Chapter 10

Genetic:
Mendel and Beyond

Definitions

- ✓ Transmission genetics
  - ✒ How is variation passed from one generation to the next
- ✓ Molecular genetics
  - ✒ How DNA and the cell carry these instructions
- ✓ Phenotype
  - ✒ Physical and behavior characteristics
- ✓ Genotype
  - ✒ Collection of genes (genome)
- ✓ Gene
  - ✒ A region of DNA that codes for a protein

Genetics

- ✓ Study of inheritance
  - ✒ Transmission genetics
    - ☞ The study of how variation passed from one generation to the next.
  - ✒ Molecular genetics
    - ☞ The study of how DNA carries genetic instructions and how the cells carry out these instructions.

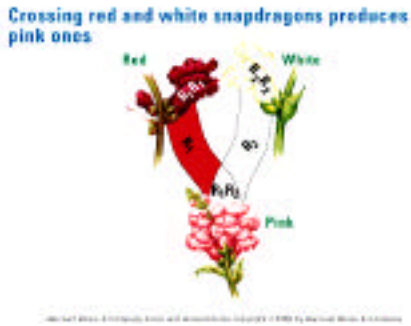
Genetic Characteristics

- ✓ Phenotype
  - ✒ Physical and behavior characteristics
    - ☞ Height, skin color, hair color
- ✓ Genotype
  - ✒ Genetic constitution of our cell or organism
    - ☞ Collection of genes
  - ✒ Genes
    - ☞ Region of DNA that codes a protein (structural genes) or regulates expression of a protein (regulatory genes)

Laws of Inheritance

- ✓ All organisms use DNA as the genetic material.
- ✓ In eukaryotic organisms, DNA is organized into chromosomes.
- ✓ All chromosomes exist as pairs in sexual reproduction.
- ✓ In all eukaryotes, chromosomes behave in the same way during meiosis and fertilization.

Equal blending of traits (blending of inheritance)



Asexual reproduction

✓ Offspring have genes from one parent
✓ Mitotic process
✓ Cloning
✓ Energy efficient

Sexual reproduction

✓ Offspring inherit genes from each parent
✓ Genetic recombination (diversity)
✓ Meiotic process
✓ Uses a lot of energy

Diploid cells possess 2 copies of a gene

✓ Each gene is located on a homologous chromosome.
✓ Alternative versions of a gene are called alleles.
✓ Alleles are located on the chromosomes--one on each homolog.

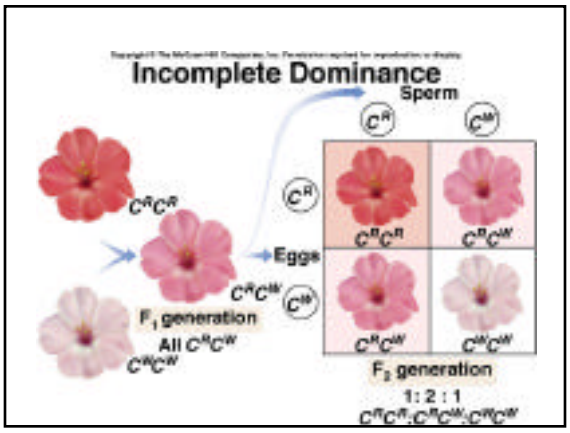
Allele pairs

✓ If an allele pair are identical, or the cell contains 2 copies of the same allele, the organism is HOMOZYGOUS.
✓ If an allele pair are different, or the cell contains two different alleles of a gene, the organism is HETEROZYGOUS.

