

CHAPTER 6

Chromosomes and Meiosis



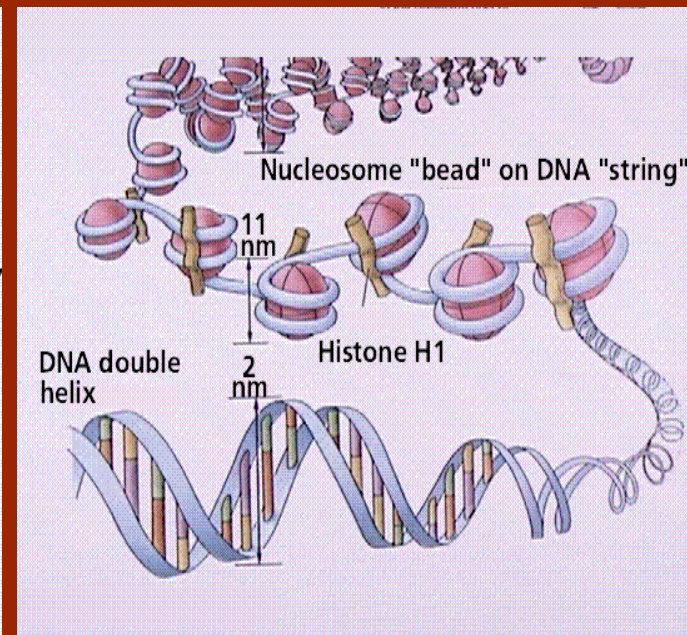
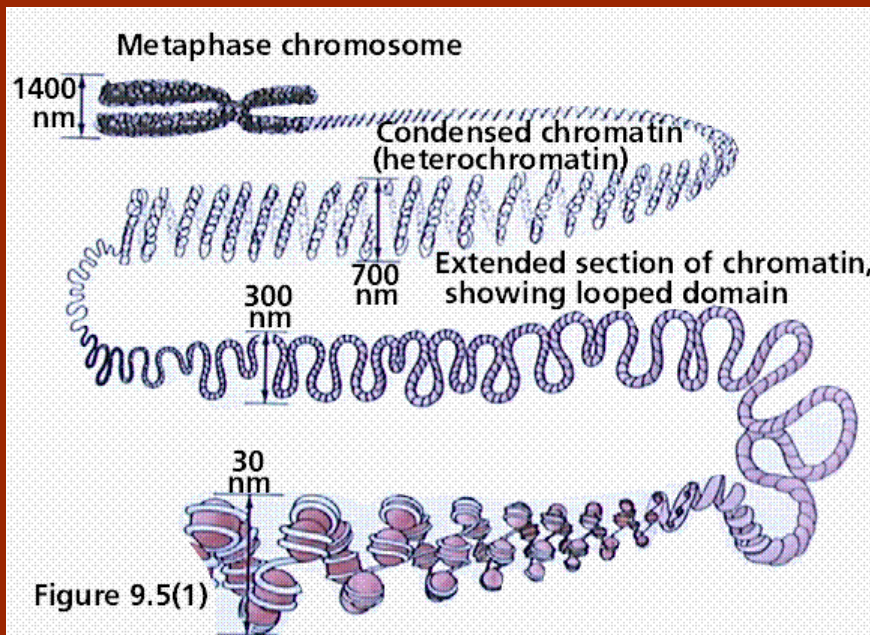
CHROMOSOMES

- DNA (deoxyribonucleic acid) is a long, thin molecule that directs cellular functions and heredity.
- DNA contains information that is encoded in segments called **genes**.
- A single molecule of DNA contains thousands of genes.



