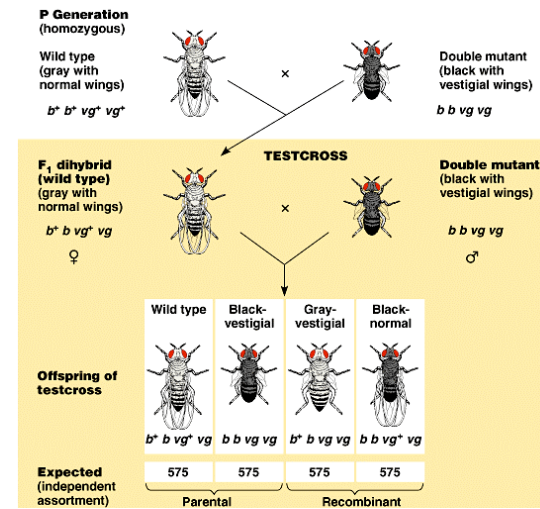
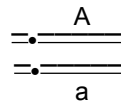


Genetic Linkage and Mapping



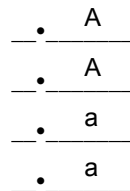
Notation

Aa
Diploid
Adult



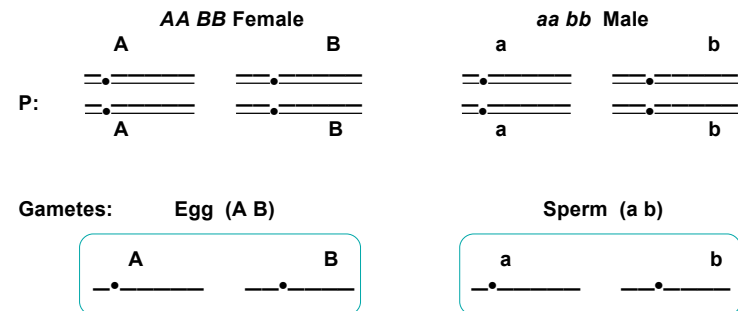
Two homologous chromosomes, four chromatids total

Haploid gametes (single chromatid)



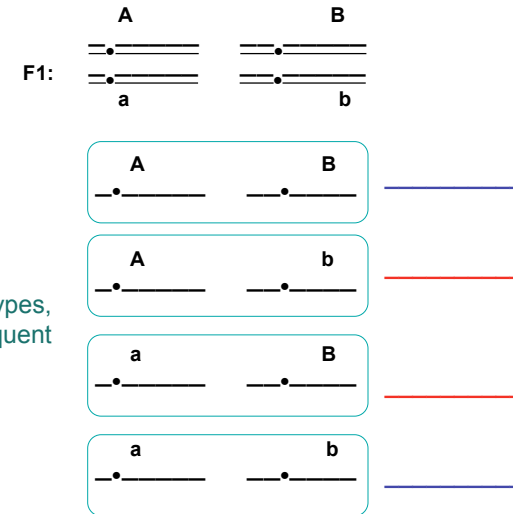
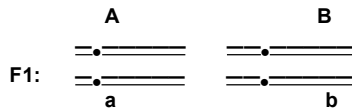
1/2 A : 1/2 a

Dihybrid Cross



F1 adult

after the S phase



F2 of dihybrid cross when genes not linked

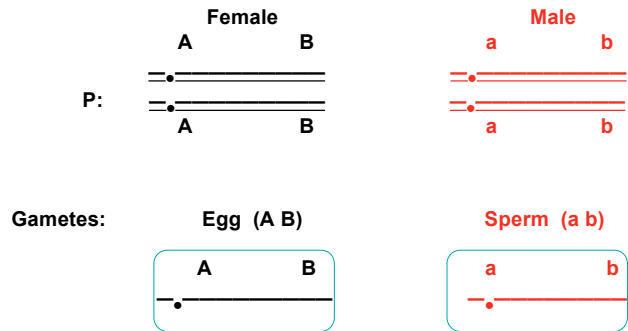
What proportion of the gametes of the double heterozygote are recombinant?

But what if the genes are on the same chromosome?

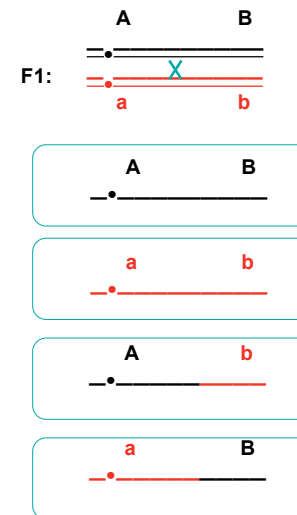
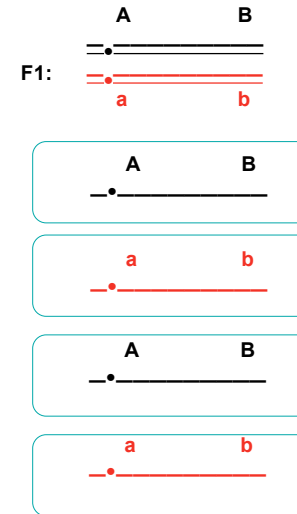
(What if the genes are linked?)

