

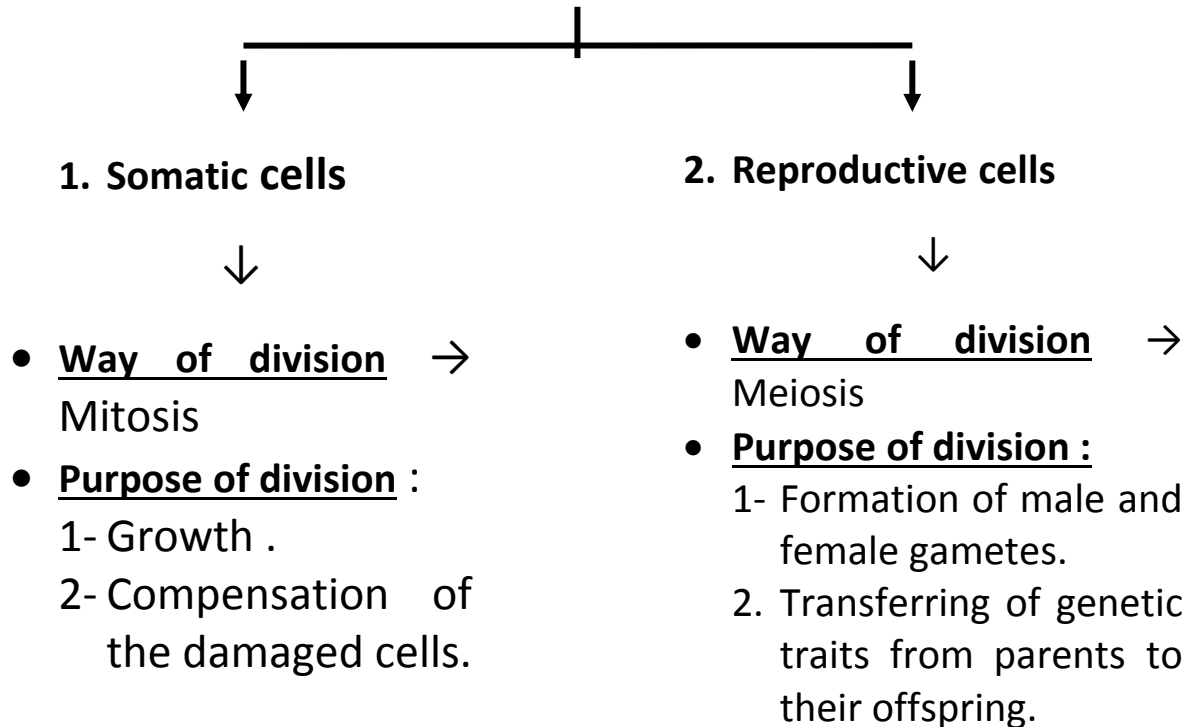
Cell Division

Unit (4)

Lesson (1)

The cell is the building unit of living organisms.

Kinds of cells in multicellular organism's body:



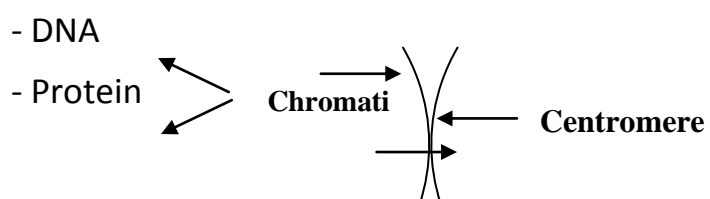
Nucleus is the part that is responsible for the cell division

Because :

It consists the genetic material of the living organism which contains **Chromosomes** that have the main role in cell division.

** General Structure of the chromosome:

- Two connected threads each one is called (Chromatid).
- The 2 chromatids are connected at a point called (Centromere).



- Chemically, the chromosome consists of a
 - Nucleic acid → DNA.
 - Protein.

