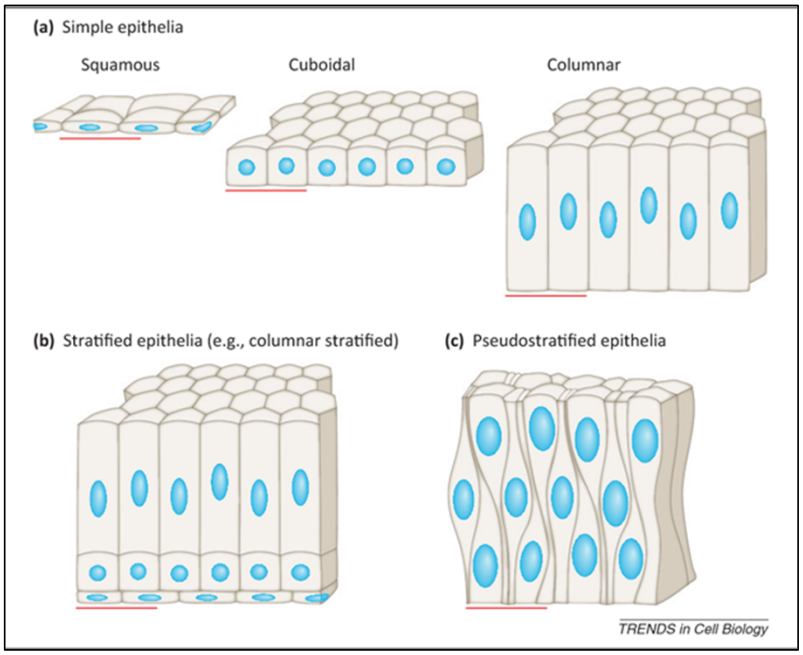
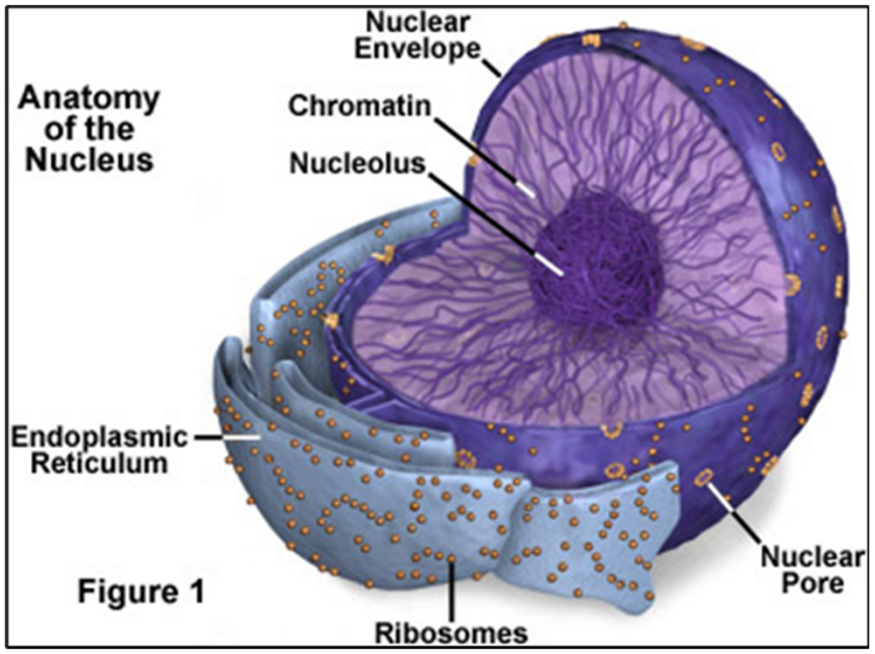




Assist.lec.: Safa Jalil AL-Yassiri

The cell and tissue

- The human body develops from a single cell called the zygote, which results from the fusion of the ovum (female egg cell) and the spermatozoon (male germ cell).

- Individual cells are too small to be seen with the naked eye. However, they can be seen when thin slices of tissue are stained in the laboratory and magnified by a microscope.

What is a cell?