They do not assort independently at meiosis

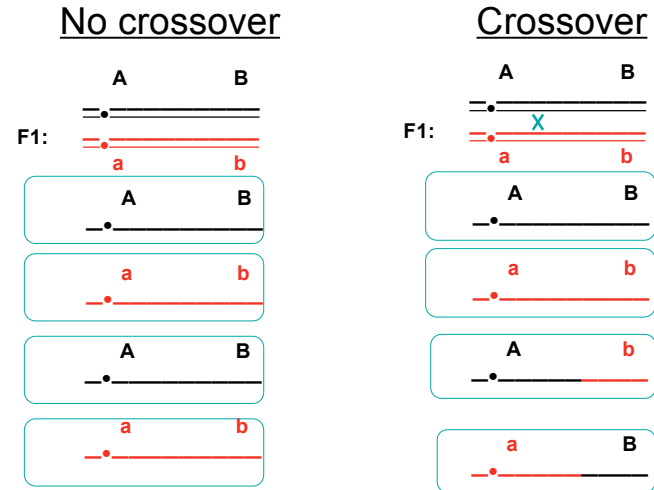
Two linked genes



When there is no crossing over between markers, all gametes are _____



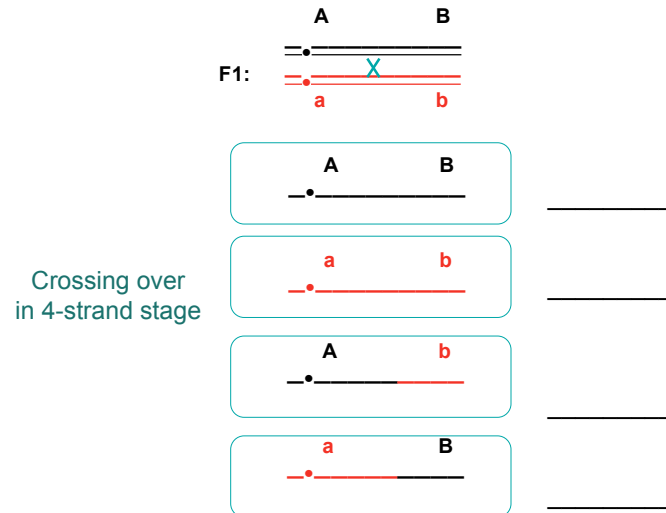
When there is a crossover, _____ of gametes are **parental** and _____ are **recombinant**



When genes are on the same chromosome, but far apart:

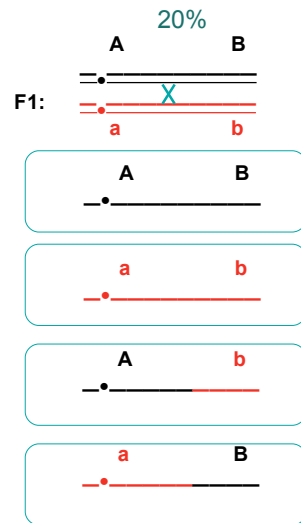
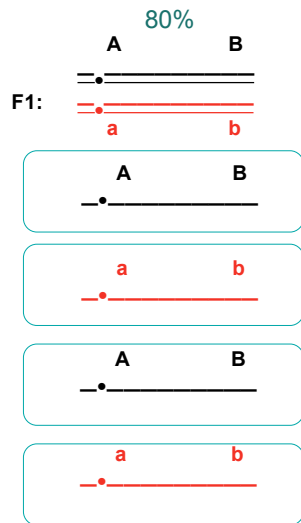
Crossing over between them will be common, approaching 100% of the time

In this case, what proportion of all F1 gametes will be recombinant (have a combination of alleles that was not present in the original true-breeding parents)?



Genes that are so far apart on the same chromosome that crossing over occurs between them in 100% of meioses behave as if they are unlinked:

_____ parental combinations
 _____ recombinants



What if genes are close together?

Say that crossing over occurs between the genes in 20% of meioses

What proportion of F1 gametes will be recombinant?

If crossing over between genes occurs in 20% of meiosis

_____ of gametes will be recombinant

Genes with < 50% recombination are on the same chromosome

Genes that have 50% recombination (*independent assortment*) are either on non-homologous chromosomes or

The frequency of crossing over between two genes on the same chromosome is proportional to the distance between the genes

This is the basis of *genetic mapping*

At small distances crossing over is rare and few gametes are recombinant (r is near 0%)

As distance between genes increases, crossover frequency increases, and more gametes are recombinant ($_ < r < _$)

