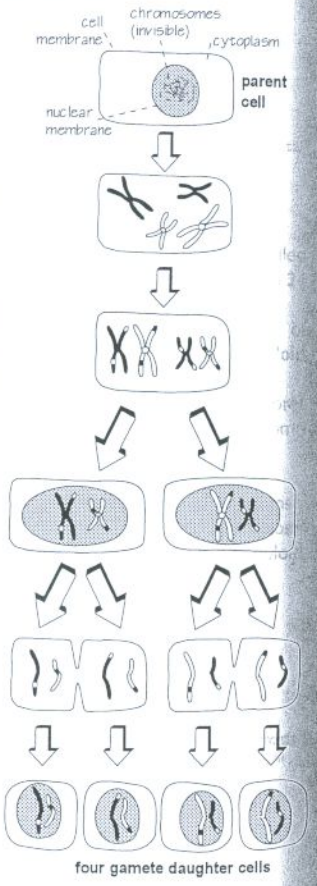
Meiosis

Meiosis is the process of cell division that occurs only in the reproductive organs when a parent cell divides to produce gamete daughter **sex cells** for reproduction.

The process starts, as in mitosis, with the parent cell replicating its chromosomes so that it has a copy of each chromosome. In a series of stages, **four** daughter cells are finally formed replacing the parent cell. The new cells have a half set of chromosomes, each different to each other and unique to this particular cell division.

The key stages of meiosis are described below.



The cell is between divisions.

1. Meiosis begins. The nuclear membrane slowly disappears and the chromosomes thicken and become visible.
   Only two pairs of chromosomes are shown.

2. The chromosomes arrange themselves in like pairs across the centre of the cell. The chromosomes can exchange segments (called **Crossing Over**) so each chromosome has different genes.

3. The cell divides forming two new cells with a different mix of chromosomes. The chromosome number however is unchanged.

4. Division continues as the chromosomes separate and go to opposite ends of the cells.
   It is random as to which chromosome pair goes to which end (called **Independent Assortment**). The two cells divide again. The second meiotic division is similar to mitosis.

5. Four daughter gamete cells are formed with half the number of chromosomes. Each has a different chromosome set that is unique to this particular cell division.

A vital feature of meiosis is the **mixing** of chromosomes which is essential to producing a range of **genetic variation**. This is achieved in two ways.

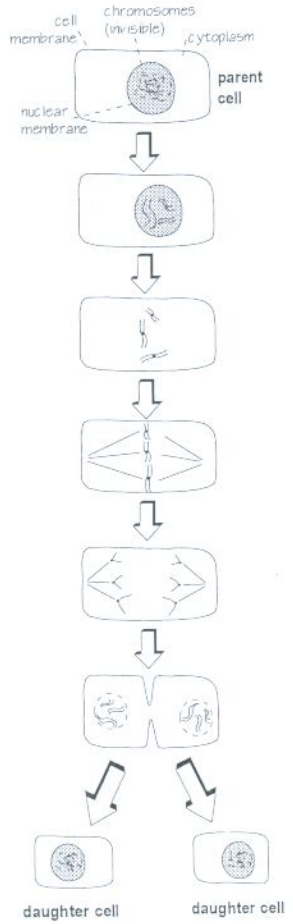
- **Crossing Over**
  Chromosomes lying beside each other can 'swap' bits of chromosome between each other. This introduces some variations between the chromosome pairs.

Mitosis

Mitosis is the process of cell division that occurs in all cells *except* those that produce sex cells. This cell division produces new cells for growth, repair and replacement of old cells.

The process starts with the parent cell replicating its chromosomes so that it has a copy of each chromosome. In a series of stages, **two** daughter cells are finally formed replacing the parent cell. The new cells have exactly the same number and type of chromosomes as the parent cell.

The key stages of mitosis are described below.



The cell is between divisions. The chromosomes are invisible because they are stretched out.

1. The start of mitosis. The chromosomes shorten, fatten and become visible under a microscope.

2. The chromosomes replicate and the nuclear membrane around the cell nucleus slowly disappears.

3. The chromosomes line up singly along the middle of the cell.

4. One chromatid from each chromosome is pulled to each end of the cell (the pole) by its centromere.

5. The cell now starts splitting into two daughter cells. Two new nuclear membranes then form.
   In animal cells, the cell membrane grows between the two new cells. In plant cells, a cell wall grows between them.

6. The division is complete. Each chromatid makes a replica of itself ready for the next division.

- The new daughter cells are identical in chromosome number and type.
- When duplication occurs at interphase, mistakes can occur. These are called **mutations** and can cause death or disablement in the organism. Often a mutation is imperceptible and its importance may lie in providing the raw material for evolution.
- The chromatids of a chromosome are pulled apart.

Meiosis:

In meiosis, a cell with two sets of chromosomes divides _____ to produce four cells, each with only _____ chromosome set. Meiosis only occurs in sexually mature multicellular organisms. In mammals it occurs in _____ and _____ and produces _____. In some land plants and fungi meiosis produces _____, which then divide mitotically to produce gametes. In flowering plants meiosis occurs in the stamens (producing microspores or pollen grains) and in the ovules (producing megaspores). The microspores and megaspores then undergo a number of mitotic divisions, the last of which produces the actual gametes.

Meiosis has two results:

- **_____ of the number of chromosomes from _____ to _____**

  It is in meiosis I (the first division) that the chromosome number is reduced from diploid to haploid. Firstly chromosomes _____ and then the chromosomes come together in _____ pairs. The homologous pairs then segregate, moving to opposite _____ of the cell.
  In meiosis II (the second division) the two chromatids of each chromosome separate and move to opposite poles of the cell so each of the four _____ cells receives the haploid number of chromosomes.

- **Production of genetically un-identical nuclei** or **Meiosis produces genetic variation**

  Besides reducing the chromosome number from diploid to haploid, meiosis produces four genetically _____ daughter nuclei. This genetic variation is caused by _____ assortment of chromosomes and _____ over. During meiosis I, the two members of each homologous pair are dragged to opposite poles of the cell. In doing so, each pair behaves _____ of every other pair.