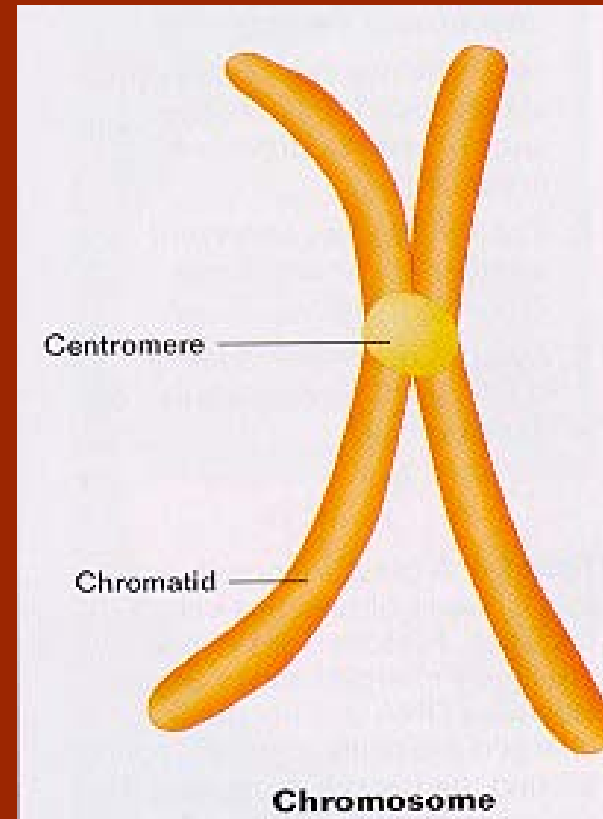
Chromosome Structure

- A **chromosome** forms when a single DNA molecule, and its associated proteins (histones), coil tightly prior to cell division.
- DNA only coils in the form of chromosomes when the cell is preparing for cell division



Chromosomes

- By the time chromosomes coil and become visible, the DNA has been copied, and **each chromosome** consists of two copies ensuring that each new cell will have the same genetic information.
- The identical strands of DNA are each called **chromatids** and are held together by a **centromere**.



Chromosomes

- Body cells (**somatic cells**) contain two copies of each chromosome, referred to as **homologous chromosomes**.
- Homologous chromosomes are similar in size, shape and have the same **type** of genetic information (code for the same characteristics).
- One **homologue** originates from the female parent and the other from the male parent.



Chromosomes

- Human cells have 23 different PAIRS of homologous chromosomes.
 - 1 pair is the sex chromosomes (determine sex and related characteristics)
 - In humans and many other species, females are designated **XX** and males are designated **XY**.
 - 22 pairs are autosomes (determine other traits)

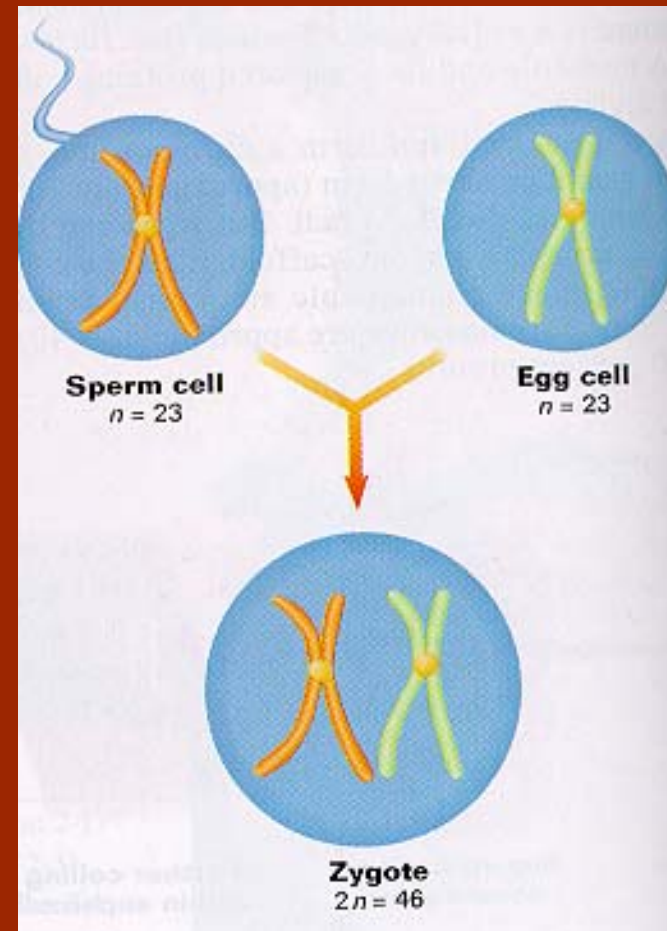


Chromosome Number

- The number of chromosomes in cells is constant within a species.
- **Diploid cells ($2n$)** contain two homologues of each chromosome.
 - Somatic cells
- **Haploid cells (n)** contain one homologue of each chromosome.
 - Sex cells – gametes (egg and sperm)
- For humans $2n = 46$. ($\therefore n = ?$)