Alleles

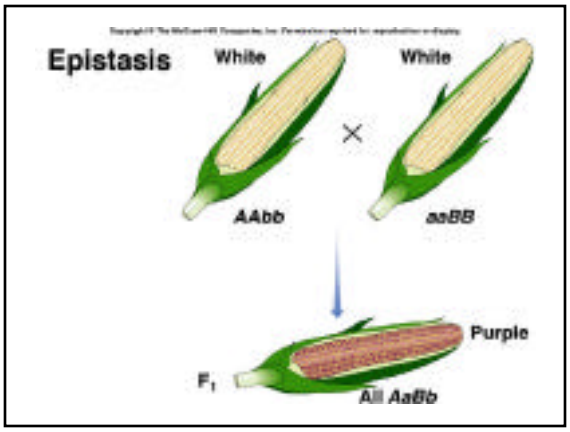
Dominance

✓ Dominance:
  ✒ One member of an allele pair is expressed over the other allele
✓ Recessive:
  ✒ The allele that is either not expressed, or whose expression is masked by the expression of the dominant allele
✓ Incomplete dominance:
  ✒ neither trait is masked by the other
✓ Codominance:
  ✒ Both traits are equally expressed



Incomplete dominance

Two genes with 4 alleles that control eye color

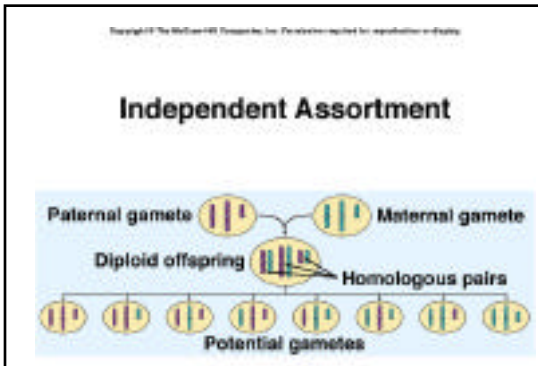


Law of Segregation

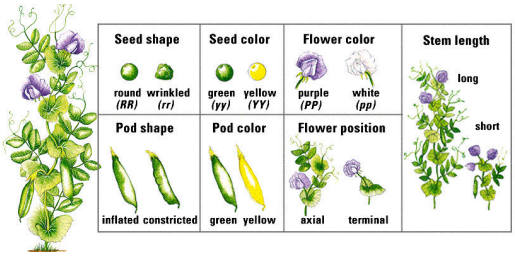
- ✓Each organism has two genes (or alleles) for each trait expressed.
- ✓These alleles segregate in the production of gametes.

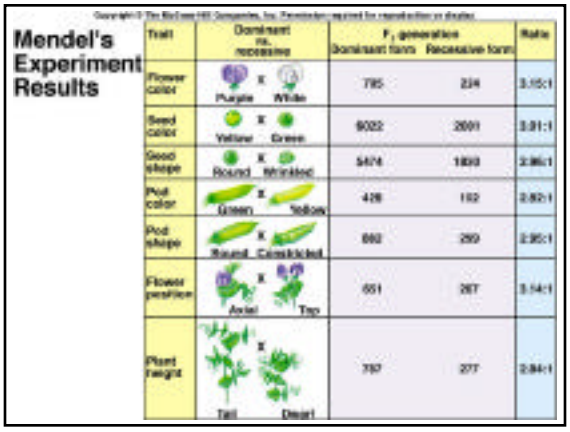
Law of Independent Assortment

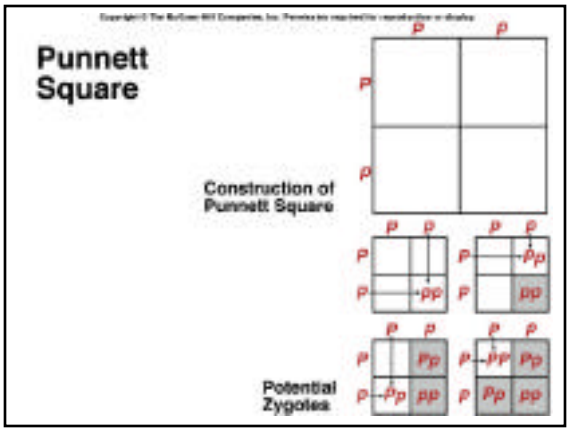
- ✓Unlinked genes or alleles assort (separate) independently in meiosis.



