

Genetics

3.2- Chromosomes

Essential idea:

- Chromosomes carry genes in a linear sequence that is shared by members of a species.

Nature of science:

- Developments in research follow improvements in techniques
 - Autoradiography was used to establish the length of DNA molecules in chromosomes. (1.8)

International-mindedness:

- Sequencing of the rice genome involved cooperation between biologists in 10 countries.
 - Asian rice (*Oryza sativa*) possesses up 63,000 genes divided up between 12 chromosomes.
 - Several leading labs around the world (including Brazil, Canada, China, France, India, Japan, Korea, Taiwan, Thailand, UK and USA) are collaborating to complete the sequencing of the genome.
 - Different chromosomes/region of chromosomes have been assigned for sequencing to various countries.

Prokaryote Chromosomes

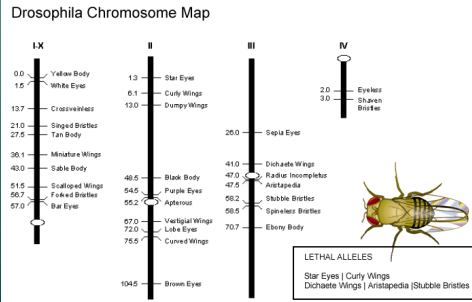
- Prokaryotes have one chromosome consisting of a circular DNA molecule.
- Some prokaryotes also have plasmids but eukaryotes do not.

Eukaryote Chromosomes

- Eukaryote chromosomes are linear DNA molecules associated with histone proteins.
 - Eight histones create nucleosomes which create super-coiling.

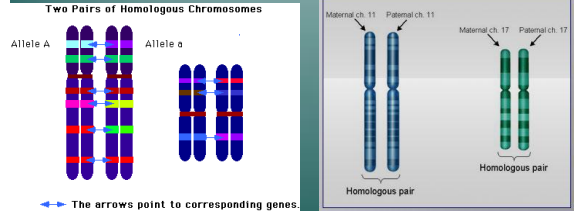
Eukaryote Chromosomes

- In a eukaryote species there are different chromosomes that carry different genes.



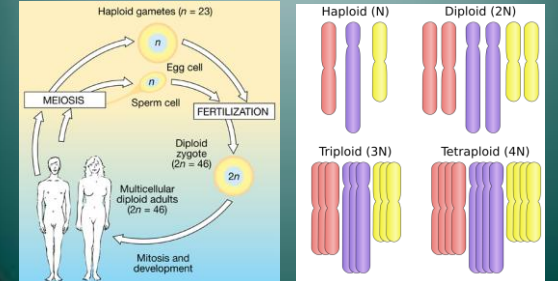
Eukaryote Chromosomes

- Homologous chromosomes carry the same sequence of genes but not necessarily the same alleles of those genes.
 - The two DNA molecules formed by DNA replication prior to cell division are considered to be sister chromatids until the splitting of the centromere at the start of anaphase. After this, they are individual chromosomes.



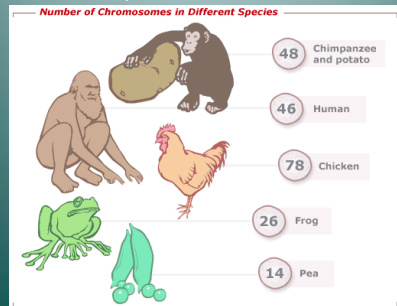
Eukaryote Chromosomes

- Diploid nuclei have pairs of homologous chromosomes (somatic cells).
- Haploid nuclei have one chromosome of each pair (gametes).



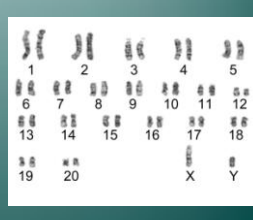
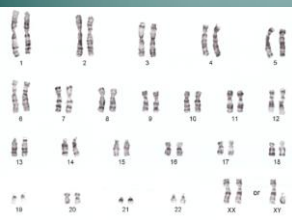
Eukaryote Chromosomes

- The number of chromosomes is a characteristic feature of members of a species.