Cells are the basic building blocks of all living things. The average adult human body consists of more than 100 trillion cells. Cells are the basic, living, structural, and functional units of the body. The scientific study of cells is called cell biology or cytology.

- They provide structure for the body,
- Take in nutrients from food, convert those nutrients into energy, carry out specialized functions.
- Cells also contain the body's hereditary material (DNA) and can make copies of themselves.
- Each living cell carries out the tasks of taking food, transforming food into energy, getting rid of wastes, and reproducing.

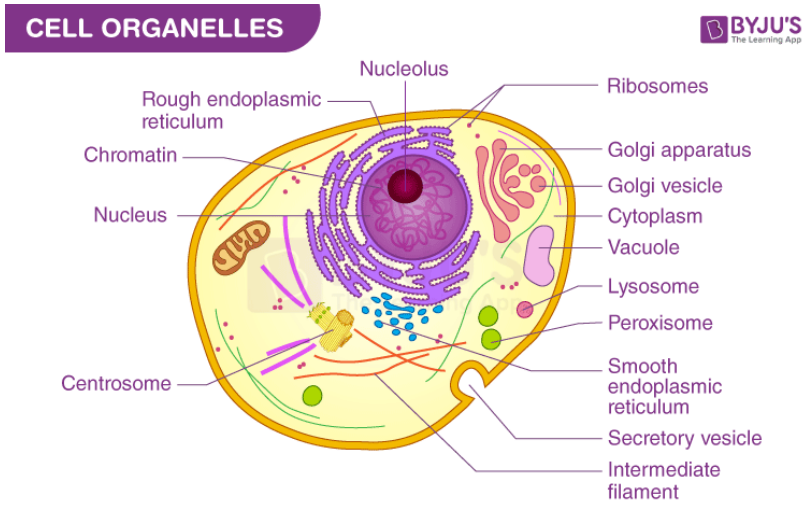
Every living organism falls into one of two groups: eukaryotes or prokaryotes

Prokaryotes: are unicellular organisms that lack membrane-bound structures, the most noteworthy of which is the nucleus. Prokaryotic cells tend to be small, simple cells like bacteria

Eukaryotes: are organisms whose cells have a nucleus and other organelles enclosed by a plasma membrane. Organelles are internal structures responsible for a variety of functions, such as energy production and protein synthesis.

Most of our body cells have three main parts:

- ❑ Plasma membrane
- ❑ Cytoplasm
- ❑ Nucleus



plasma membrane: forms the cell's flexible outer surface, separating the cell's internal environment (everything inside the cell) from the external environment (everything outside the cell).

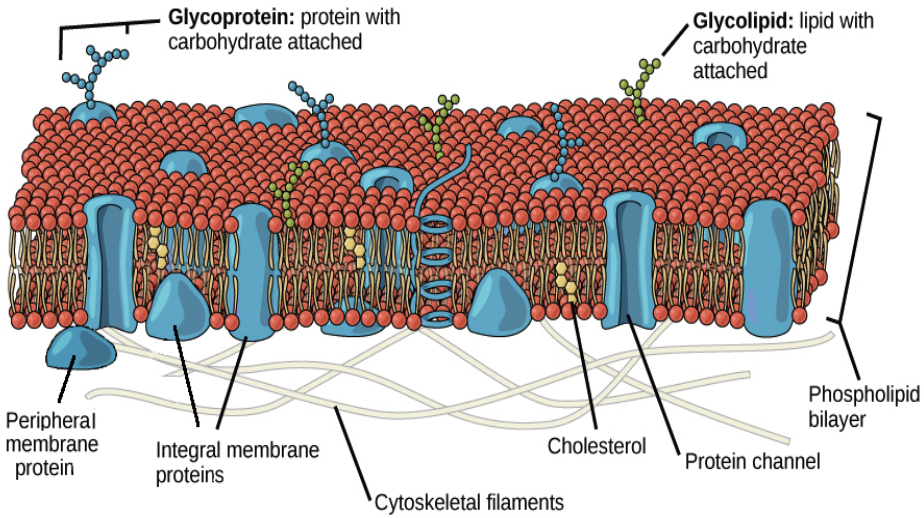
Main functions:

- ❑ It is a selective barrier that regulates the flow of materials into and out of a cell (transport nutrients into the cell and also to transport toxic substances out of the cell).
- ❑ The plasma membrane also plays a key role in communication among cells and between cells and their external environment.