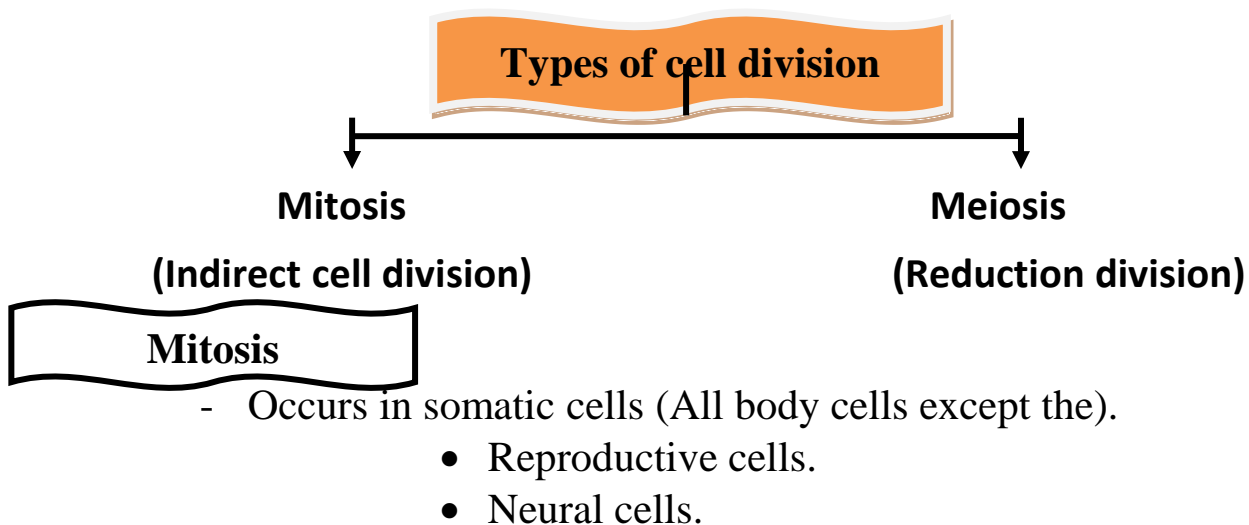
(DNA) → carries the genetic traits of the organism.

- The number of the chromosomes is fixed for same members of same species but different from one species to another.
 - The number of chromosomes in
 - **human = 46**
 - rabbits = 44
 - Mosquito = 6
 - onion = 16.
 - Note that in human for example the somatic cells (Such as skin, stomach, blood) contains 46 chromosomes while the gametes contain 23 chromosomes only.
- ↓ ova or sperum
- (reproductive cell) -

So, somatic cells contain 2 sets of chromosomes one inherited from the father and the other from the mother.

i.e. → Somatic cell → diploid number → (2N).

→ Gametes → Haploid number → N.



So it is important in – growth.

- compensation damaged cells.

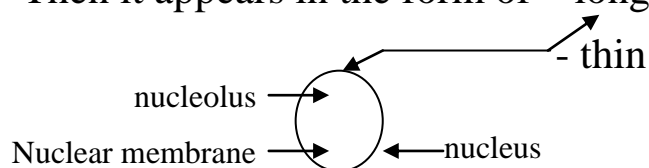
Before cell division the cell passes through a phase called **Interphase** : during interphase

- The cell prepares for division through important biologic process.
- The amount of genetic material Duplicates.

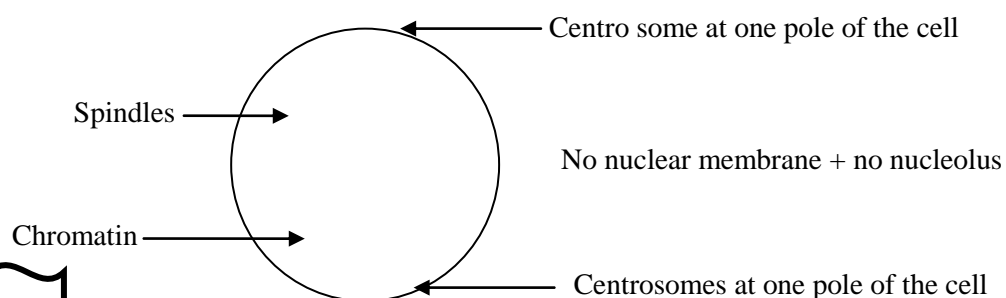
Then cell division start in 4 steps or 4 stages celled phases :

