# 3.3 MEIOSIS

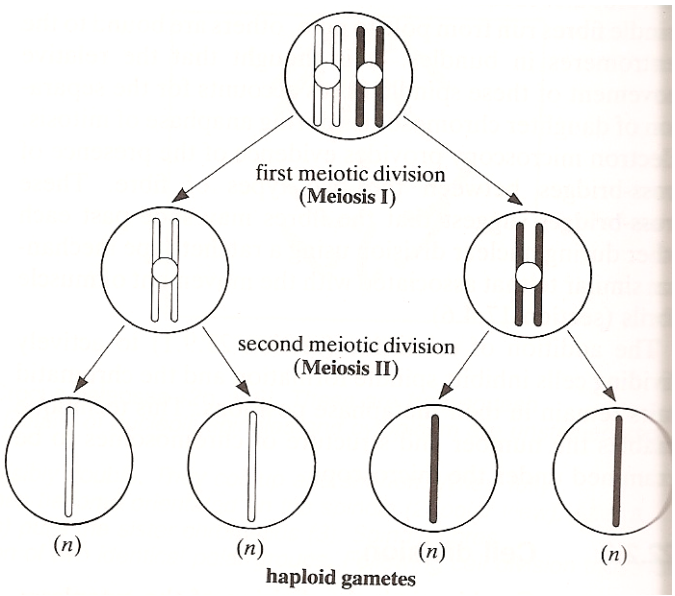
Meiosis (meio- to reduce) is a form of nuclear division involving a reduction from a diploid number (2n) of chromosomes to the haploid number (n). In its simplest terms it involves a single duplication of chromosomes (DNA replica as in mitosis) in the parent cell followed by two cycles of nuclear divisions (first & second meiotic division).

→ Thus, a single diploid cell gives rise to four haploid.

**Homologous chromosomes**

Chromosomes that are derived from maternal and paternal gamete nuclei which come together and pair up.

***Diagram of meiosis***



**Prophase I** (the longest phase)

- Pairs of chromosomes shorten and become visible as single structures
- Crossing over occurs (chiasmata) leading to new gene combinations in the resulting chromatids (genetic crossing over)
- Centrioles move to opposite poles
- Nuclear membrane break down

**Metaphase I**

- Chromosomes become visible
- Spindle microtubules attach to the centromeres on the equator
- At the end of metaphase I the chromosomes of each pair start to move to the poles

**Anaphase I**

- At the end of anaphase I, each of the two chromosomes of each pair reach the poles

**Telophase I**

- Nuclear membranes form around the group of chromosomes present at each pole
- The cell starts to divide into two daughter cells
- The chromosomes start to uncoil partially (become thinner and longer)
- At the end of Telophase I the two cells either enter a brief period of interphase or immediately proceed to the second meiotic division. <u>The DNA is not replicated</u>

**Prophase II**

- Chromosomes (pair of chromatids) become shorter and thicken again
- Centrioles move to the opposite poles in animal cells
- The nuclear membranes break down

**Metaphase II**

- Spindle microtubules attach to the centromeres
- Chromosomes line up to the equator
- The centromeres divide

**Anaphase II**

- The two chromatids of each chromosome move to the opposite poles
- Gradually the chromatids reach the poles

