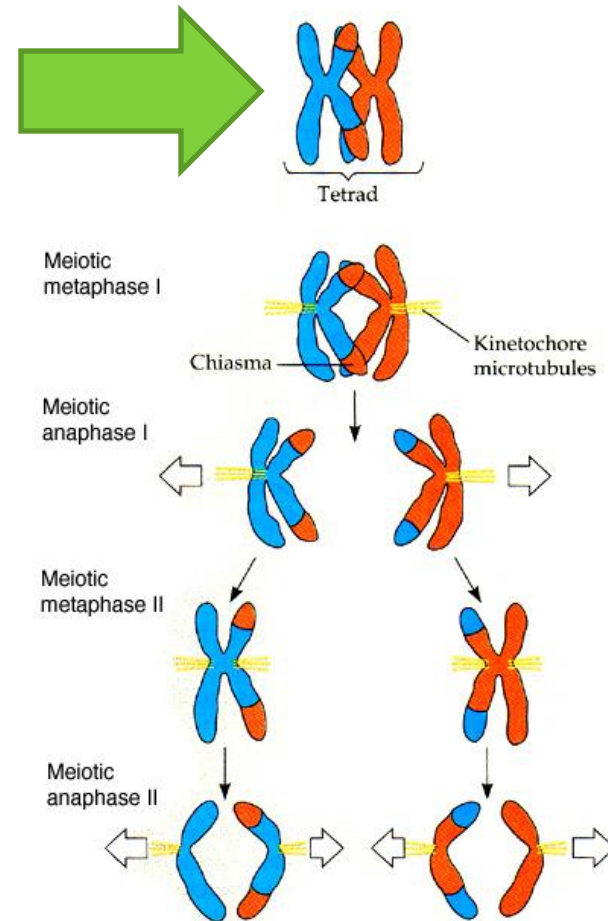
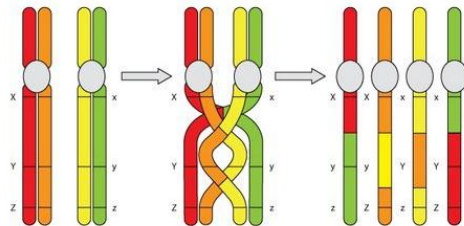


Three Point Crosses

Genetic Mapping

What is a three point cross?

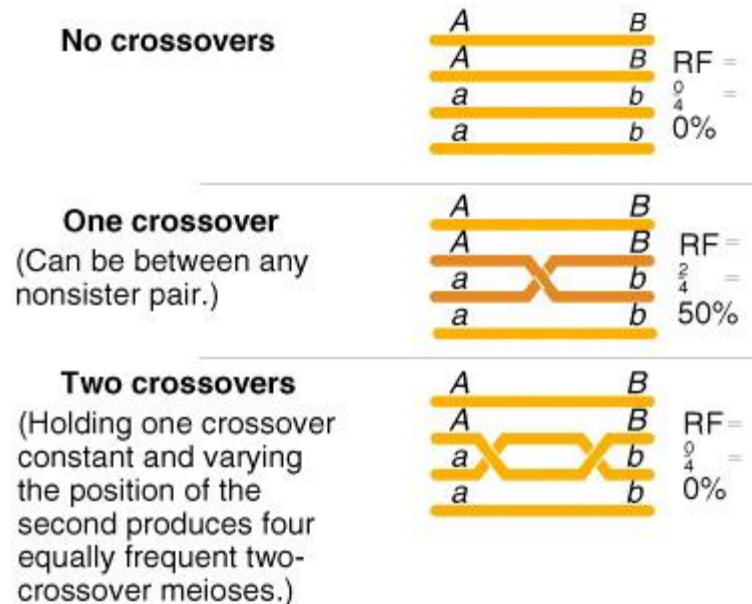
- During meiosis, chromosomes are replicated and form a tetrad (see arrow). While the chromosomes are lined up close to one another, they have the opportunity to interact with one another, get tangled, and recombine to form new combinations of alleles.
- **Three point cross** refers to using 3 points (genes) to determine the order and distance between the genes.