I- Prophase

- Chromatin which is duplicated inside the nucleus is called the chromatin reticulum. Ch. Net ← nucleus.
- The chromatin reticulum intensifies and condensed.
- Then it appears in the form of – long – thin – doubled



- The centrosome (a part inside cell outside nucleus) form spindle fibers called spindle extending between the 2 poles of the cell.
- The nuclear membrane and nucleolus disappear.



N.B

In plant cells no centrosome so the spindles fibers are formed from intensifying cytoplasm at the cell poles.

II-Metaphase :

- Chromosomes are arranged along the cell equator.
- Each chromosome is connected with one of the spindle fibers at its centromere.

III-Anaphase :

- The centromere of each chromosome splits into two halves, so the chromatids separate from each other.
- Spindle fibers begin to shrink and two identical groups of chromatids are formed.
- Each group of chromatids migrate towards one of the cell's poles.

IV-Telophase

- A complete set of chromosomes that have the same number of mother cell's chromosomes are formed on both poles of the cell.
- A nuclear threads are formed and nuclear network is formed around the chromatin material and a new cytoplasmic membrane leading to the formation of 2 new separate cells.
- Each cell has the same number of chromosomes of parent cell (2 N).

N.B

If for any reason the number of the parent cell didn't have the same number of the off-spring cells so, this resulted cells will have different properties → damage or disease to the organism.

Meiosis

- Occurs in living organisms that reproduce by gametes.
- In human and animals it occurs in the testis → for male gametes and in the ovary to produce female gametes. (sperm ♂ + ova ♀).
- In flowering plants it occurs in the (anther) to produce male gametes → pollen grains. While the female gametes are produced from the ovary (eggs).
- Production of haploid number (N) gametes (contain half the number of chromosomes of the parent cell).

Phases of meiosis:

- Interphase → chromosomes are doubled only once.
- First meiotic division → (Reduction), of chromosome no.
- Second meiotic division → Increase no. of cell production.

First meiotic division,...

I- Prophase I,...

- Chromatin condenses and appears in the form of distinct chromosomes.
- Chromosomes are arranged in homologous pairs each pair consists of (4) chromosomes so it is called **Tetrad**.
- Each 2 homologous chromosomes in the tetrad move away from each other.
- Each chromosome consists of two chromatids linked together by the centromere.
- The spindle appears and the chromosomes connect to spindle fibers.
- The nuclear membrane disappears.

II-Metaphase I,...

Chromosomes pairs arrange at the cell equator.

III- Anaphase I

- Every two homologous chromosomes move away from each other as the spindle fibers shrink.
- One of the two chromosomes migrates towards a cell pole and the other migrates towards the other pole.
- Therefore, each pole contains half the number of the chromosomes of the parent cell.

IV-Telophase I

- A nuclear membrane is formed around the chromosomes at each of the cell poles leading to the formation of 2 nuclei.
- Each nucleus contains half the original number of chromosomes of the parent cell i.e. each cell contains (N) chromosomes.

