

Genetic Linkage:-Part A

The tendency of genes (DNA sequences) to stay together in a chromosome is called genetic linkage. The genes linked together in a chromosome are called the Linkage group. It was observed in the fruitfly *Drosophila*, TH Morgan and colleagues (1910) determined that genes are not completely independent. The linkage group is equivalent to a chromosome. Thus, due to the linkage, the genes present in a particular chromosome will inherit together when the gametes are formed.

For example, the “A” and “B” alleles which are present in same chromosome will both be passed on together if the chromosome is inherited. “A” and “B” are linked due to their occurrence in the same chromosome. Similarly., “a” and “b” are linked in the other chromosome.

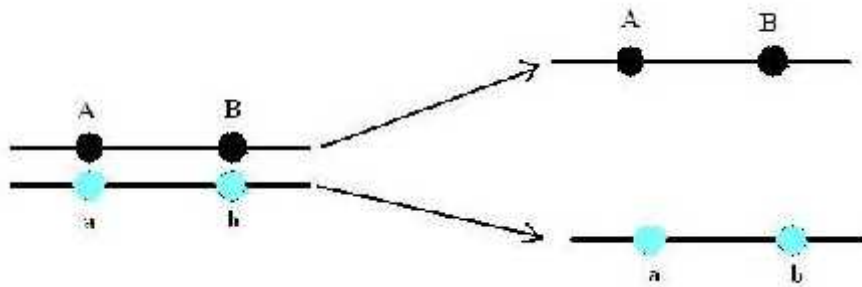


Fig:Linked genes tend to be inherited together because they are located on the same chromosome.

Above image taken from google

Law of independent assortment suggests that when two or more than two factors are considered together, each member of a pair of homologous chromosomes segregates during meiosis independently of the members of other pairs, so that alleles carried on different chromosomes are distributed randomly to the gametes. For example Plants having round and yellow seeds (RRYY) crossed with plants having wrinkled green(rryy) seeds, all the F1 plants have the genotype RrYy. When these are selfed,, the factors for the two characters assort or separated independently of each other. R may enter the gamete either with Y or y and r also may enter the gamete with Y or y. Thus four types of gametes are formed: - RY, Ry, rY and ry are formed, which can recombine in 16 ways to produce 9 genotypes and four phenotypes in the F2 generation. Dihybrid F2 ratio of 9 : 3 : 3 : 1 and test cross ratio of 1 : 1 : 1 : 1 in diploid plants are expected on this general principle of independent assortment.

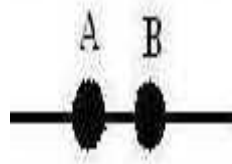
Types of linkage, depending upon the distance between linked genes in a chromosome.

1)complete linkage

2)Incomplete linkage

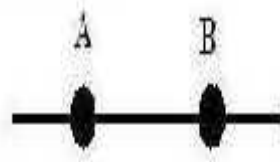
3)Absent linkage

Complete Linkage:-During synapsis exchange of segment take place. In such condition the possibility of separation of two genes situated close together is greatly reduced. When genes are closely associated and tend to transmit together, it is called complete linkage.



‘A’ & ‘B’ are too close to each other

Incomplete Linkage:-When linked genes are situated at long distance in chromosome and have chances of separation by crossing over are called incomplete linked genes and the phenomenon of their inheritance is called incomplete linkage.



‘A’ & ‘B’ are separated to allow crossing over between them

Absent (Not detectable) Linkage:-The probability of cross over increases with the physical distance between genes on a chromosome , and genes that are located quite far from each other with in a linkage group may not exhibit any detectable linkage.



‘A’ & ‘B’ are too far apart to allow crossing over between them in all

Test cross:-By crossing plants having unknown genotype (example TT or Tt) with a homozygous recessive plants (tt), it is possible to know the unknown genotype within one generation.

For example to know whether a given tall plant has the genotype TT or Tt it is crossed with homozygous dwarf (recessive) tt plant.

a) If the unknown genotype is TT

$$\begin{array}{ccc} \text{TT} & \times & \text{tt} \\ & \downarrow & \\ & \text{Tt} & \end{array}$$

All offspring would be tall

b) If the unknown genotype is Tt

$$\begin{array}{ccc} \text{Tt} & \times & \text{tt} \\ & \downarrow & \\ \text{Tt,Tt} & & \text{tt,tt} \end{array}$$

50% Tall 50% dwarf