Structure of the Plasma Membrane:

The plasma membrane consists of:

- ➢ **Phospholipid bilayer** (fatty substances). have a head which is electrically charged and hydrophilic (meaning 'water loving') and a tail which has no charge and is hydrophobic (meaning 'water hating').
- ➢ **Cholesterol**
- ➢ **glycoprotein** means Carbohydrate are attached to proteins
- ➢ **Glycolipid** Carbohydrate are attached to lipid



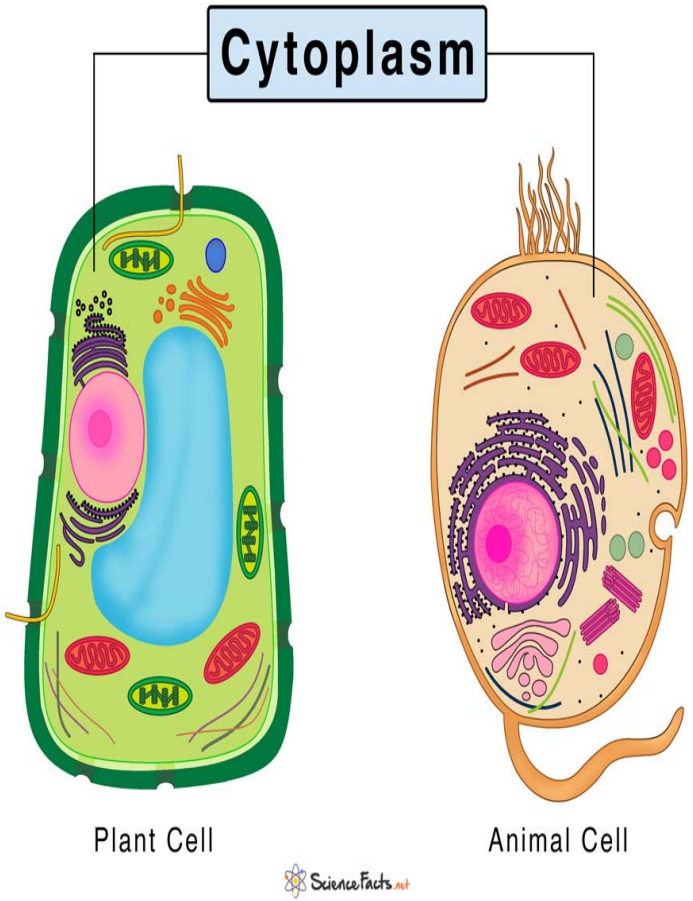
Cytoplasm: has two components: cytosol and organelles.

- Cytosol the fluid portion of cytoplasm (an aqueous gel), also called the cytoplasmic matrix. The matrix consists of a variety of solutes, including inorganic ions (Na^+ , K^+ , and Ca^{2+}) and organic molecules such as carbohydrates, lipids, proteins, and RNAs (ribonucleic acids).

- Organelles has a characteristic shape and specific functions.
  can be divided into two groups:

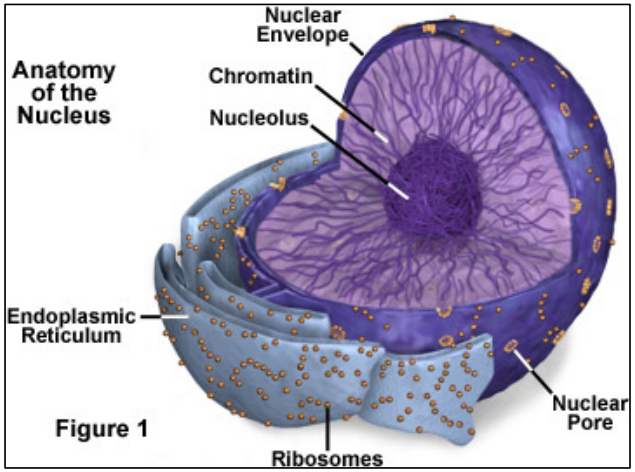
- **Membranous organelles** with membranes that separate the internal environment of the organelle from the cytoplasm. For example (Nucleus, Endoplasmic reticulum, Golgi apparatus, Vesicles,, Lysosome, Mitochondria and Vacuole)

