

Crossing over

2010

Crossing over can be defined as the interchange of corresponding chromosomal parts between chromatids of homologous pair of chromosome resulting in a recombination of linked genes.

as it occurs in the first division of meiosis

According to the occurrence in somatic or germ cells following two types of crossing over have been recognized.

① Somatic or mitotic Crossing over:-

When the process of crossing over occurs in the chromosome of body or somatic cells of an organism during the mitotic cell division, it is known as mitotic crossing over. The somatic crossing over is rare in occurrence has no genetic significance.

② Germinal or meiotic crossing over:-

Usually the crossing over occurs in the germinal cells during the gametogenesis in which includes the

May 2010	30	31						
	2	3	4	5	6	7	8	
	9	10	11	12	13	14	15	
	16	17	18	19	20	21	22	
	23	24	25	26	27	28	29	

Process is a genetic by which the two chromosomes of homologous pair are equal fragment with each other

At that stage each chromosome is replicated into two strands called sister chromatids

$$\frac{9119}{L} \times \frac{9117}{L} = \frac{9118}{L} \times \frac{9118}{L} + \frac{17}{L}$$

meiotic cell division, takes place. This type of crossing over is known as meiotic or germinal crossing over. The meiotic crossing over is universal in its occurrence & is of great genetical significance.

Example in crossing over.

① Recombination in Drosophila.

In a cross betⁿ a grey body vestigial wing (BBrr) & black body long wing (bbRR), Drosophila produce F₁ all of this are (BbRr). When female flies and crossed (bbrr) male then double recessive having vestigial wing & black coloured produce four type of offspring with following percentages

- Grey vestigial 41.5% } Non cross over
Black long 41.5% } or real
- Black vestigial long 8.5% } cross over
long grey 8.5% } recombination

thus the recombination of gene ^{17%} or reappearance of non parental combination is found as 17% of the offspring.

Notes

March 2010	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31			

Ex. 2 Recombination of Maize.

APRIL 2010

In the same way, the appearance of recombination can also be represented in maize. As described when a heterozygous colour & normal felled seed plant of maize produced as a result of cross betⁿ colourless, shrunken seed plant in F₂ generation four varieties are

9 FRI

- 1. Coloured full 48.2 } 96.4% Parental combi
- Colourless shrunken 48.2 } ratios
- 3. Coloured shrunken 1.87
- 4. Colourless Full 1.8 } 3.6 Recombination

The formation of new combination has occurred on account of exchange of chromosome part between homologous chromosome.

Mechanism of Meiotic Crossing over:-

The process of crossing over includes following stages.

- ① Synapsis
- ② Duplication
- ③ Crossing over
- ④ Terminalization.

	30	31					1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
May 2010	16	17	18	19	20	21	22
	23	24	25	26	27	28	29

Notes

11 SUN Synapsis:- During the zygotene prophase of the meiotic cell division, homologous chromosomes come close to each other and pairing of them takes place. The phenomenon of pairing is called synapsis.

Duplication:- The synapsis is followed by duplication of chromosomes during this stage, each homologous chromosome of a bivalent chromosome splits longitudinally and ~~formed~~ to form two identical sister chromatids, which remain held together by centromere.

12 MON

3. Crossing over:- The crossing over occurs only during the four strand or tetrad stages. During the process of crossing over, two non-sister chromatid first breaks at the corresponding points due to the activity of a nuclear enzyme endonuclease. Then a segment on one side of each break connects with a segment

on the opposite side of the break, so that the two non-sister chromatids cross each other. The fusion of the chromosomal segment with that of the opposite one take place due to the action of an enzyme ligase. The crossing of two chromatids is known as Chiasma formation.

The crossing over may take place at several points in one tetrad and may result in the formation of several ~~that~~ chiasmata. The number of chiasmata depend on the ~~strength~~ length of the chromosome, because the longer of chromosome the greater the number of chiasmata.

14 WED

④ Terminalization

After the occurrence of process of crossing over, the non-sister chromatids starts to repel each other because, the force of synapsis attraction keepings them together lapse. The chromatids separate from the centromere towards the chiasma is known as terminalization. Due to the terminalization the homologous chromosome

May 2010	30	31	4	5	6	7	1
	2	3					8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29

Notes

are separated completely

.....

Significance of crossing over

APRIL 2010

15 THU ① Crossing over shows new combination of genes which result in the variation among species. These variations are helpful for natural selection and evolution of species.

② The phenomenon of crossing over is universal in its occurrence and it occurs in viruses, bacteria, moulds, plants and animals. It is necessary for the natural selection because due to this the chances of variation increase.

16 FRI 3. Crossing over suggests that genes are arranged linearly in the chromosome.

4. Crossing over helps in the hybridization experiments for evolution of new characters viz. disease resistant, pest resistant etc.

⑤ It helps in building chromosomal map i.e. location of genes on the chromosome.

⑥ It helps in the understand the nature