

Chapter 2: Genetics - Some Basic Fundamentals

1. Introduction to Genetics:

Genetics is the study of heredity and the variation of inherited characteristics. It explains how traits are passed from parents to offspring through genes.

2. Mendel's Laws of Inheritance:

Gregor Mendel, the father of genetics, formulated three fundamental laws based on his experiments with pea plants:

1. **Law of Dominance:**
 - In a pair of contrasting traits, one trait (dominant) masks the expression of the other trait (recessive).
 2. **Law of Segregation:**
 - Allele pairs separate during the formation of gametes, and each gamete carries only one allele for each trait.
 3. **Law of Independent Assortment:**
 - Genes for different traits are inherited independently of each other.
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3. Monohybrid Cross:

- A monohybrid cross involves the inheritance of a single trait.
 - **Example:** Crossing a tall pea plant (TT) with a short pea plant (tt).
 - **Genotype Ratio (F₂ generation):** 1:2:1 (TT:Tt:tt)
 - **Phenotype Ratio:** 3:1 (Tall:Short)
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4. Dihybrid Cross:

- A dihybrid cross involves the inheritance of two traits.
- **Example:** Crossing pea plants with round yellow seeds (RRYY) and wrinkled green seeds (rryy).
- **Phenotype Ratio (F₂ generation):** 9:3:3:1

- (Round Yellow: Round Green: Wrinkled Yellow: Wrinkled Green)
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5. Important Genetic Terms:

- **Gene:** A segment of DNA that codes for a trait.
 - **Allele:** Different forms of a gene (e.g., T and t for height).
 - **Homozygous:** Having two identical alleles for a trait (TT or tt).
 - **Heterozygous:** Having two different alleles for a trait (Tt).
 - **Dominant:** The allele that expresses itself in the phenotype (T).
 - **Recessive:** The allele that gets masked by the dominant one (t).
 - **Mutation:** A change in the DNA sequence leading to variations.
 - **Variation:** Differences in traits among individuals of the same species.
 - **Phenotype:** The observable traits of an organism (e.g., tall plant).
 - **Genotype:** The genetic makeup of an organism (e.g., TT, Tt, tt).
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6. Sex Determination in Human Beings:

- The sex of a human is determined by the combination of sex chromosomes:
 - **Male:** XY
 - **Female:** XX
 - The male gamete (sperm) can carry either X or Y, while the female gamete (egg) always carries X.
 - If the sperm carries X and fuses with the egg (X), the offspring will be female (XX).
 - If the sperm carries Y and fuses with the egg (X), the offspring will be male (XY).
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7. Sex-Linked Inheritance:

Some genetic disorders are linked to the X chromosome (X-linked inheritance). These include:

- **Haemophilia:** A disorder where blood doesn't clot properly.
 - **Colour Blindness:** An inability to distinguish between certain colors.
 - Since males have only one X chromosome, they are more likely to be affected by X-linked disorders compared to females, who have two X chromosomes (one of which can mask the effect if normal).
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8. Key Points:

- Mendel's experiments laid the foundation for understanding heredity.
- Monohybrid and dihybrid crosses help predict genetic outcomes.
- Sex determination is based on the combination of sex chromosomes.
- X-linked inheritance affects males more frequently due to the presence of a single X chromosome.