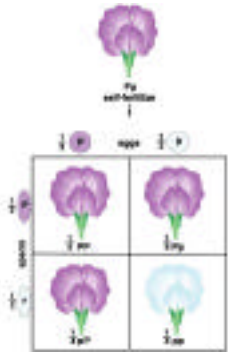
Mendel's pea traits



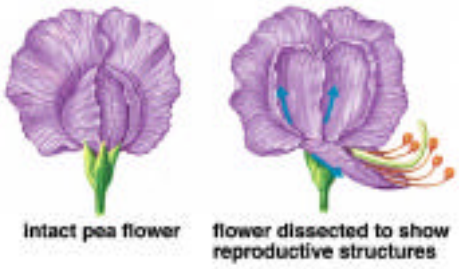




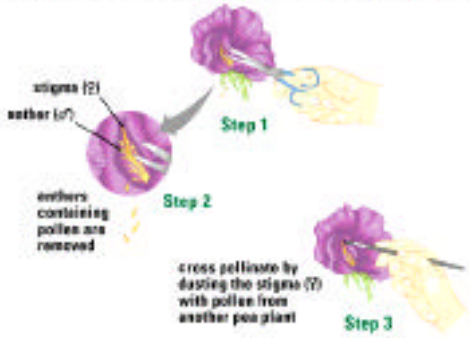
Punnett square method

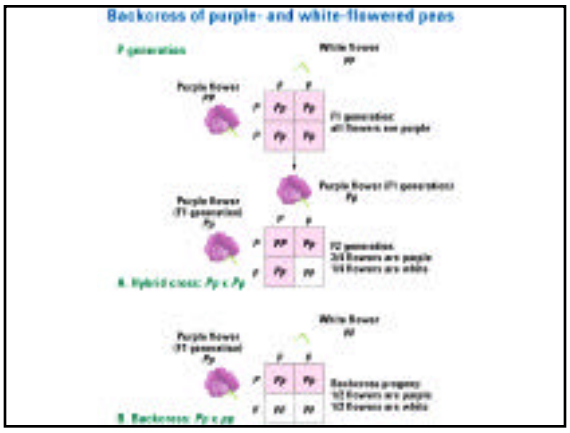


Pea flower

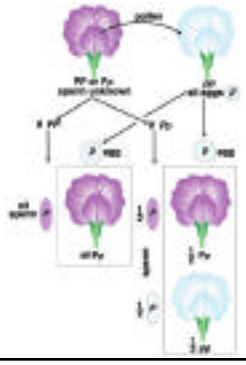


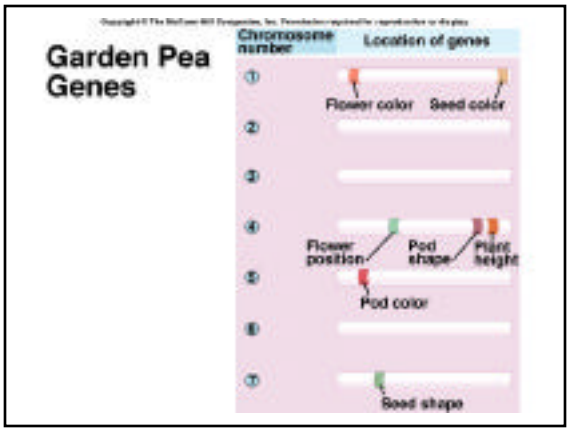
Plants are sterilized to prevent self fertilization