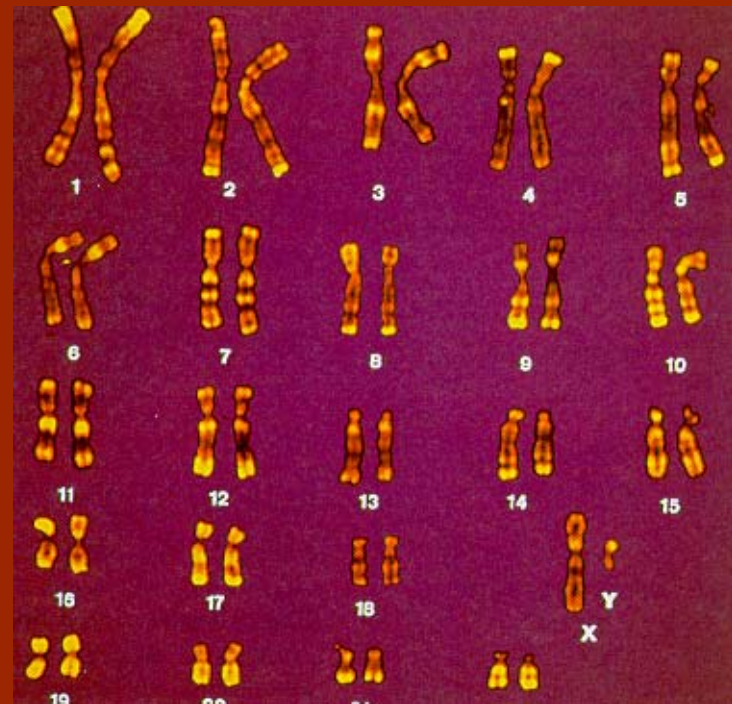


- The haploid gametes are fused in fertilization which restores the diploid number in the zygote (the fertilized egg).



Karyotypes

- A karyotype is a pictorial spread of an individual's chromosomes.
- It can be used to detect some genetic abnormalities (Down's Syndrome)