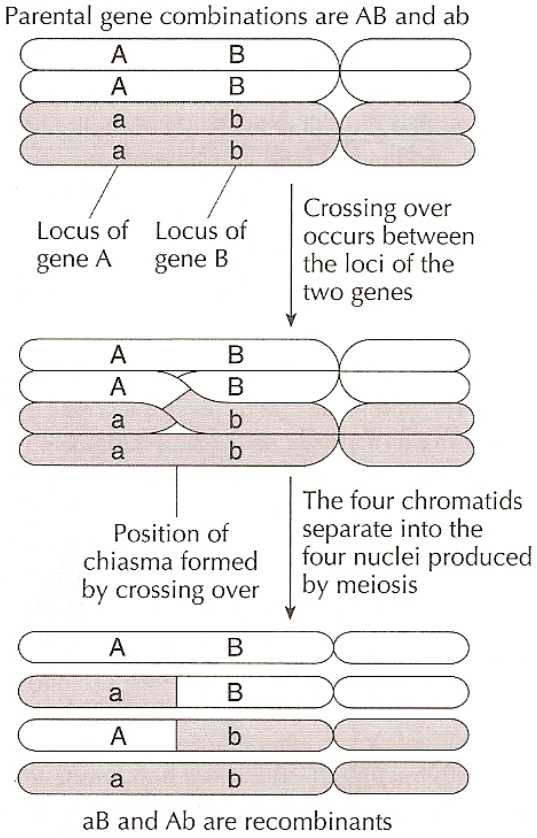
**Telophase II**

- Nuclear membranes form around the groups of chromatids at each pole. Each chromatid is now considered to be a chromosome
- Each of the two cells divide to form four (4) cells in total
- The chromosomes uncoil, lengthen and become very indistinct
- Nucleoli appear
- In most organisms the cells formed at the Telophase II develop into gametes

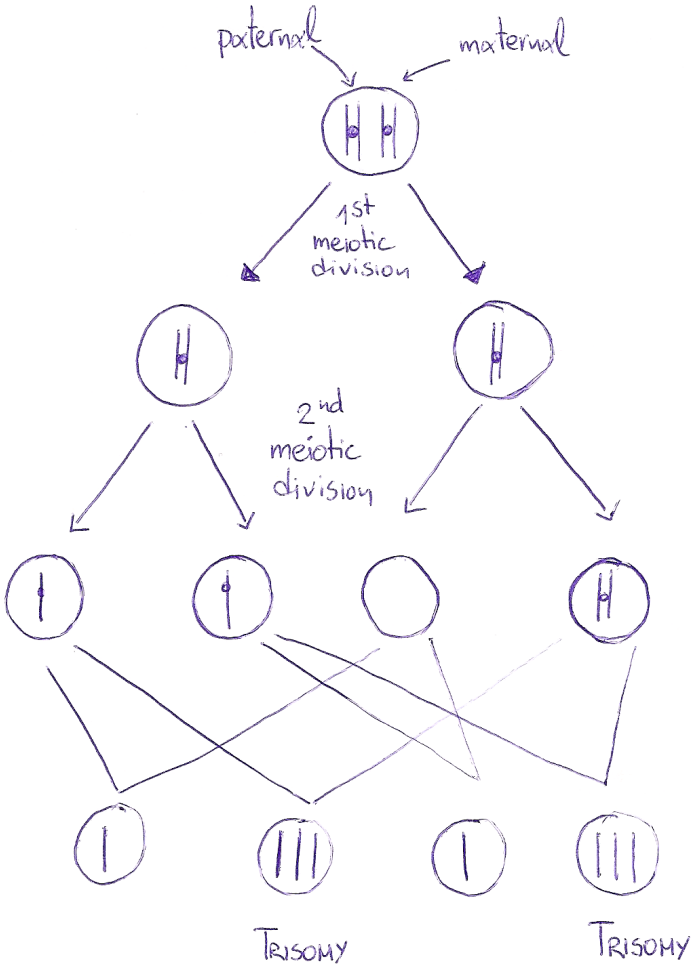
**Genetic variety (due to crossing over)**

As a result of the crossing (site of exchange between chromatids) the alleles from one chromosome (eg parental alleles A, B, C) become attached to alleles of the homologous chromosome (maternal alleles a, b, c), leading to new gene combinations in the resulting chromatids. This variation occurs when the diploids become haploids.

Crossing over occurs just prior to the first meiotic division!!



**<u>Non - disjunction</u>** is non separation of chromosomes and can lead to changes in chromosome pair number (e.g Trisomy 21- Down's Syndrome)




Non – disjunction can occur in any of the 23 pairs leading to 47 chromosomes instead of 46. If this non – separation of chromosomes occurs at the 21st pair then the patient suffers by **TRISOMY 21** or else **DOWN SYNDROME**

| **Mother's age** | **25** | **30** | **35** | **40** | **45** |
|---|---|---|---|---|---|
| **Chance of Down baby** | 1 in 1250 | 1 in 1000 | 1 in 400 | 1 in 100 | 1 in 30 |