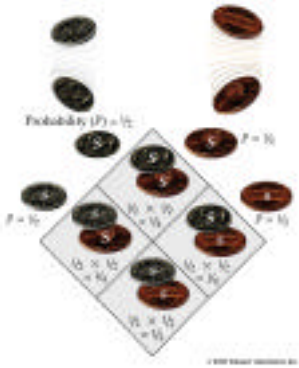


Test Cross

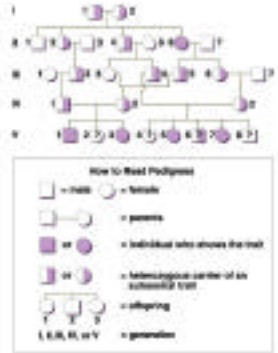




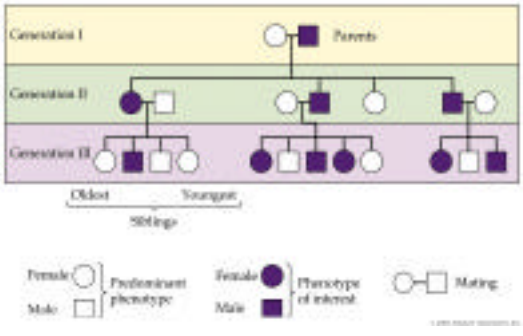
Independent events

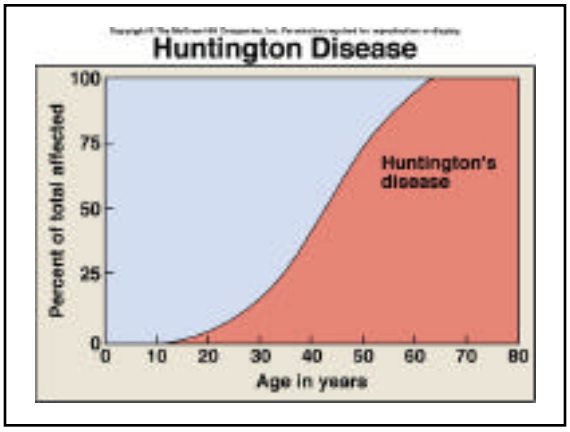


Reading pedigrees

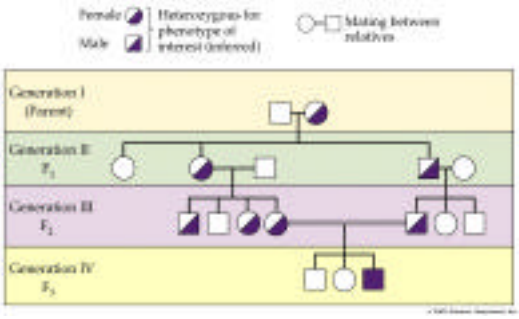


Dominant Pedigree (Huntington's disease)

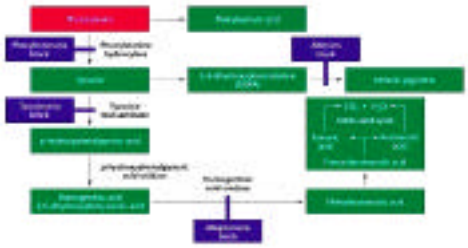




Recessive pedigree (albinism)



Phenylketonuria (PKU)