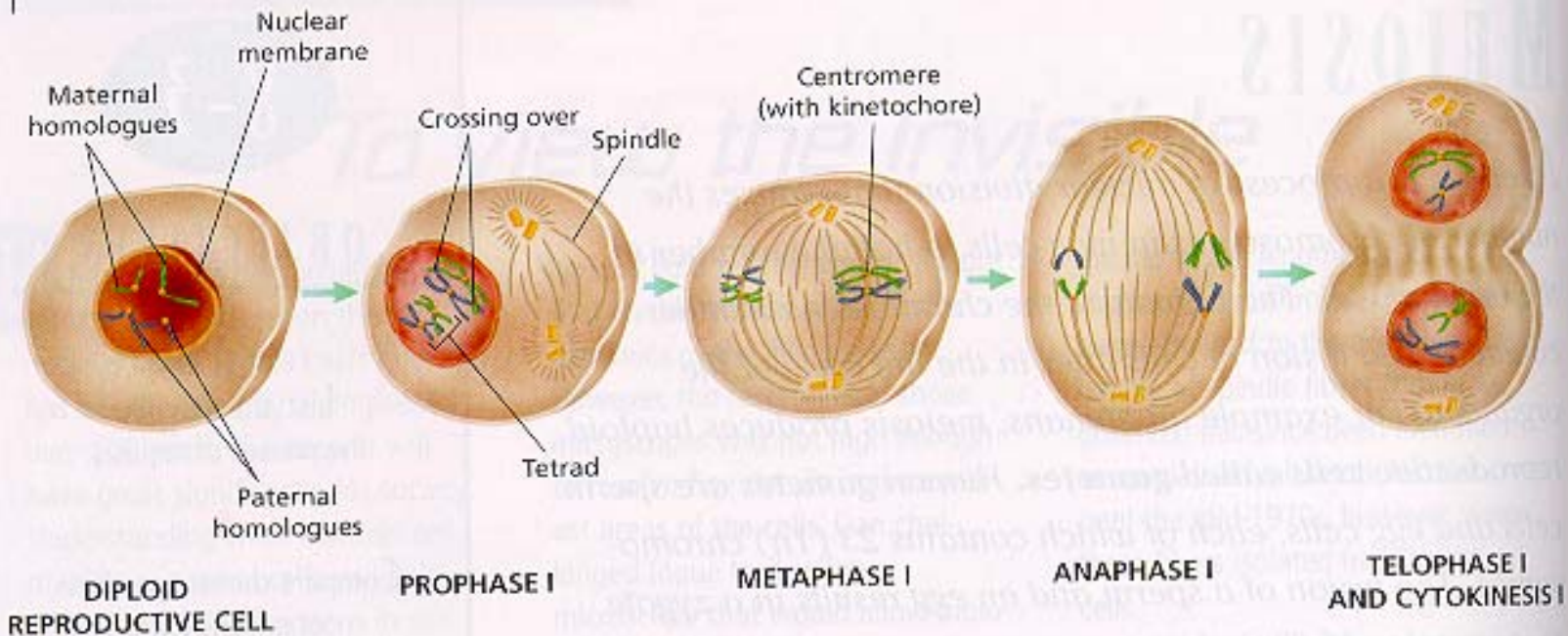
MEIOSIS

- Meiosis is a form of cell division that halves the number of chromosomes in cells.
- Meiosis takes place in order to make gametes
- Four **haploid** gametes are produced from one **diploid** cell.
- Meiosis consists of two successive nuclear divisions.



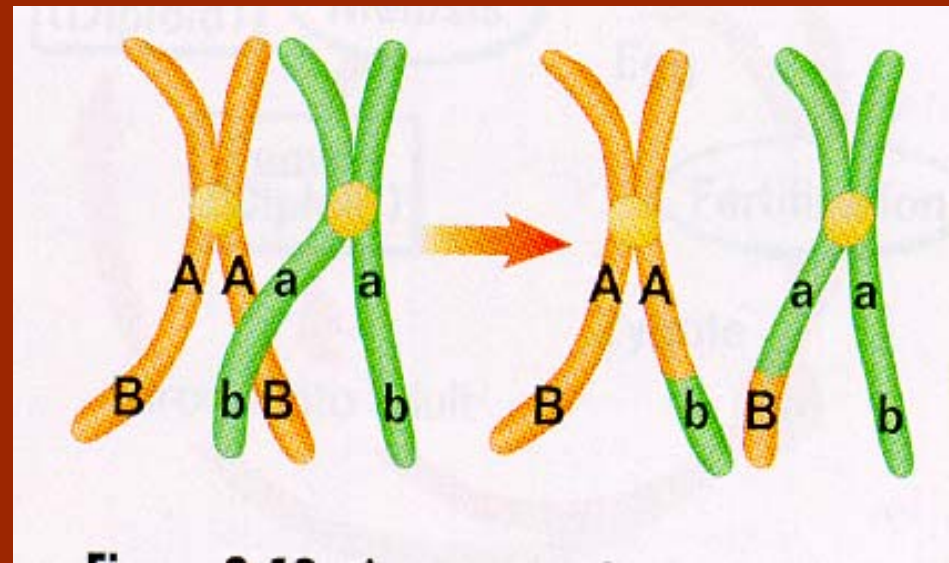
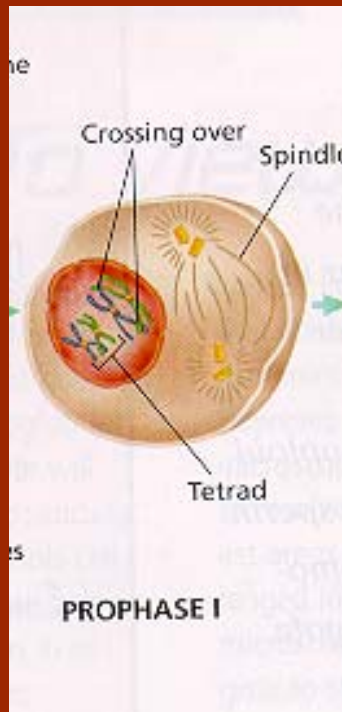
Meiosis I