- **Non membranous organelles** without membranes. For example (Cytoskeleton, Ribosomes, Centrosome and Centrioles)



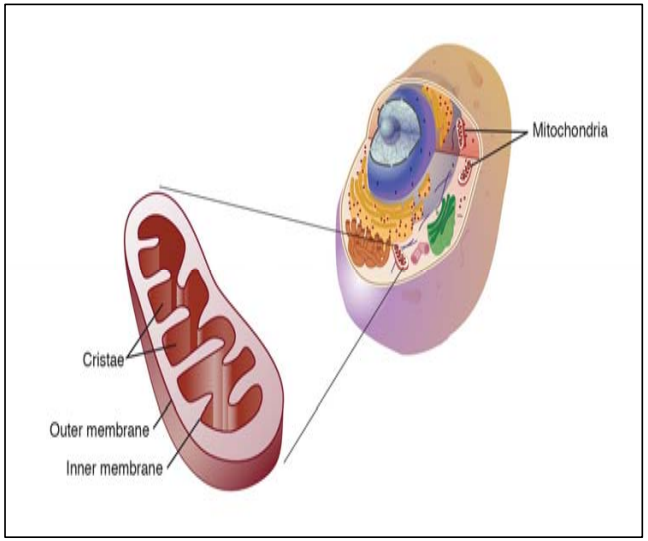
Nucleus

Is typically one nucleus per cell. However, this is not always the case. Skeletal muscle cells, for instance, have two.
The nucleus contains the cell's DNA, The nucleus sends out messages to tell the cell to grow, divide, or die. A membrane called the nuclear envelope separates the nucleus from the rest of the cell. Nuclear pores within the membrane allow small molecules and ions to cross back and forth, while larger molecules need to transport proteins to help them through.



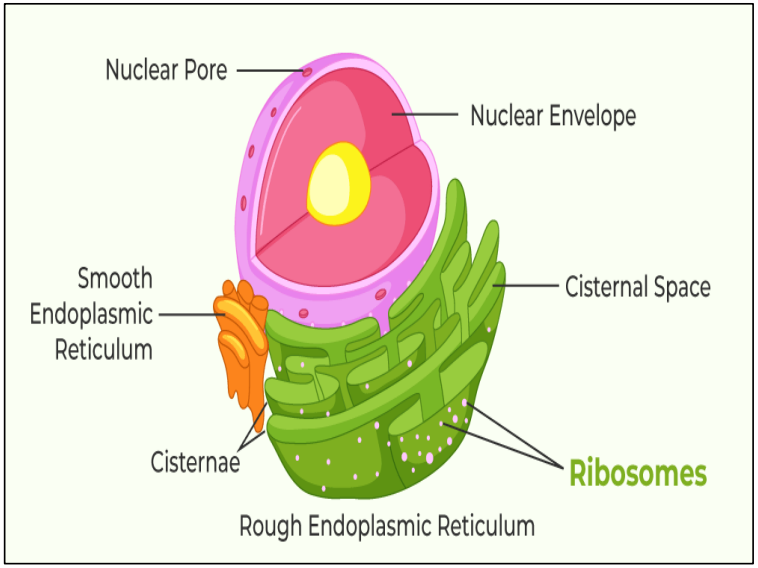
Mitochondria:

Is described as the 'power house' of the cell. They are involved in aerobic respiration, the processes by which chemical energy is made available in the cell in the form of ATP (adenosine triphosphate), which releases energy when the cell breaks it down. Some different cells have different amounts of mitochondria because they need more energy. For example, muscle, liver and kidney.



