

In a general way, we can say that the probability or chance that an event will occur can be defined as the proportion of times in which that event occurs in a very large number of trials. If there are x trials and the event occurs on the average y times during the x trials, then the probability is expressed as y/x . The probability would be between zero and one. The closer the probability is to zero, the less chance is there for the event to occur. When probability is one, the event is certain to occur.

Rules of probability:

The multiplication rule: While considering probabilities it is important to note that the inheritance of certain genes such as for height of pea plants (tall or dwarf), flower colour (red or white), seed texture (round or wrinkled) are independent events. If we consider each gene separately, the probability of any one F_2 plant being tall is $3/4$, and of its being dwarf $1/4$.

Similarly, there is a probability of $3/4$ that an F_2 plant will bear red flowers and $1/4$ that the flower will be white. Now what is the probability that an F_2 plant would be both tall and coloured? Assuming that the inheritance of each gene is an independent event, the probability that a plant be coloured and tall is equal to the product of their individual probabilities, *i.e.*, $3/4 \times 3/4 = 9/16$. Thus there are 9 chances out of 16 that an F_2 plant be coloured and tall. Stated in a general way, when the probability of an event is independent of that of another event, and the occurrence of one does not influence the occurrence of the other, probability that both events will occur together is the product of their individual probabilities.

The Addition Rule: The probability that *one* of several mutually exclusive events will occur is the *sum* of their individual probabilities. This law is applicable when different types of events cannot occur together. If one occurs the other is *excluded*. When a coin is tossed there are two alternatives, either heads or tails will appear. If the probability for heads is $1/2$, for tails $1/2$, then the probability that either heads or tails will appear is $1/2 + 1/2 = 1$.

DOMINANCE RELATIONSHIPS

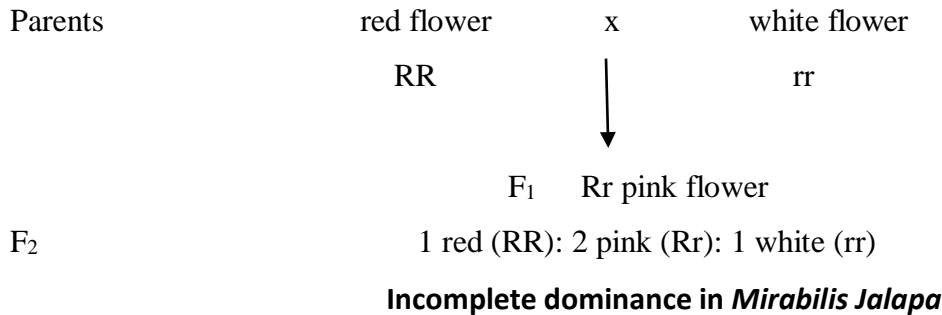
i) Complete dominance:

In case of complete dominance, the phenotype produced by heterozygotes is identical with that produced by homozygotes for the concerned dominant allele. The dominant allele in such a situation is known as completely or fully dominant. An example of

complete dominance occurs for seed shape in peas. Round seed shape is produced by the dominant allele W, while wrinkled shape is determined by its recessive allele w. Seeds having the genotype Ww are round and indistinguishable from those having the genotype WW. As a result, characters showing complete dominance yield the typical 3:1 monohybrid ratio in F₂.

ii) Incomplete dominance:

Mendel always observed complete dominance of one allele over the other for all the seven characters which he studied in garden pea. Later on, cases of incomplete dominance were reported. For example, in four ‘O’ clock plant (*Mirabilis Jalapa*) there are two types of flowers, viz., red and white. A cross between red and white flowered plants produced plants with intermediate flower colour, i.e., pink colour in F₁ and a modified ratio of 1 red: 2 pink: 1 white was observed in F₂.



iii) Codominance:

In case of co dominance both alleles express their phenotypes in heterozygote. The example is AB blood group in human. The people who have blood type AB are heterozygous exhibiting phenotypes for both the I^A and I^B alleles. In other words, heterozygotes for co- dominant alleles are phenotypically similar to both parental types. The main difference between co -dominance and incomplete dominance lies in

the way in which genes act. In case of co- dominance, both alleles are active, while in case of incomplete dominance only one allele (dominant) is active.

iv) Overdominance:

In case of some genes, the intensity of character expression is greater in the heterozygotes than in the two concerned homozygotes. This situation is known as overdominance. True overdominance is known in the case of some genes. Many cases of presumed overdominance may actually be cases of repulsion phase linkage and/or epistasis. The white eye (w) gene of *Drosophila* exhibits overdominance for some of the pigments, e.g., sepiapteridine and himmelblaus. Allele w produces white eye in homozygous state (ww), while its completely dominant allele W gives rise to the normal dull red eye colour. Eye pigments sepiapteridine and himmelblaus are present in low concentrations in ww homozygotes, while WW homozygotes have relatively higher concentrations of these pigments. However, flies heterozygous for this gene (Ww) have an appreciably higher concentration of these two pigments than the two homozygotes (WW and ww). Genes showing overdominance would also give rise to 1:2:1 ratio in F₂.