10.2 Inheritance

Dihybrid Cross

- A dihybrid cross is a cross between two individuals that shows the inheritance of two different genes at the same time; usually involving unlinked autosomal genes.
- The parents carry different pairs of alleles for each trait.
- One parent carries a homozygous dominant allele, while the other one carries a homozygous recessive allele. The offsprings produced after the crosses in the F1 generation are all heterozygous for specific traits.

Steps for creating a Dihybrid cross

1. Determine all possible combinations of alleles in the gametes for each parent.
2. Cross the offsprings of the F1 generation to determine the offsprings of the F2 generation.
3. Write out the phenotype ratios of potential offspring.

Example of a dihybrid cross (F2 generation)

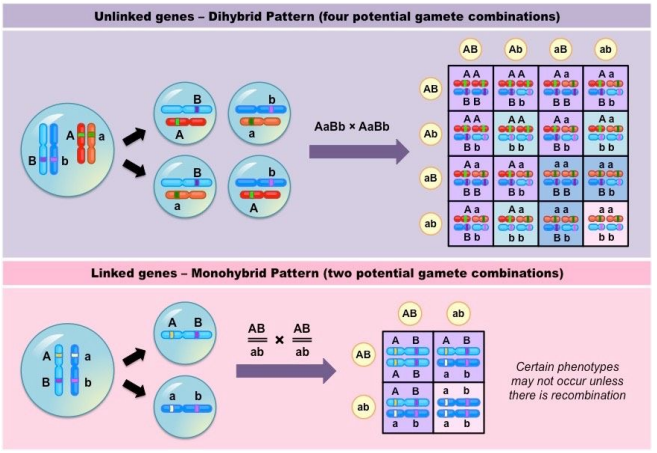
BbSs x BbSs

	BS	Bs	bS	bs
BS	BBSS	BBSs	BbSS	BbSs
Bs	BBSs	BBss	BbSs	Bbss
bS	BbSS	BbSs	bbSS	bbSs
bs	BbSs	Bbss	bbSs	bbss

Linked genes

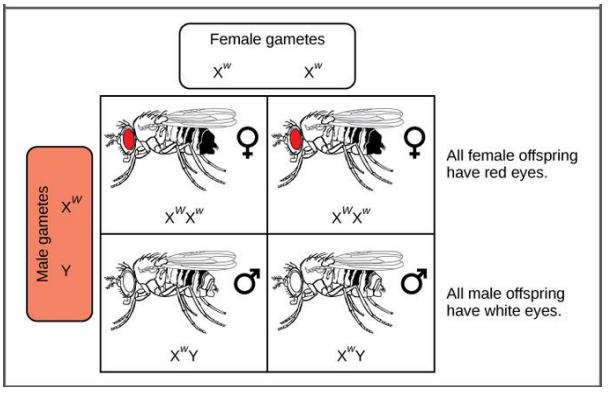
- Gene loci are said to be linked if on the same chromosome.
- Any genes that are found on the same chromosome and are therefore more likely to be inherited together are considered to be linked.
- When these genes (alleles) are inherited together as a group, they are considered to be a part of the same linkage group.
- Linked genes may become separated via recombination (due to crossing over during synapsis in meiosis I)

Linked genes are represented as vertical pairs: $\frac{AB}{ab}$



Sex Linkage

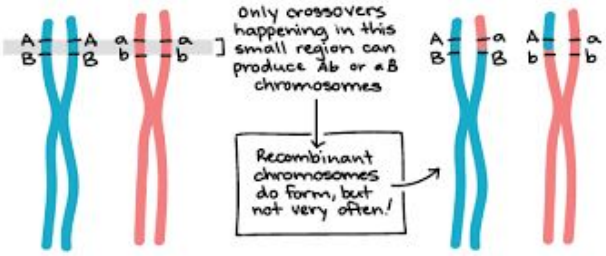
- When cross-breeding red-eyed wild types with white-eyed mutants, a clear sex bias in the phenotypic distribution were discovered.
- All-female offspring of a red-eyed male were red-eyed, whereas all male offspring of a white-eyed female were also white-eyed.
- Morgan described this distribution as a 'sex-limited' inheritance.
- It was inferred that it was caused by the gene for eye color is located on a sex chromosome (i.e. X-linked).



Gene Linkage

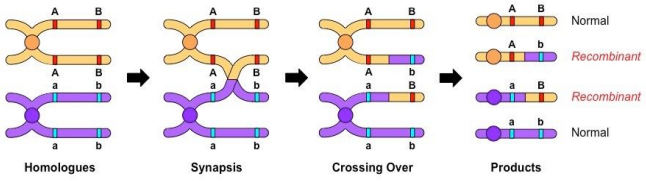
2 key proposals-

1. The alleles for these traits were located on a shared chromosome (gene linkage) and hence did not independently assort.
2. Linked alleles could be uncoupled via recombination (crossing over) to create alternative phenotypic combinations, but these new phenotypes would occur at a much lower frequency.



- crossover frequency may be a product of the distance between two genes on a chromosome - genes with a higher crossover frequency are further apart, whereas genes with a lower crossover frequency are closer together.

Recombinants in linked genes



- Recombinants of linked genes are those combinations of genes not found in the parents.
- If linked genes become separated by a chiasma, there will be an exchange of alleles between the non-sister chromatids which creates new allele combinations that are different from those of the parent.
- frequency of recombinant phenotypes within a population will typically be lower as crossing over is a random process
- relative frequency of recombinant phenotypes will be dependent on the distance between linked genes.
- The frequency of two linked genes will be greater when the genes are further apart on the chromosome.

Polygenic traits

- These are characteristics controlled by more than two gene loci.
- tend to exhibit continuous variation
- Increasing the number of loci responsible for a particular trait increases the number of possible phenotypes.
- These are also influenced by environmental factors

Example - Human height

- It is controlled by multiple genes
- environmental factors such as diet and health (disease) can further influence an individual human's height.

Example - Skin color

	ABC	*ABc*	*AbC*	*aBC*	*Abc*	*aBc*	*abC*	*abc*
ABC	6	5	5	5	4	4	4	3
ABc	5	4	4	4	3	3	3	2
AbC	5	4	4	4	3	3	3	2
aBC	5	4	4	4	3	3	3	2
Abc	4	3	3	3	2	2	2	1
aBc	4	3	3	3	2	2	2	1
abC	4	3	3	3	2	2	2	1
abc	3	2	2	2	1	1	1	0