

MODULE 15

AIM

The aim of this module is to provide students with an introduction to Gene interaction.

CONTENTS AND OBJECTIVES

- Introduction
- Allelic interaction
- Complete dominance
- Incomplete dominance
- Co-dominance

GENE INTERACTION

INTRODUCTION

- A gene is defined as the unit of heredity that may influence the outcome of an organism's traits.
- Each gene may exist in alternative forms known as alleles. Alleles code for different versions of a particular trait.
- Genes in humans are present in homologous pairs. We inherit one from each of our parents.
- The genotype of an organism is determined by the specific combination of these alleles.
- The set of observable characteristics of the individual is known as the phenotype. It should be noted that the phenotype of an individual is dependent on its genetic constitution.
- Now, the gene for a particular trait may exist in two allelic forms ó one dominant (A) and the other recessive (a). A dominant allele masks the expression of a recessive allele and is represented by an uppercase letter. A recessive allele is the one which exerts its effect only in the homozygous state; in heterozygous state its expression is masked by the dominant allele. Therefore, there could be 3 possible genotypes for a particular character- AA, Aa and aa.
- Just as different alleles of 1 gene can interact in complex ways. 2 different genes can also act together to modify a phenotype.
- Interactions can occur between 2 different genes (**Gene interaction**) or two alleles of the same gene (**Allelic interaction**).

Allelic Interaction

Interaction between the alleles influencing a given trait can be of 3 types:

- 1) Complete Dominance
- 2) Incomplete dominance
- 3) Codominance

COMPLETE DOMINANCE

In diploid organisms, each parent carries two alleles for a trait. Thus, parents may be homozygous or heterozygous with respect to a given trait.

- **Homozygous** indicates that they possess two dominant alleles for a trait. It can further be of two types-
Homozygous dominant genotypes having two dominant alleles for a trait (AA) and
Homozygous recessive genotypes having two recessive alleles for a trait (aa).
- **Heterozygous** indicates that they possess one of each allele for a particular trait (Aa).

In complete dominance, the phenotype produced by a homozygous dominant (AA) is identical to the one produced by a heterozygote (Aa). It happens because the dominant allele produces enough protein for the appearance of the phenotype.

In Mendel's experiment, the monohybrid cross between the tall and dwarf pea plants produced a phenotypic ratio of **3:1** with complete dominance. Similarly, a self-fertilized dihybrid gives a **9:3:3:1** phenotypic ratio.

Some of the human traits correspond to Mendel's law and show complete dominance. Eg., dark colour of hair and eyes and polydactyly (extra finger).

INCOMPLETE DOMINANCE

Incomplete dominance is a condition which arises when neither allele is dominant over the other. This suggests that dominance is not a universal occurrence.

In incomplete dominance a cross between two individuals with two different phenotypes (AA x aa) for a given trait results in offspring having a third phenotype (intermediate) produced as a result of blending of the parental phenotypes. The intermediate phenotype is shown largely by the heterozygotes which carry copies of both the alleles.

A well known example of this condition is Four O'clock plants (*Mirabilis jalapa*). When a plant with red flowers is crossed with the one having white flowers, pink coloured F₁ plants

are obtained. When the pink flowered F1 plants are self-crossed, the phenotypic ratio of F2 plants so obtained is 1:2:1 which is the same as their genotypic ratio.

CO-DOMINANCE

Co-dominance is a condition where the alleles lack dominant and recessive relationship. As a result, the effects of both are observed to same degree phenotypically. The phenotypic effect of both the alleles is observed in heterozygous condition (Aa) which is distinct from the effect produced in homozygous condition.

An example of co-dominant alleles is MN blood group alleles in humans.