leads to differences among individuals.
Not all variations are useful—only those variations which help an organism survive are selected by nature.

Example:
Children resemble their parents in features like eye colour, height, hair type, etc., but still show differences.

Accumulation of Variation During Reproduction

During reproduction, small changes occur in DNA copying. These changes accumulate over generations.

Key Points:

- In asexual reproduction, variations are very small
- In sexual reproduction, variations are larger due to mixing of genes
- Each generation shows new combinations of traits

- In asexual reproduction → only DNA copying errors cause variation
- In sexual reproduction → variation comes from **both parents + recombination**

Importance of Variation

1. Helps organisms adapt to environmental changes
2. Increases chances of survival of species
3. Leads to evolution over time
   Example: Bacteria resistant to heat survive better during heat waves

Heredity

Heredity is the process by which traits are passed from parents to offspring.

Traits

Traits are characteristics or features of an organism.

Types of Traits :

• **Inherited traits** → passed through genes
• **Acquired traits** → developed during life (not inherited)

Example of acquired trait:
Muscle building, learning skills

Inherited Traits

Inherited traits are those traits which are passed from parents to offspring through genes.

Example:
• Blood group
• Eye colour
• Earlobe type (free or attached)

Mendel's Contribution

Gregor Johann Mendel is known as the Father of Genetics.

He conducted experiments on pea plants and established the basic laws of inheritance.

Mendel was the first scientist to use **mathematics (ratios)** in biology.

Why Pea Plants?

• Easy to grow
• Short life cycle
• Clear contrasting traits
• Can self-pollinate and cross-pollinate

Mendel's Experiments

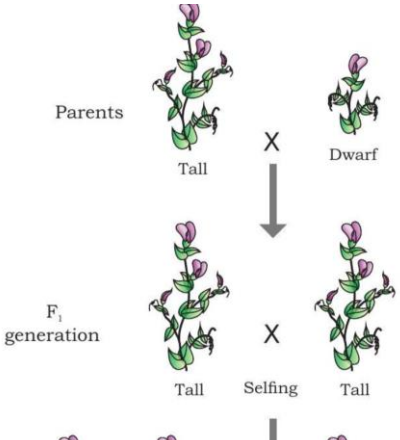
Mendel studied traits such as:
• Tall and short plants
• Round and wrinkled seeds
• Yellow and green seeds

Monohybrid Cross

A cross between two plants differing in one trait.

Example: Tall × Short Plants

Parent Generation:
Tall (TT) × Short (tt)



F1 Generation:
All plants are Tall (Tt)
→ Shows that Tall trait is dominant

F2 Generation (Self-pollination of F1)

Result:
• 3 Tall : 1 Short

Genotypic Ratio:
• 1 TT : 2 Tt : 1 tt

F1 plants **carry both traits**, but only dominant trait shows.
Recessive trait is **not lost**, it is just hidden.

Dominant and Recessive Traits

Dominant Trait

A trait that expresses itself even in the presence of another trait.

Example:
Tallness (T)

Recessive Trait

A trait that expresses only when both alleles are same.

Example:
Shortness (t)

Laws of Inheritance

Mendel proposed three laws:

1. Law of Dominance

When two different traits are present, only one trait (dominant) is expressed.

2. Law of Segregation

The two alleles of a trait separate during gamete formation.
Each gamete gets **only one allele**.

3. Law of Independent Assortment

Traits are inherited independently of each other.
Inheritance of one trait does not affect another trait.

Dihybrid Cross

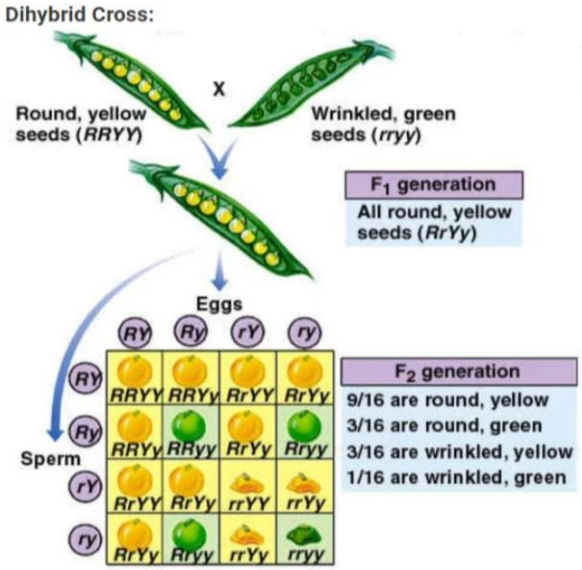
A cross involving two traits at the same time.

Example:
Seed Shape and Seed Colour

- Round (R) / Wrinkled (r)
- Yellow (Y) / Green (y)

F2 Ratio: 9 : 3 : 3 : 1

- 9 Round Yellow
- 3 Round Green
- 3 Wrinkled Yellow
- 1 Wrinkled Green



New combinations appear because genes recombine independently.

Genes and Chromosomes

Gene

A gene is a segment of DNA that controls a particular trait.

Chromosomes

Chromosomes are structures made of DNA that carry genes.

Key Points:

- Humans have 23 pairs of chromosomes
- Each parent contributes one set
- Genes are located on chromosomes

Each cell has **two copies of each gene**, but gametes have only **one copy**.

Expression of Traits

Genes control traits by producing proteins.

Example:
- A gene produces an enzyme
- The enzyme controls growth
- More enzyme → more growth → tall plant

If enzyme works less efficiently → less growth → short plant

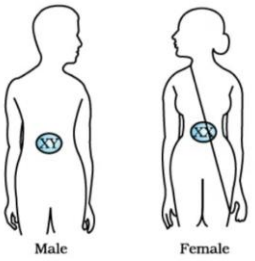
Sex Determination

Sex determination is the process by which the sex of an individual is decided.

Sex Determination in Humans

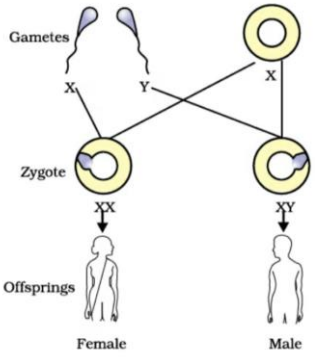
Humans have 23 pairs of chromosomes.

Out of these:
• 22 pairs → Autosomes
• 1 pair → Sex chromosomes



Types of Sex Chromosomes

• Female: XX
• Male: XY



How Sex is Determined

1. Mother always contributes X chromosome
2. Father contributes either:
   • X → Girl (XX)
   • Y → Boy (XY)