

# Linkage and Meiotic Crossing Over

## Encyclopedia Article

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# Linkage and Meiotic Crossing Over

Linkage is a term used to describe the physical association of genes located on the same **chromosome**. When genes are located on the same chromosome, they do not assort independently and, as a result, linked genes are separated only by breakage or cross-over during **meiosis**.

When genes are closely linked, the alleles inherited from one parent tend to stay together. Correspondingly, the alleles from the other parent also stay together during assortment. The **characters and traits** (e.g., seed cover smoothness, flower color, etc.) associated with linked genes fail to follow expected Mendelian mathematical distributions in offspring when compared to alleles that are inherited independently of one another.

Linkage can be established by conducting a test cross (e.g., the mating of a dihybrid with a homozygous recessive for a particular trait. Test crosses are valuable to geneticists because they provide insight into the actual genotype of the gametes involved in a mating.

Linkage is also a term used to describe the phenomenon of two or more non-allelomorphic genes repeatedly occurring in the same **gamete** (a **haploid** reproductive **cell**). These genes and their appropriate alleles are passed from generation to generation as a joined unit not subject to separation through independent assortment.

Because linkage occurs on the same chromosome, one chromosome is one linkage group. When cross over occurs during meiosis (**cell division** that produces four haploid gametes), the linkage breaks down. **Crossing over** is the exchange of genes by chromosomes during meiosis that alters the genetic information contained within the chromosome. The further apart the alleles are on the chromosome the more likely a cross over event will occur between their respective locations.

Linkage values and changes in linkage values following cell division provide a rough guide to the physical distance between genes located on the same chromosome. Cross-over mapping produced some of the earliest forms of genetic (or linkage) maps. Linkage maps were based on the percentages of cross-over between linked non-allelomorphic genes and showed the relative locations of genes within the chromosomes of an organism.