

CHAPTER-8

HEREDITY AND EVOLUTION



Revision Notes

Introduction

- ▶ Variations arise usually during the process of sexual reproduction. They may be few in asexual reproduction, but many in case of sexual reproduction.
- ▶ The minor variations arising during sexual reproduction are caused by slight inaccuracies in DNA copying. In sexual reproduction, variations are also caused by crossing over process during meiosis.
- ▶ Beneficial variations help the species to survive better in the environment.
- ▶ Nature selects the beneficial variations thereby leading to evolution.
- ▶ Sexual reproduction produces offspring with similar body design of the parents. However, the offsprings are not identical and show a great deal of variation from the parents.
- ▶ **Importance of Variation:**
 - (i) Depending upon the nature of variations, different individuals would have different kinds of advantages. e.g., Bacteria that can withstand heat will survive better in a heat wave.
 - (ii) Main advantage of variation to species is that it increases the chances of its survival in a changing environment.

Mendel and His Work on Inheritance

- ▶ **Gregor Johann Mendel (1833 & 1884)** started his experiments on plant breeding and hybridization. He proposed the laws of inheritance in living organisms.
- ▶ Mendel was known as the **Father of Genetics**.
- ▶ Plant selected by Mendel was *Pisum sativum* (garden pea). Mendel used a number of varieties of garden pea to study the inheritance of seven pairs of contrasting characters.

- ▶ **Seven pairs of** contrasting characters in garden plant, selected by Mendel were:

| Character | Dominant Trait | Recessive Trait |
|-----------------|----------------|-----------------|
| Flower colour | Violet | 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/Short |

- ▶ Mendel conducted a series of experiments in which he crossed the pollinated plants to study one character (at a time).

Key Word

Monohybrid cross is a cross between two pea plants with one pair of contrasting characters. e.g., Cross between a tall and a dwarf plant (short)

- ▶ In case of **monohybrid cross** with pure line breeding varieties of plants, the **phenotypic** ratio obtained in F₂ generation was 3:1.

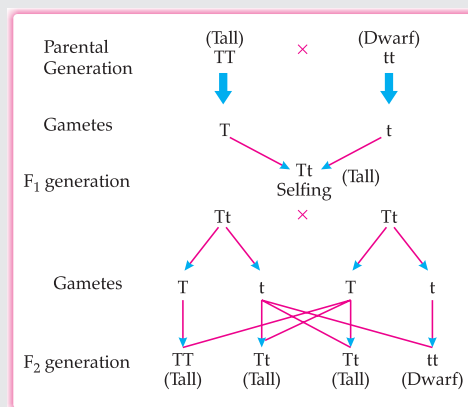
Key Words

Phenotype is the characteristic which is visible in an organism whereas genotype is the genetic composition of an individual.

Dihybrid cross is a cross between two plants having two pairs of contrasting characters. e.g., Cross between green round seed with a yellow wrinkled seed.

Example 1

Cross between tall and dwarf pea plants :

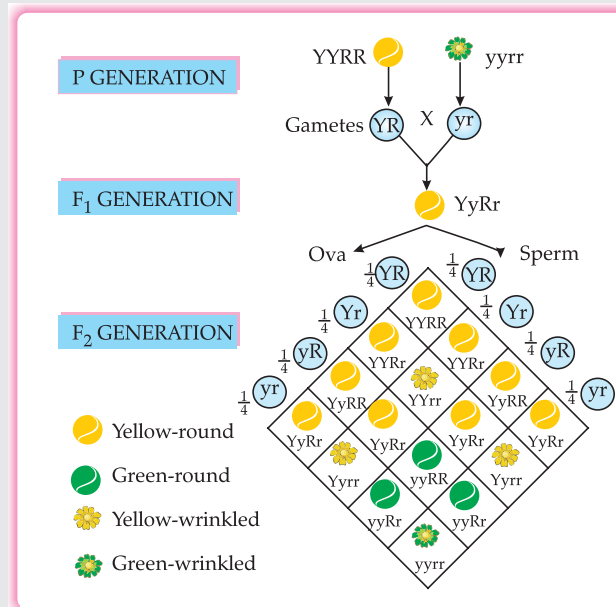


(a) Phenotypic ratio:-Tall: Dwarf (3:1), (b) Genotypic ratio:-Pure Tall: Hybrid Tall: Pure Dwarf (1:2:1)