Albinism

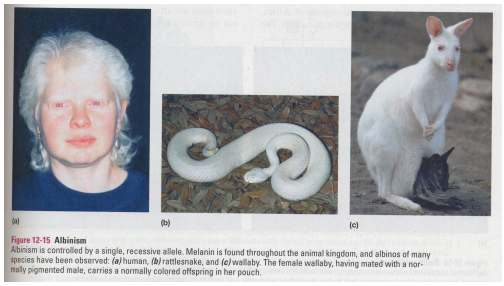
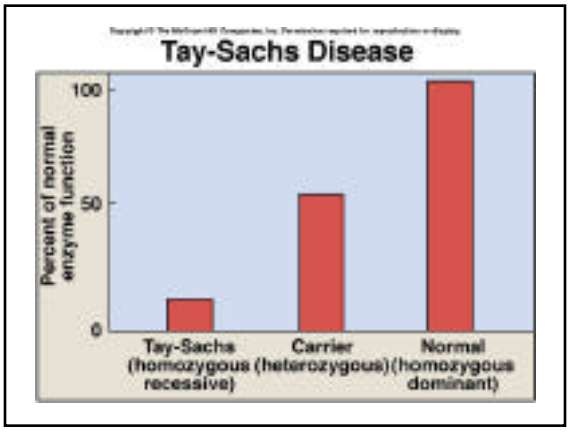
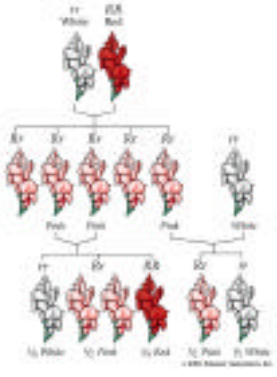


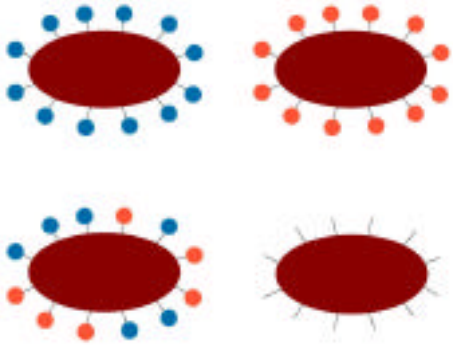
Figure 12-15 **Albinism**
Albinism is controlled by a single, recessive allele. Melanin is found throughout the animal kingdom, and albinos of many species have been observed: *(a)* human, *(b)* rattlesnake, and *(c)* wallaby. The female wallaby, having mated with a normally pigmented male, carries a normally colored offspring in her pouch.