- Meiosis I separates homologous chromosomes and reduces the chromosome number in half.
 - Prophase I – formation of tetrad and crossing-over



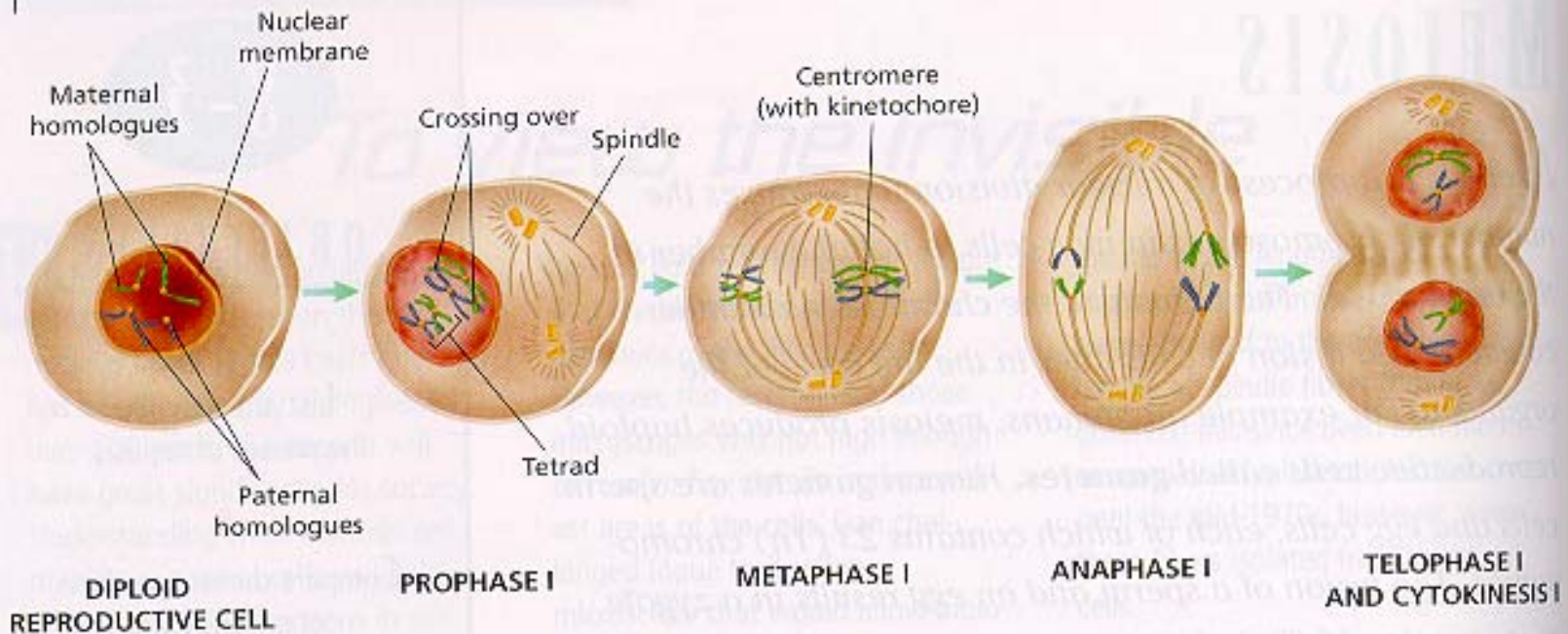
Meiosis I - Crossing Over

- Crossing over (exchange of genetic material between homologues) occurs during Prophase I. It produces genetic recombination.