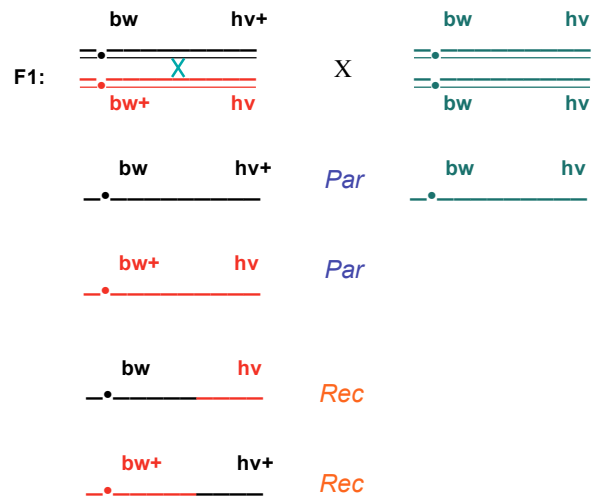
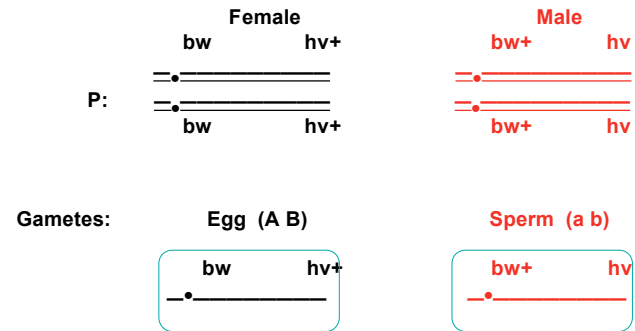
At greater distances, crossover nearly always occurs and $r \rightarrow _$

How would you tell if a gamete produced by a double heterozygote is recombinant or parental?

How would you determine the genotypes of gametes produced by a doubly-heterozygous individual?

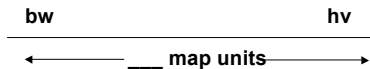
Mate double heterozygote to
an individual that is
homozygous recessive for
both traits

Two linked genes



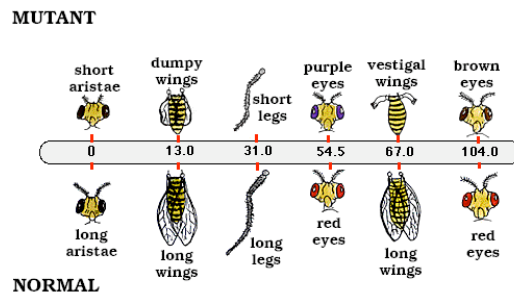
If 15% of the offspring of the testcross are recombinant, what proportion of meioses had crossover between the *brown* and the *heavy-veined* genes?

If 15% of the gametes are recombinant, the genes are said to be 15 map units apart on a genetic map

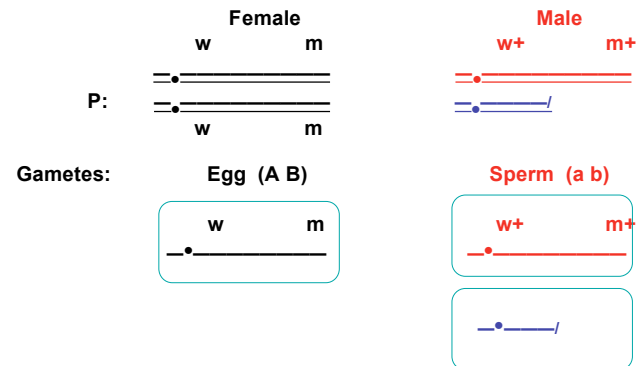


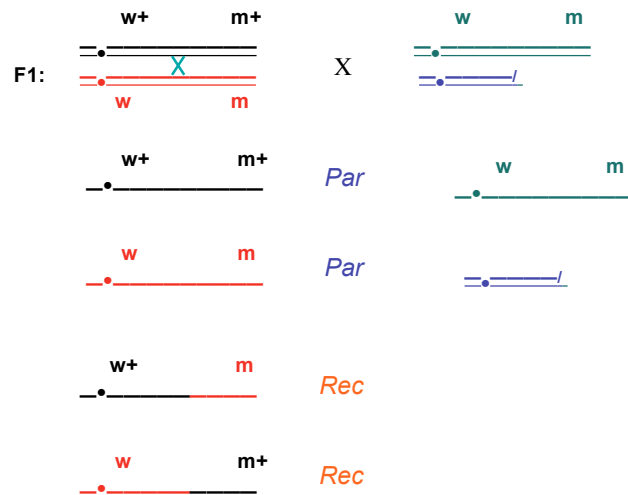
Unit of distance in linkage map is a map unit: 1 map unit is equal to 1 percent recombination

A map unit is also equivalent to the physical distance along a chromosome which will experience 1 crossover event in every 100 meiotic divisions



Two X-linked genes





**62.8% non-recombinant offspring,
37.2% recombinant offspring**

How far apart (in map units) are the genes?

 map units

If two genes are 50 map units apart, what proportion of recombinant offspring would you observe?

What would you conclude about these two genes?