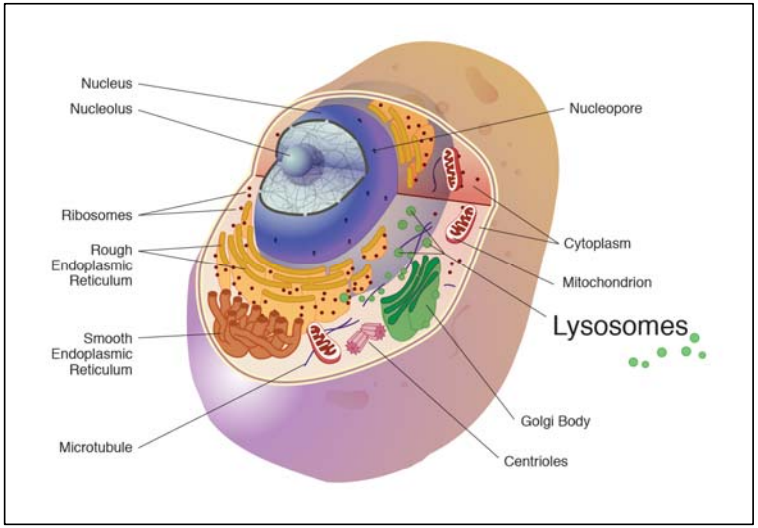
Ribosomes

Are tiny, granular organelles are found inside the cytosol of the cell and play an important role in protein synthesis by translating the genetic information conveyed by messenger RNA (mRNA) into functional proteins. When present in free units or in small clusters in the cytosol, the ribosomes make proteins for use within the cell, and are also found on the outer surface of rough endoplasmic reticulum it will make proteins that will be utilized inside or outside the cell.



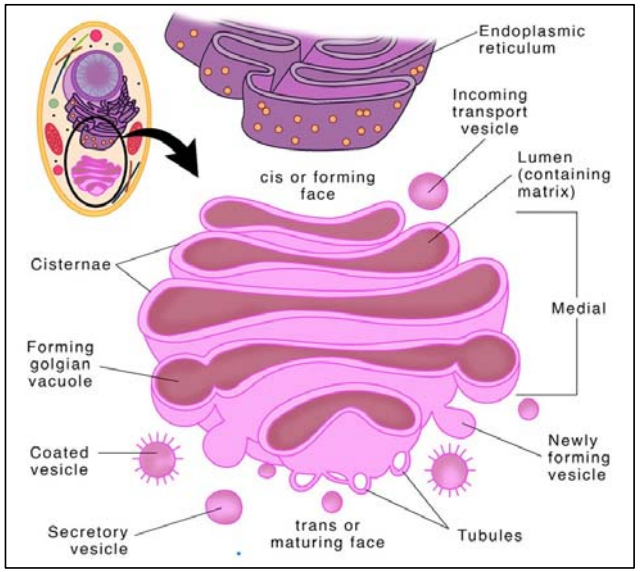
Lysosomes

Are one type of secretory vesicle formed by the Golgi apparatus. They contain a variety of enzymes involved in breaking down fragments of organelles and large molecules (e.g. RNA, DNA, carbohydrates, proteins) inside the cell into smaller particles that are either recycled, or extruded from the cell as waste material. Lysosomes in white blood cells contain enzymes that digest foreign material such as microbes.



Golgi apparatus

The Golgi apparatus consists of stacks of closely folded flattened membranous sacs. The proteins move from the endoplasmic reticulum to the Golgi apparatus where they are 'packaged' into membrane-bound vesicles called secretory granules. The vesicles are stored and, when needed, move to the plasma membrane, through which the proteins are exported.

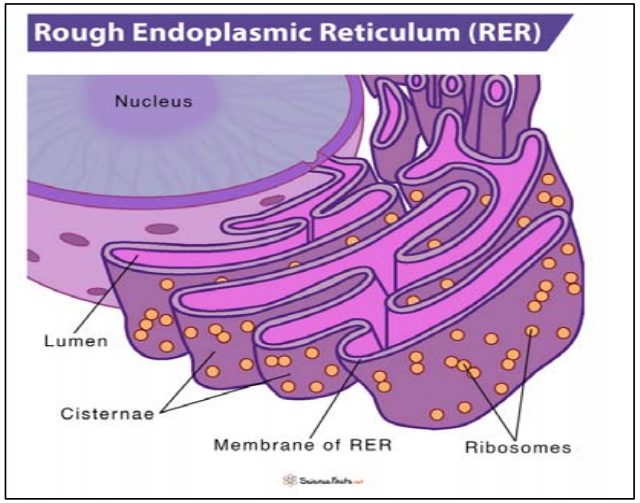


Vesicles and Vacuoles: that function in storage and transport. Vesicles can fuse with other membranes within the cell system while vacuoles are not.

