ALLELIC RELATIONSHIPS

1 . Dominant and Recessive Alleles.

Whenever one of a pair of alleles can come to phenotypic expression only in a homozygous genotype, we call that allele a recessive factor. The allele that can phenotypically express itself in the heterozygote as well as in the homozygote is called a **dominant** factor. Upper- and lowercase letters are commonly used to designate dominant and recessive alleles, respectively. Usually the genetic symbol corresponds to the first letter in the name of the abnormal (or mutant) trait.

Example. Lack of pigment deposition in the human body is an abnormal recessive trait called "albinism." Using A and a to represent the dominant (normal) allele and the recessive (albino) allele. respectively, 3 genotypes and 2 phenotypes are possible:

Genotypes	Phenotypes
AA (homozygous dominant)	Normal (pigment)
Aa (heterozygotc)	Normal (pigment)
Aa (homozygous recessive)	Albino (no pigment)

Carriers. Recessive alleles are often deleterious to those who possess them in duplicate A heterozygote may appear just as normal as the homozygous dominant genotype. A heterozygous individual who possesses a deleterious recessive allele hidden from phenotypic expression by the dominant normal allele is called a **carrier.** Most of the deleterious alleles harbored by a population are found in carrier individuals.

2. Codominant Alleles.

Alleles that lack dominant and recessive relationships may be called incompletely dominant, partially dominant, semidominam or codominanl. This means that each allele is capable of some degree of expression when in the heterozygous condition. Hence the heterozygous genotype gives rise to a phenotype distinctly different from either of the homozygous genotypes. Usually the heterozygous phenotype resulting from codominance is intermediate in character between those produced by the homozygous genotypes.

Example. The alleles governing the M-N blood group system in humans are codominanis and may be represented by the symbols LM and LN. Two anti-sera (anti-M and anti-N) arc used to distinguish three genotypes and their corresponding phenotypes (blood groups). Agglutination is represented by + and nonagglutinution by -.

Genotype	Reaction with		Blood groups
	Anti - M	Anti - N	Phenotype
$L^M L^M$	+	-	M
$L^M L^N$	+	+	MN
$L^N L^N$	-	+	N

3- MULTIPLE ALLELES

If the mutant allele has developed from the wild form of allele due to mutation, one may expect that the wild form of allele can mutate in more than one way. The mutant form of allele too can mutate once again to give rise to another mutant form of allele. Therefore, it is possible to have more than two allelic forms, i.e., **multiple alleles**, of one kind of gene. Although only two actual alleles of a gene can exist in a diploid cell (and only one in a haploid cell), the total number of possible different allelic forms that might exist in a population of individuals is often quite large. This situation is termed as **multiple allelism**, and the set of alleles itself is called a **multiple allelic series**.

The most important and distinguishing features of multiple alleles are summarized below :

1.Multiple alleles of a series always occupy the same locus in the chromosome.
2.Because, all the alleles of multiple series occupy same locus in chromosome, therefore, no crossing-over occurs within the alleles of a same multiple allele series.

3.Multiple alleles always influence the same character.
4.The wild type allele is nearly always dominant, while the other

mutant alleles in the series may show dominance or there may be an intermediate phenotypic effect.

5.When any two of the mutant multiple alleles are crossed, the phenotype is mutant type and not the wild type.

Example, the human blood groups designated A, B, O, or AB are determined by three types of alleles denoted IA, IB, and IO, and the blood group of any person is determined by the particular pair of alleles present in his or her genotype.

4- LETHAL GENES

Lethal genes are mutant genes and result in the death of the individual which carries them. Death of the individual occurs either in the prenatal or postnatal period prior to sexual maturity. A **fully** (completely) **dominant lethal allele** kills both in homozygous and heterozygous states. Individuals with a dominant lethal allele die before they can leave progeny. Therefore, the mutant dominant lethal is removed from the population in the same generation in which it arose. **Recessive lethal genes** kill only when they are in a homozygous state and they may be of two kinds : 1. one which has no obvious phenotypic effect in heterozygotes and 2. one which exhibits a distinctive phenotype when heterozygous.

The **completely lethal genes** usually cause death of the zygote, later in the embryonic development or even after birth or hatching. Complete lethality, thus, is the case where no individuals of a certain genotype attain the age of reproduction. However in many cases lethal genes become operative at the time the individuals become sexually mature. Such lethal genes which handicap but do not destroy their possessor are called **subvital**, **sublethal** or **semilethal** genes. The lethal alleles modify the 3:1 phenotypic ratio into 2 : 1.

Examples of Lethal Alleles

A. Lethal alleles in plants. In plants, recessive lethal alleles are known which produce **albinism**, where absence of chlorophyll is lethal (fatal) to them. Following two examples illustrate this fact :

In snapdragons (Antirrhinum majus) three types of plants occur : 1. green plants with chlorophyll ; 2. yellowish green plants with carotenoids, usually are referred as pale green, **golden** or **auria** plants and 3. white plants without any chlorophyll. The homozygous green plants have the genotype CC and the homozygous white plant has the genotype cc. The auria plants have the genotype Cc because they are heterozygotes of green and white plants.

B. Lethal alleles in human beings. In humans several hereditary diseases have lethal effects. Few important lethal genes of man are following :

Congenital ichthyosis. One of the most typical cases of a recessive lethal gene in man is expressed in congenital ichtyosis. At birth children afflicted with this disease have a crusted leathery skin with deep fissures down to the subcutaneous tissue; the fissures lead to bleeding, infection and death. Congenital ichthyosis occurs only when there occurs homozygous condition for its recessive lethal genes.