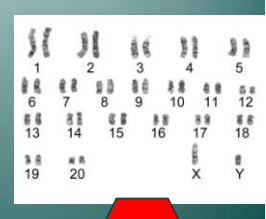
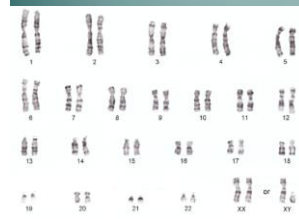
Eukaryote Chromosomes

- A karyogram shows the chromosomes of an organism in homologous pairs of decreasing length.
 - A Karyotype is a property of a cell; the number and type of chromosomes present in the nucleus, not a photograph or diagram of them.



Eukaryote Chromosomes

- Sex is determined by sex chromosomes and autosomes are chromosomes that do not determine sex.



End

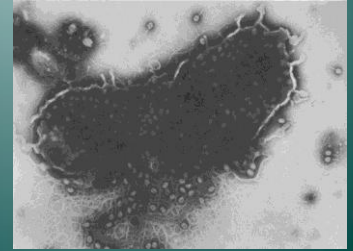
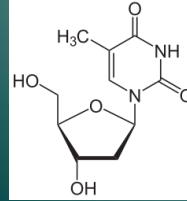
Cairns' Technique

- Measures the length of DNA molecules by autoradiography.
- John Cairns (1963) produced images of DNA molecules from *Escherichia coli* (*E. coli*)



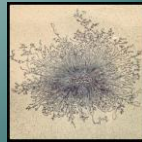
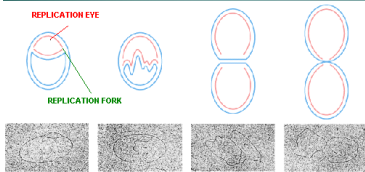
Cairns' Technique

- E. coli* was grown with thymidine (deoxyribose and thymine) containing a radioactive isotope of hydrogen (labeling the DNA).
- The *E. coli* cells were broken open by enzymes to release the cell contents.
- The cell contents were applied to a photographic emulsion and placed in the dark (for two months)



Cairns' Technique

- Dark areas on the photographic emulsion indicated the presence of DNA
- The images showed that *E. coli* possesses a single circular chromosome which is 1,100 μm long (*E. coli* cells have a length of only 2 μm)
- Cairns images also provided evidence to support the theory of semi-conservative replication



Back

Application:

- Comparison of genome size in T2 phage, *Escherichia coli*, *Drosophila melanogaster*, *Homo sapiens* and *Paris japonica*.

Organism	Number of Base Pairs	
T2 phage (virus)	164 thousand	
<i>Escherichia coli</i> (bacteria)	4.6 million	
<i>Drosophila melanogaster</i> (fruit fly)	130 million	
<i>Homo sapiens</i> (humans)	3.2 billion	
<i>Paris japonica</i> (plant)	150 billion	

Back

Application:

- Comparison of diploid chromosome numbers of *Homo sapiens*, *Pan troglodytes*, *Canis familiaris*, *Oryza sativa*, *Parascaris equorum*

Organism	2n Number Chromosomes	
<i>Homo sapiens</i> (human)	46	
<i>Pan troglodytes</i> (chimpanzee)	48	
<i>Canis familiaris</i> (domestic dog)	78	
<i>Oryza sativa</i> (asian rice)	24	
<i>Parascaris equorum</i> (equine roundworm)	2	

Back

Remember 1.2 Notes

Prokaryotic Structure

- Eubacteria and Archaeobacteria
- Most are just visible with light microscopes (1-10 μm)
- Structures:
 - Nucleoid Region- Large circular DNA molecule (no nucleus).
 - Plasma membrane- outermost membrane; regulates the entrance and exit of molecules.
 - Plasmids- small accessory rings of DNA
 - Cytoplasm- consists of cytosol, a semi-fluid medium.

Back