Endoplasmic reticulum (ER)

Endoplasmic reticulum is a series of interconnecting membranous canals in the cytoplasm. There are two types:

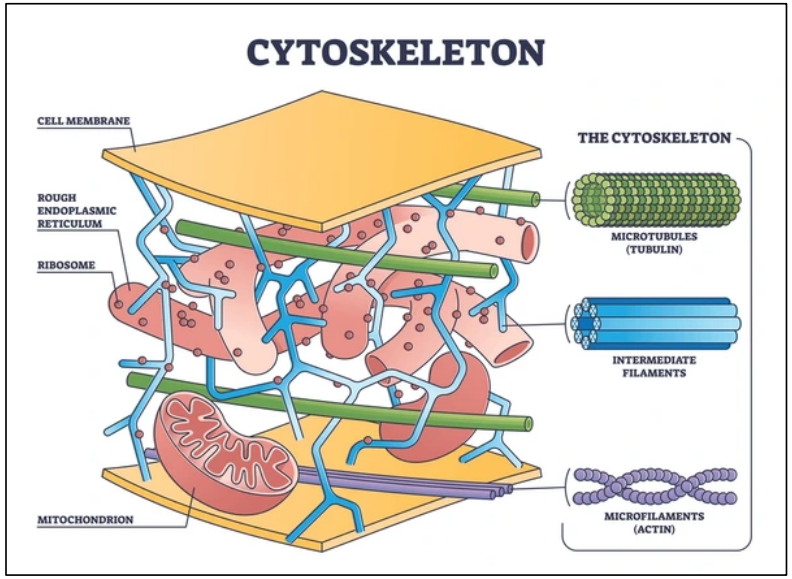
- Smooth ER: synthesis lipids and steroid hormones, and is also associated with the detoxification of some drugs.
- Rough ER: the site of synthesis of proteins due to presence of ribosomes .



Microfilaments and Microtubules

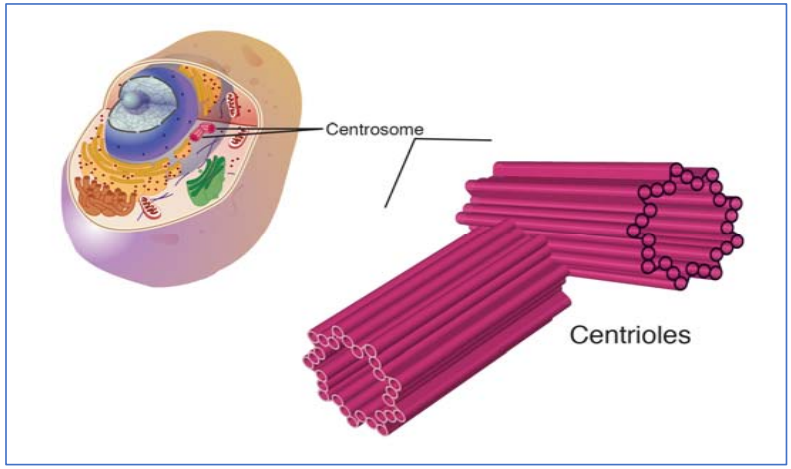
- **Microfilaments:** These are tiny strands of protein that provide structural support and maintain the characteristic shape of the cell.

- **Microtubules:** These are contractile protein structures in the cytoplasm involved in the movement of the cell and of organelles within the cell, the movement of cilia (small projections from the free border of some cells).



Centriole and Centrosome:

Is a barrel-shaped organelle which lives normally within the centrosome. The centrosome is the area of the cytoplasm produces the microtubules of a cell a key component of the cytoskeleton. Within that centrosome there are two centrioles are physical objects made up of microtubules. And those centrioles are very important for cell division.



