

In the absence of independent assortment, crossing over should be the reason for the presence of recombinants in the testcross progeny. Crossing over involves exchange of chromosome segments between non-sister chromatids of homologous chromosomes and the resulting chromosomes after crossing over will exhibit no morphological differences. Therefore, except the visible chiasmata, there is no other cytological observation which will substantiate that actual exchange of chromosome segments really takes place. However, it is not necessary that chiasmata should be associated with exchange of chromosome segments. Therefore, to demonstrate that crossing over is associated with actual exchange of chromosome segments, special experiments were devised by Curt Stern in *Drosophila* and by **H.S. Creighton** and **B. Mc Clintock** in maize (corn).

Cytological Proof of crossing over (Curt Stern's experiment in *Drosophila*)

Drosophila (fruitfly) stocks were utilised by **C. Stern** to study genetic crossing over between the two genes controlling two separate characters, eye colour and eye shape. In one X-chromosome of female *Drosophila* has a translocated part of Y-chromosome attached to it while the other X-chromosomes was broken into two fragments. These two X-chromosomes in the female fly could be distinguished not only from each other, but also from normal X-chromosome under the microscope. In the female fly, only one of the two fragments of an X-chromosome carried mutant alleles for *carnation* eye (*car* is recessive showing light eye colour) and *barred* eye shape (*B* is dominant showing narrower eyes). The other X-chromosome, having a part of Y attached, carried normal alleles of these two genes, so that the female heterozygote for both these genes (*car B/+ +*) had barred eyes with normal eye colour, since *car* is recessive to +.

Such females were crossed with male flies having recessive alleles for both these genes (*car, +*). In such a situation, this makes a simple testcross. If no crossing over takes place between the two genes in question, two types of gametes i.e., *car B* and ++ will be produced from the female flies. Crossing over will give two additional types of gametes i.e., *car +* and + *B* (See Figure). Male fly produce two types of gametes (*car +* and Y), because crossing over does not take place in *Drosophila* male. Due to fertilization of the four types of female gametes (two types of non-crossover and the other two types of crossover gametes) with the two types of male gametes (*car +* and Y), four kinds of female flies and four kinds of male flies will be produced (Figure).

The female flies which are classified as crossovers (recombinants) on the basis of phenotype i.e., *carnation* with normal eye shape and red barred were studied cytologically under microscope. It

was found that carnation flies did not have any fragmented X-chromosome, but rather had normal X-chromosome. On the other hand, barred flies had a fragmented X-chromosome with a segment of Y-chromosome attached to one of the two fragments of X-chromosome. Such cytological observations suggested that genetic crossing over was accompanied with an actual exchange of chromosome segments between non-sister chromatids of homologous chromosomes. This has proved that genetic crossing over is the result of cytological crossing over. Similar proof of cytological crossing over was provided by Creighton and Mc Clintock in Miaze.

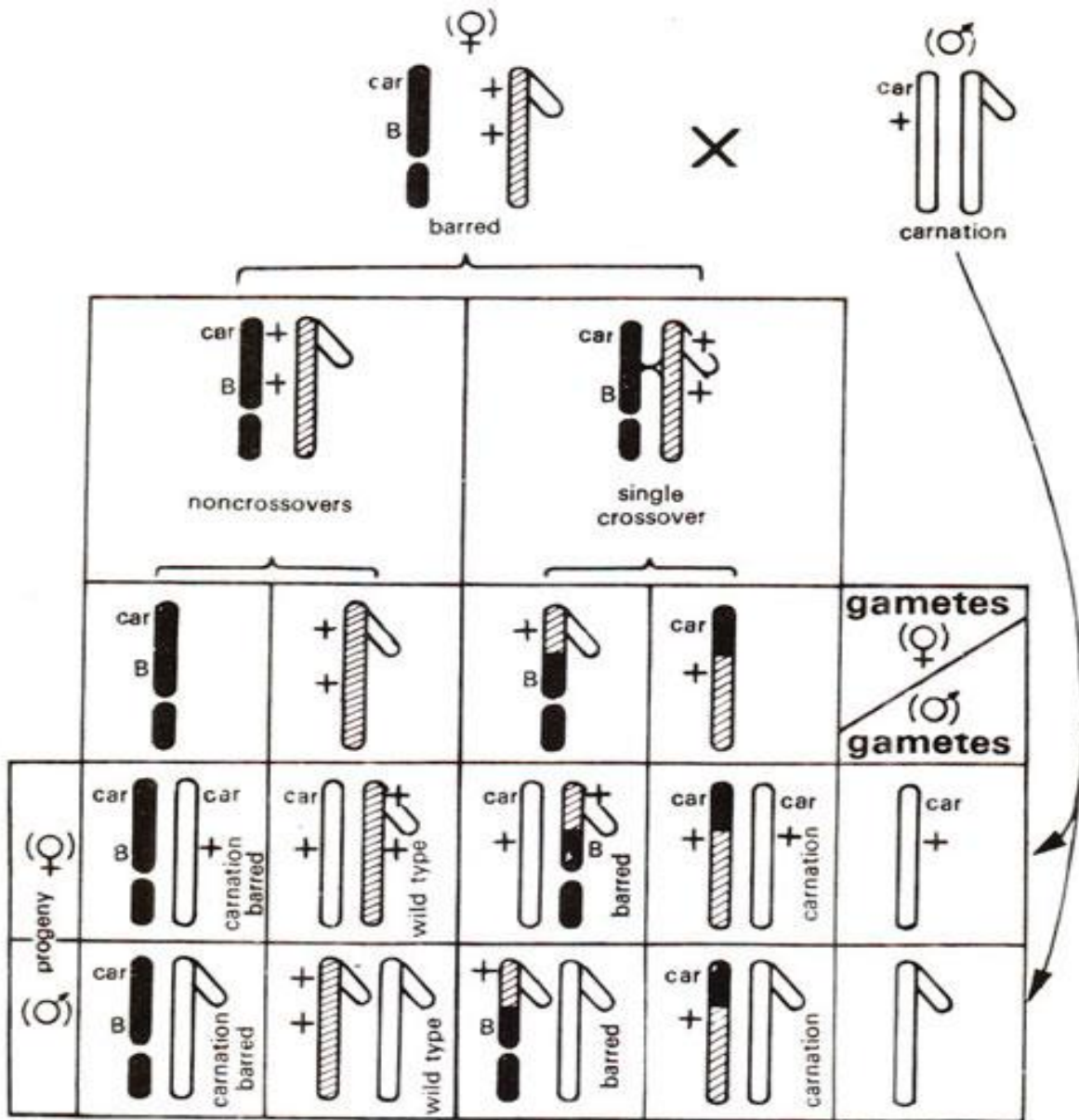


Fig. Curt Stern's experiment to demonstrate cytological crossing over.