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 F_2 generation was 3:1.

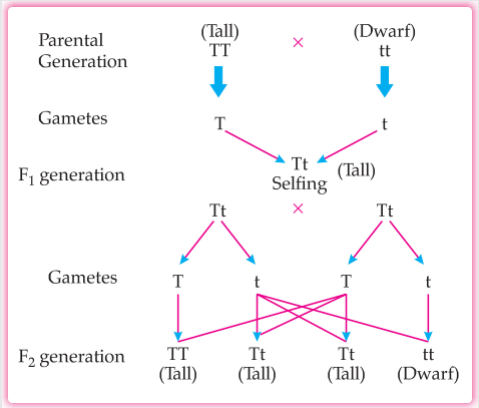
Key Words

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 :

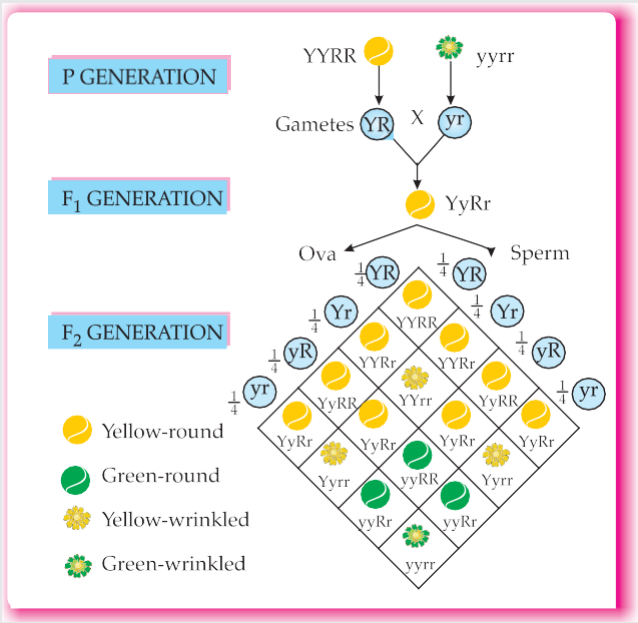


(a) Phenotypic ratio:-Tall: Dwarf (3:1), **(b)** Genotypic ratio:-Pure Tall: Hybrid Tall: Pure Dwarf (1:2:1)

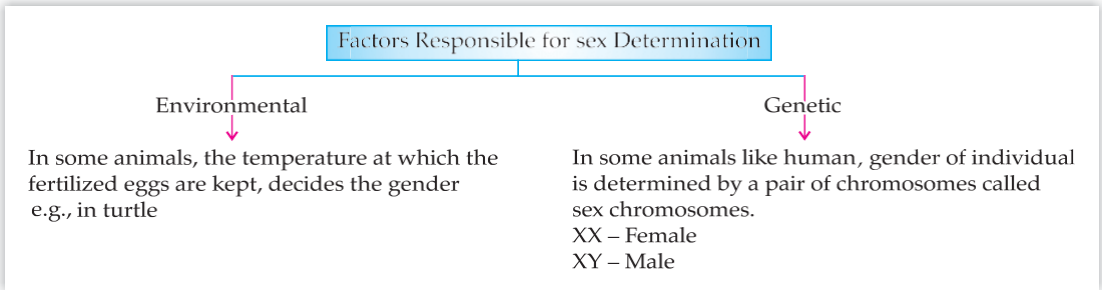
- In case of **dihybrid cross** *i.e.*, involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation was 9:3:3:1.

Example 2

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

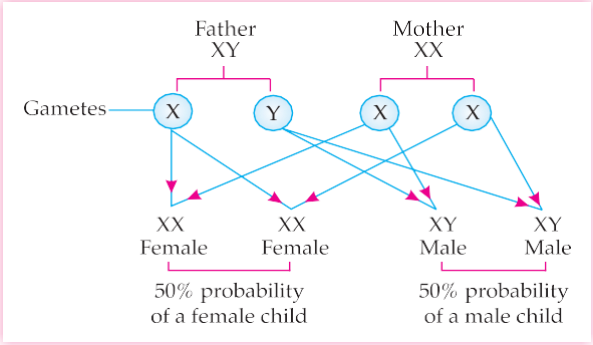


- Based on above monohybrid cross, he proposed Law of Dominance, which states that "When parents having pure contrasting characters are crossed then only one character expresses itself in F_1 generation. This character is the dominant character and the character which cannot express itself is called 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.