**** After telophase I, the cell enters into the second meiotic division,...**

**** Second meiotic division,...**

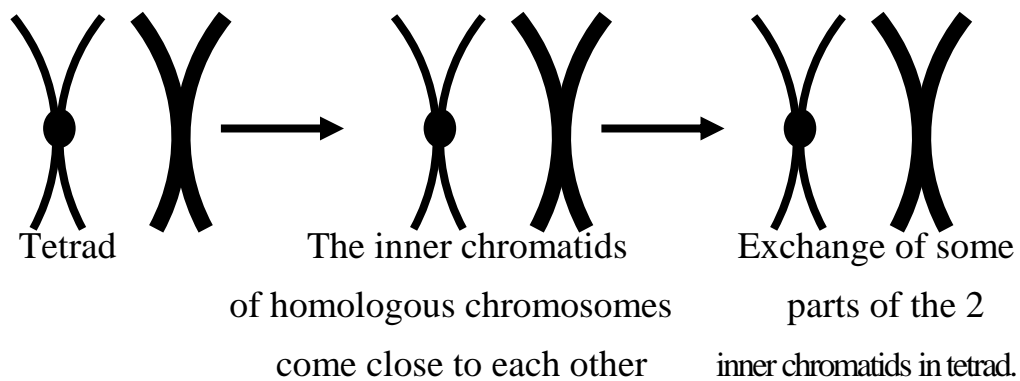
It aims to increase the number of the produced cells from the first meiotic division.

- Each produced cell is called a gamete that contains half the number of chromosomes of the parent cell.
- Each cell of the 2 cells resulted from the first meiotic cell division is divided in a way similar to mitotic cell division.
- In the final phase (Telophase II) of this division, 4 cells are produced and each of them contains half the number of chromosomes of the parent cells.

Cross over phenomena,

It is a phenomenon that takes place at the end of prophase I where some parts of the two inner chromatids of each tetrad are exchanged to produce new genetic arrangements.

So, cross over phenomenon is responsible for the difference between members of some species.



Importance of cross – over phenomenon,

Cross over phenomenon has an important factor for the variation of genetic traits among members of the same species → as the exchange between the 2 inner homologous chromosome's chromatids and distribute them randomly in the gametes.

(Science, Technology and Society)

- How to prepare a slide from the growing tip of onion's root,...
- 1- Plant the onion in a beaker of water until it gives out roots with 2-3 cm in length.
- 2- Cut some growing roots from the top with 1-2 cm length by a scalpel and put those roots in a glass tube.
- 3- Add 1-2ml hydrochloric acid 18% to the roots for 20min, then put the tube in a water bath with a temp 50°C for 7min.
- 4- Wash the roots in distilled water to get rid of the acid, then add 1-2ml fulgen sol² to the roots and leave them 30min.
- 5- Using the scalpel cut the growing tip carefully and add 2 drops of acetic acid and use a tweeze to carry them and put on a clean glass slide.
- 6- Cover the root tip with cover slip and press by thumb.
- 7- Examine the slide by a compound microscope and study phases of mitosis.

(Technological Application)

I- Nanotechnology and Cancer Treatment :

- Cancer occurs when the body cells are divided continually without controlling.

- The mass resulted from this is called (Tumor).
- Using nanotechnology, scientists have developed smart microscope bombs that penetrate cancer cells and explode them from inside.
- They were used to kill the cancer cells in an experimental nice- Mice suffered from cancer were able to live 300 days after this ttt. Other mice that didn't receive this treatment didn't live more than 43 days.
- The Egyptian scientist Dr. Mustafa El-Said discovered a way to detect a cancer cells.
- This teq. Starts by loading protein (they have the ability to attach to the canorous cell secretions with a NANO molecules of gold.

Injecting them into palient :

- The infected cell surface and proteins get intertwined with golden molecules to make it possible to monitor the infected cells through a microscope each cell separately.
- The method of treatment is focusing laser with a certain degree to the gold molecules, then it absorbs the light and convert it into heat which leads to burn and kill infected cell that has suck to them.

2- Liver Transplantation :

Some cells in the human body are not divided at all such as nerve cells and red cells of blood.

Some cells are not divided in normal conditions but they retain the ability to divide under certain circumstances → like liver cells.

For example if the liver gets or injured or a part of it is cut the remaining cells undergo division to compensate the missing part.

Sexual and Asexual Reproduction

- **Reproduction process :**

It is a biological process, where the living organism produces new individuals of the same kind and thus → ensuring its continuity.

Types of reproduction :

A. Asexual reproduction

In which the living organisms produces new individuals have genetic traits identical to the parent. Occurs in :

- Unicellular living organisms. (yeast or Amoeba).
- Some multicellular animals and plants.