Interactions of Chromosomes and Crossovers

During interactions of the chromosomes in the tetrad state, the DNA strands can have no crossovers, one crossover, two crossovers or more.

In a three point cross, chromosomes that have undergone no, one, or two crossovers will be used.



Why are three point crosses important?

- By solving a three point cross you can determine two important things:
 - order of the genes on a chromosome.
 - determine the distance (in map units) between each pair of genes.

Conditions for a Three Point Cross

- The genotype of the organism must be heterozygous at all loci that will be used for the cross. Homozygous alleles do not allow for differentiation of origin of alleles.
- The genotypes of the offspring must be able to be observed in order to determine which alleles have been inherited.
- There must be a sufficient number of offspring produced to give a representative sample this is large enough to get accurate results.

Nomenclature in 3-pt crosses

- Mutant alleles are represented by letters (s, v, w, sc, etc.)
- Wildtype (non mutant) alleles are signified by a + sign.
- All three alleles that are on a single chromosome are written together.
 - s + v = two mutant alleles and one wildtype allele
 - + + + = all wildtype alleles
 - SCO- single crossover
 - DCO-double crossso

Solving a Three-Point Cross

- Draw a map of these 3 genes (v,w, and z) showing the distances between all pairs of genes, and then calculate the value of interference.

First, the offspring need to be arranged into reciprocal pairs of no crossovers, SCO, and DCO.

Because there is a higher probability of having no crossovers, the two genotypes with the highest number of offspring are NCO (no crossover) .

There are two sets of SCO, and the two with the lowest offspring will be DCO.

v	w	z	1	DCO
V	+	+	61	SCO (1)
+	w	+	88	SCO (2)
V	+	z	96	SCO (2)
+	+	z	367	NCO
+	+	+	3	DCO
+	w	z	46	SCO(1)
v	w	+	338	NCO

- Next you need to determine which order of alleles on the chromosome will result in the DCO.

- If the no crossovers are

- + + z
- v w +

And the DCO are

- + + +
- v w z

In order for this to be a double crossover, the z allele must be in the center.

- w z v

Now that we know the order of the genes, the distance between them.

+	+	z	367
v	w	+	338
+	w	+	88
V	+	z	96
V	+	+	61
+	w	z	46
v	w	z	1
+	+	+	3

Determining the Distance Between Alleles

- Order of alleles : w z v
- Distance influences the probability of crossover.
 - The larger the distance, the more likely crossover will occur.
 - The shorter the distance, crossover will occur less frequently.
- To determine the distance, add the number of times crossover occurred between the two loci.

$$\text{SCO+DCO} / \text{Total Offspring} * 100 =$$

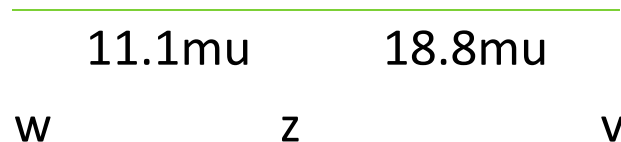
number of map units between genes

+	+	z	367
v	w	+	338
+	w	+	88
V	+	z	96
V	+	+	61
+	w	z	46
v	w	z	1
+	+	+	3

Calculations for Distances

- v – z distance
 - DCO between v and z = $1+3= 4$
 - SCO between v and z = $96+88= 184$
 - Total Crossovers between v and z = 188
 - $188/1000*100= 18.8$ map units
- z - w distance
 - DCO between z and w = $1+3= 4$
 - SCO between z and w = $46+61=107$
 - Total Crossovers between z and w = 111
 - $111/1000*100= 11.1$ map units

+	+	z	367
v	w	+	338
+	w	+	88
V	+	z	96
V	+	+	61
+	w	z	46
v	w	z	1
+	+	+	3



References

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- Created by: Miriam Schmid