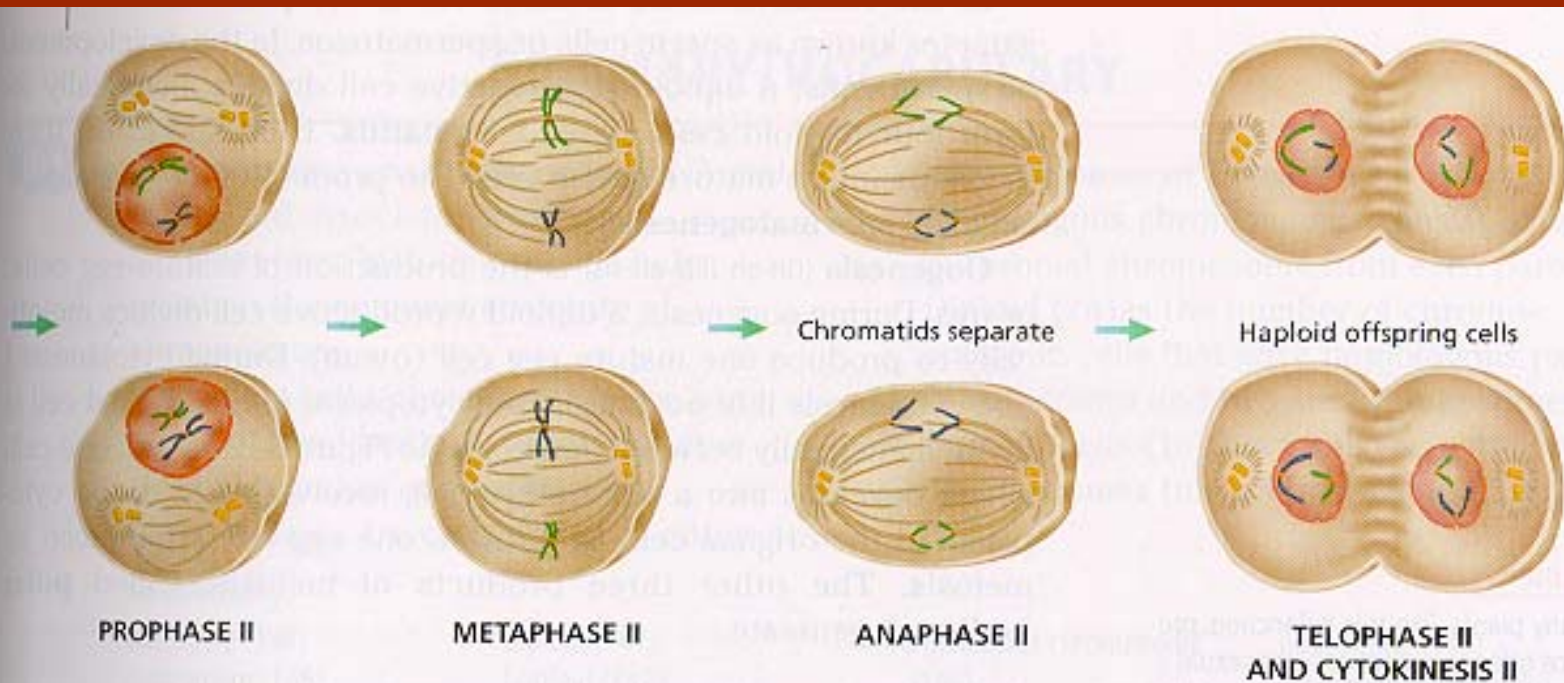
Meiosis I

- Metaphase I – homologous chromosomes line-up on the cell equator
- Anaphase I – separation of homologous chromosomes – independent assortment of parental chromosomes
- Telophase I – movement of chromosomes to opposite ends followed by cytokinesis



Meiosis II

- Meiosis II is almost identical to meiosis I except that the chromosomes do not replicate before they divide at their centromeres.
- It separates the identical chromatids.



Comparing Meiosis & Mitosis

Mitosis

- Homologous chromosomes independent
- identical daughter cells

Meiosis

- Homologous chromosomes pair, forming homologues until anaphase I
- daughter cells haploid



Comparing Meiosis & Mitosis

Mitosis

- Identical daughter cells

Meiosis

- Daughter cells have new assortment of parental chromosomes
- Chromatids not identical; crossing over