It takes place by mitosis division so no

No → * need for special systems or structures.

No → * change in genetic structure.

The daughter cells is **identical** to the parent cell.

Types of asexual rep.

I- Binary fission

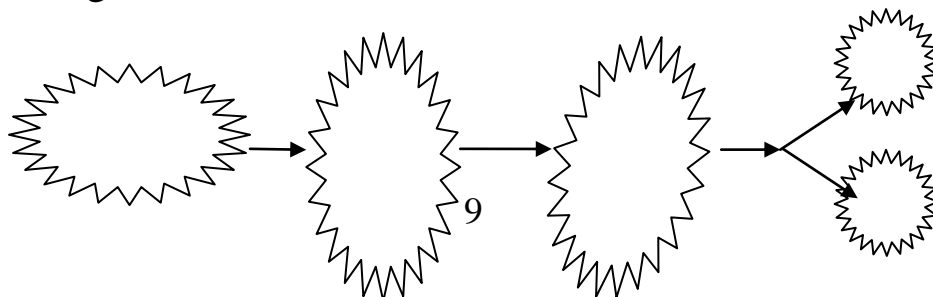
Occurs in * unicellular organism

e.g → Ameoba – paramecium – Euglena.

* Algae and bacteria.

The nucleus divides by **mitosis** and the cell splits into 2 cells.

Each cell grows and become new individual.



II- Budding

- Occurs in → unicellular yeast fungus.

→ Multicellular

Organisms → Hydra or sponges.

Lateral bulge in the cell → then cell nucleus divides into (2) nuclei one of them remains in the parent cell and the other migrate to the bud.

The bud grows gradually and remains connected to the parent cell until it is fully grown, then it separates from it.

N.B

If the buds remain connected to the parental cell colony is formed.

(Chain) = (Colony)

Budding → Mitosis.

III- Regeneration

It is the ability of animals to compensate their missing parts. i.e. the living organism can reproduce by one of its parts.

Occurs in some animals → star fish.

Starfish arms could be revived (regenerate) and give out a complete animal if they contain a part of the central disc of the animal.

Mitosis

IV- Spore propagation

Occurs in some fungi such as bread mould and mushrooms.

Fungi have special organs called sporangia each sporangium has a large number of spores that are released on that are released on

rupturing has a large number of spores that be released on rupturing of its wall.

When spores are scattered on a suitable environment they grow to give new organisms (fungi).

So on bread if a spore is placed on a wet bread it will give new fungus by Mitotic.

V- Vegetative

It occurs in plants by mitotic division it occurs without the need of seeds but by the plants vegetative organs in order to produce new plants identical to parent plant.

It also occurs by plant cells in tissue culturing.

II- Sexual Reproduction

- Occurs in higher living organisms.
- Occurs between 2 parental individuals one of them is male and the other is female.

It depends on 2 main processes :

- 1- Gametes formation.
- 2- Fertilization.

I- Gametes formation

- Gametes are formed in the reproductive cells by the meiotic division.
- Gametes contain half chromosomes number (N) of the organism's reproductive cells (2N).

II- Fertilization

- It is the combination of male gamete and female gamete to form a zygote which contains the normal number of chromosomes of the organisms.

- Zygote contains genetic material from both parents, and when it grows, it gives a new offspring with traits of its parents.
- Note that sexual reproduction is a source of genetic variation because the offspring resulted from 2 sources: male and female, i.e. the resulting offspring has new genetic traits that combine the parents' traits.

Comparison bet. Sexual and asexual reproduction

Sexual	Asexual
- It occurs by 2 living organisms, one of them is male and the other is female.	- It occurs by only one living organism.
- Occurs in most higher living organisms like plants, animals	- Unicellular and some multi-cellular organisms.
- Meiotic division	- Mitotic division
- New offspring combines the genetic traits from 2 sources.	- The new offspring gets a full copy of parent individual genetic trait.

**The End
GOOD LUCK**