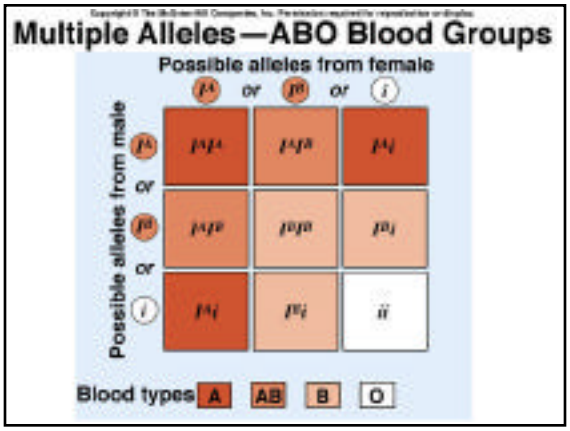


Incomplete dominance

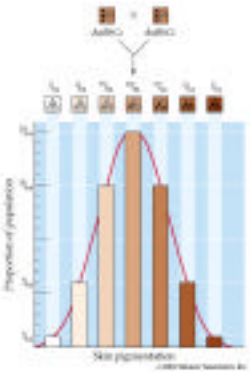


ABO Blood types (multiple phenotypes

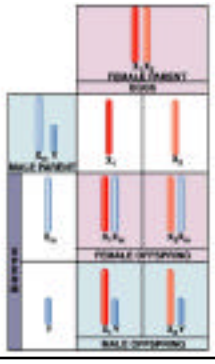


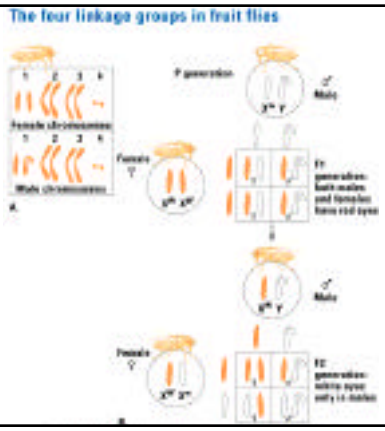


Polygenic:
melanin in the skin
3 genes

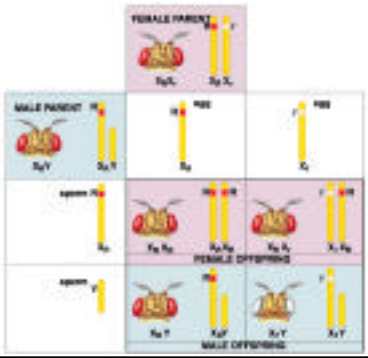


Sex determination in mammals

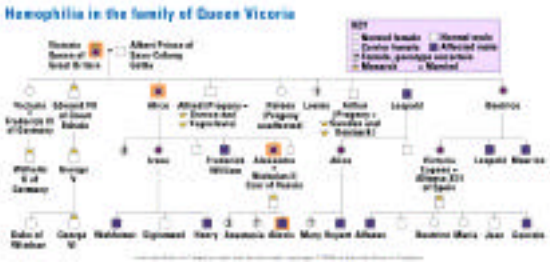




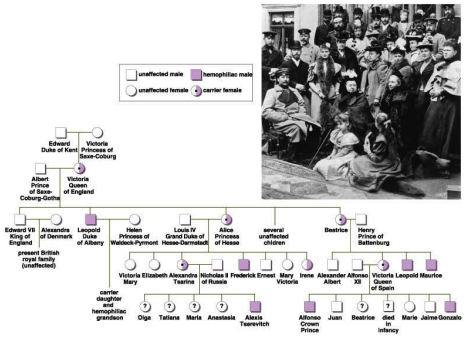
Sex linkage in fruit flies



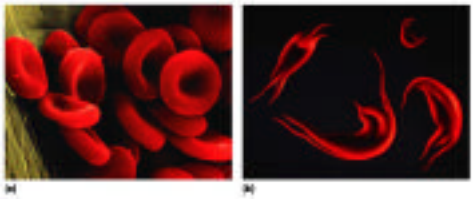
X-linkage in the royal family



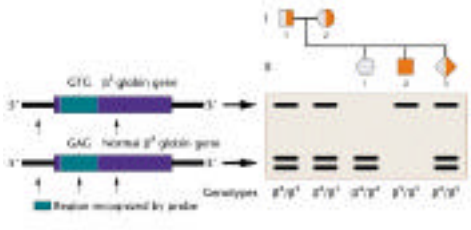
Hemophilia among the royal families of Europe