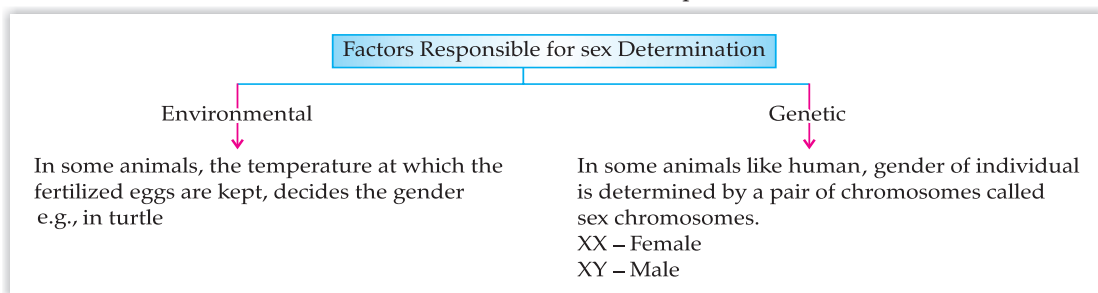
- ▶ In case of **dihybrid cross** i.e., involving two pairs of contrasting characters, the phenotypic ratio obtained in F₂ generation was 9:3:3:1.

Example 2

Cross between pea plants bearing round green seeds with plants bearing wrinkled and yellow seeds:

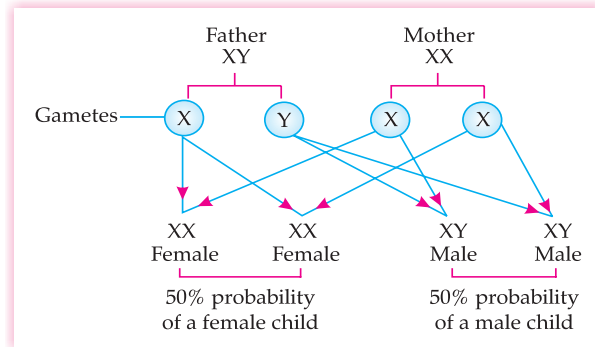


- ▶ Based on above monohybrid cross, he proposed Law of Dominance, which states that “When parents having pure contrasting characters are crossed then only one character expresses itself in F₁ generation. This character is the dominant character and the character which cannot express itself is called recessive character”.
- ▶ The homozygous dominant trait is denoted by two capital letters whereas the homozygous recessive trait is denoted by two small letters.
- ▶ Alleles are alternate forms of genes. For e.g., The gene for eye color has several alleles. Two major alleles are: brown and blue.
- ▶ A dominant allele expresses itself in the presence or absence of a recessive trait whereas a recessive allele is able to express itself only in the absence of a dominant trait.
- ▶ **Law of Segregation:** It states that every individual possesses a pair of alleles for a particular trait. During gamete formation, a gamete receives only one trait from the alleles. A particular trait can be dominant or recessive in a particular generation.
- ▶ **Law of Independent Assortment :** It states that alleles of different characters separates from each other during gamete formation.
- ▶ Genes carry information for producing proteins, which in turn control the various body characteristics.
- ▶ For a particular trait, the offspring receives one allele from the father and one allele from the mother.
- ▶ The combination of the male and female germ cells gives a diploid zygote. Thus, the normal diploid number of chromosomes in the offspring is restored.
- ▶ Different mechanisms are used for sex determination in different species.



- ▶ The process by which sex of a new born individual is determined is called sex determination.
- ▶ **Sex Chromosomes:** In human beings, there are 23 pairs of chromosomes. Out of these, 22 chromosome pairs are called **autosomes** and the last pair of chromosome which helps in deciding sex of the individual is called **sex chromosome**.
- ▶ Autosomes are pairs of chromosomes that are identical in appearance and are not involved in sex determination.
- ▶ Sex chromosomes are pairs of chromosomes involved in sex determination and are not identical in appearance (e.g., X and Y chromosome in humans).

- ▶ **Sex determination in human beings:**
- ▶ A male has one X and Y sex chromosomes (XY) while a female has two X-sex chromosomes (XX).
- ▶ An egg fertilised by X-carrying sperm result into girl child.
- ▶ An egg fertilised by Y carrying sperm results into a boy child.
- ▶ Thus, sex of the child is determined by the type of sperm that fuses with egg.



- ▶ **Acquired traits:** e.g., low weight of beetles.
- ▶ **Inherited traits:** e.g., Colour of eyes and hair, shape of nose, ear lobes.

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