Cell division:

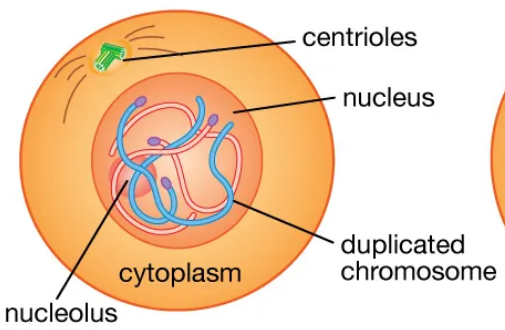
Most cells of the human body undergo cell division, the process by which cells reproduce themselves. The two types of cell division somatic cell division and reproductive cell division—accomplish different goals for the organism.

A somatic cell: is any cell of the body other than a germ cell.
A germ cell: is a gamete (sperm or oocyte) or any precursor cell destined to become a gamete.

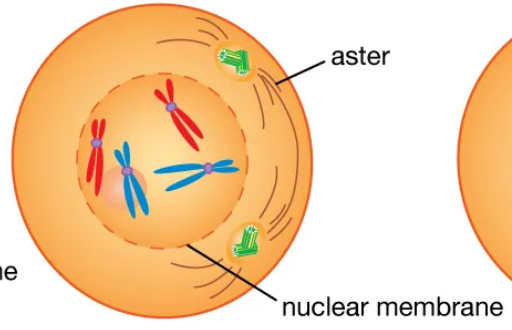
❑ Somatic Cell Division:

The cell cycle is an orderly sequence of events in which a somatic cell duplicates its contents and divides in two. Some cells divide more than others. Human cells, such as those in the brain, stomach, and kidneys, contain 23 pairs of chromosomes, for a total of 46. One member of each pair is inherited from each parent. The two chromosomes that make up each pair are called homologous chromosomes or homologs; they contain similar genes arranged in the same (or almost the same) order. When examined under a light microscope, homologous chromosomes generally look very similar. The exception to this rule is one pair of chromosomes called the sex chromosomes, designated X and Y. In females the homologous pair of sex chromosomes consists of two large X chromosomes; in males the pair consists of an X and a much smaller Y chromosome. Because somatic cells contain two sets of chromosomes, they are called diploid (2n) cells.

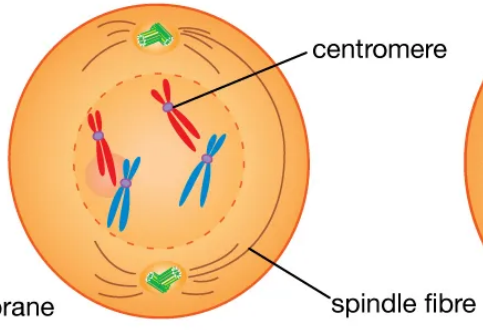
Mitosis, or somatic cell division



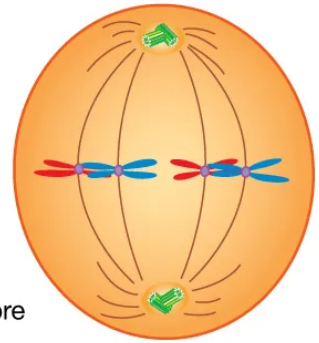
Prior to mitosis, each chromosome makes an exact duplicate of itself. The chromosomes then thicken and coil.



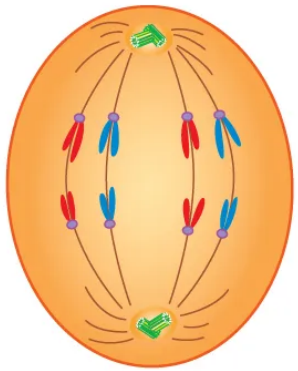
In early prophase the centrioles, which have divided, form asters and move apart. The nuclear membrane begins to disintegrate.



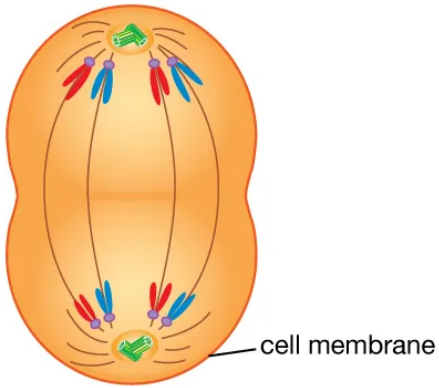
In late prophase the centrioles and asters are at opposite poles. The nucleolus and nuclear membrane have almost completely disappeared.