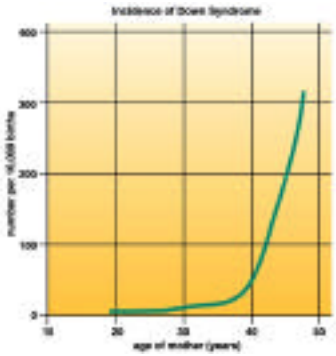
Sickle Cell anemia



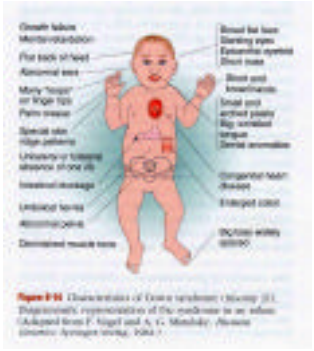
Sickle cell anemia

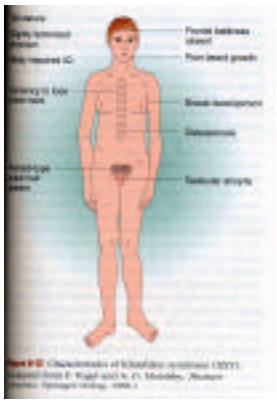


Increase in down syndrome with age

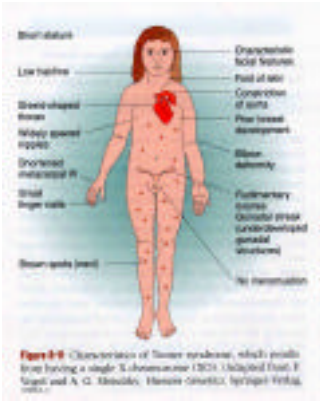


Down Syndrome



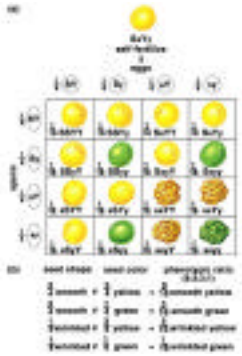


Turner syndrome

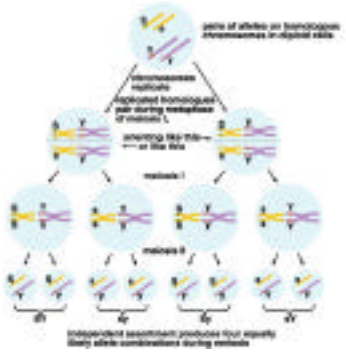


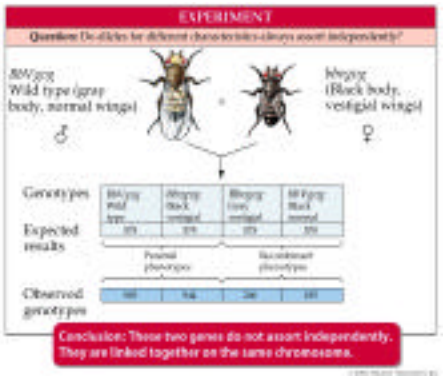
Environmental effects

Dihybrid - two traits

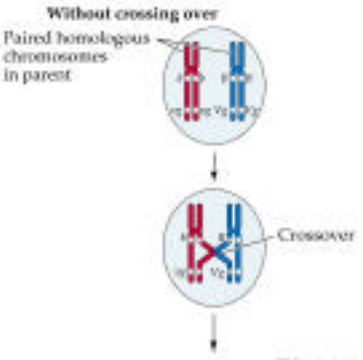


Independent assortment of alleles

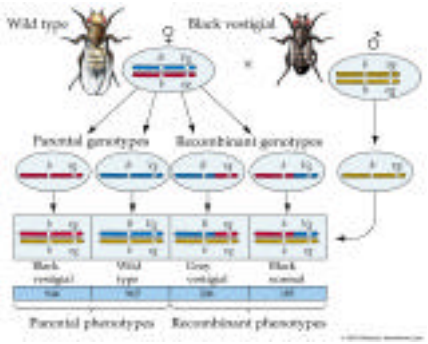




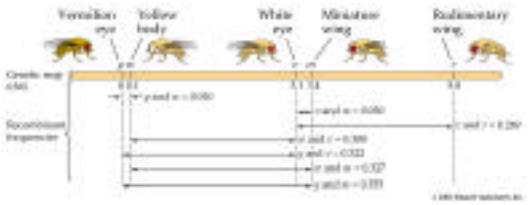
Linked genes can behave as unlinked if they are far enough apart
The more recombination - the further the gene are apart



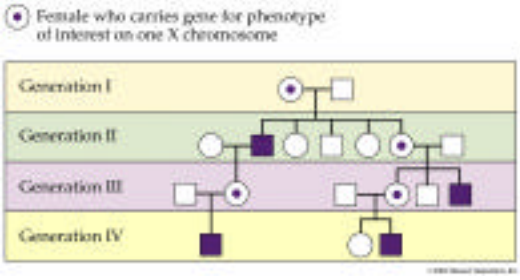
Recombination frequencies can be calculated



The higher the frequency - the further the genes are apart



Red-Green color blindness



Non nuclear inheritance

✓Mitochondria
✓Plastids

✓Passed on maternally