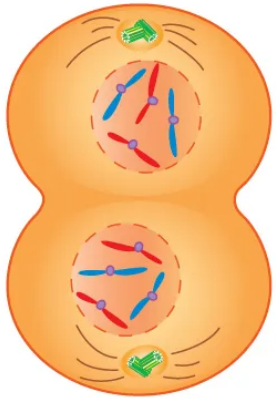
The doubled chromosomes—their centromeres attached to the spindle fibres—line up at mid-cell in metaphase.



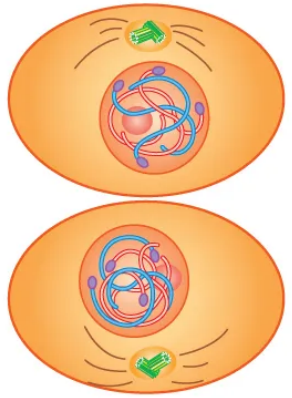
In early anaphase the centromeres split. Half the chromosomes move to one pole, half to the other pole.



In late anaphase the chromosomes have almost reached their respective poles. The cell membrane begins to pinch at the centre.



The cell membrane completes constriction in telophase. Nuclear membranes form around the separated chromosomes.

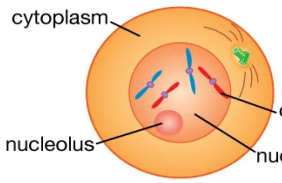


At mitosis completion, there are two cells with the same structures and number of chromosomes as the parent cell.

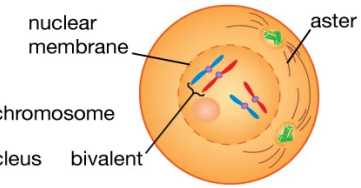
❑ Reproductive Cell Division:

In the process called sexual reproduction, each new organism is the result of the union of two different gametes (fertilization), one produced by each parent. Meiosis, the reproductive cell division that occurs in the gonads (ovaries and testes), produces gametes in which the number of chromosomes is reduced by half. As a result, gametes contain a single set of 23 chromosomes and thus are haploid (n) cells. Fertilization restores the diploid number of chromosomes.

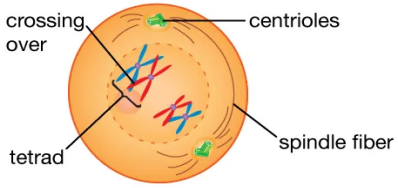
Meiosis, or sex cell division



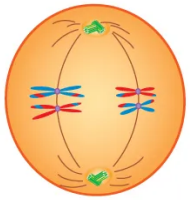
At the onset of meiosis, DNA strands thicken into chromosomes. Homologous, or like, chromosomes begin to approach each other.



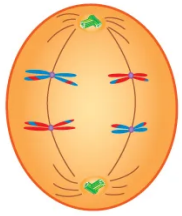
Homologous chromosomes pair to form bivalents. The centrioles divide and move to opposite poles of the cell.



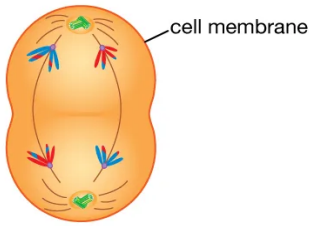
The bivalents duplicate to form tetrads, or four-chromatid groups. The nuclear membrane disintegrates. Crossing over (recombination) occurs.



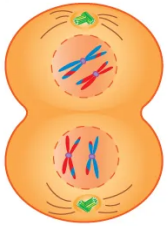
In metaphase I, the tetrads, attached to spindle fibers at their centromeres, line up at mid-cell.



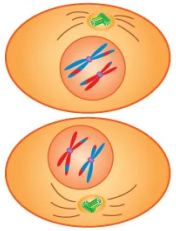
In early anaphase I, the tetrads separate, and the paired chromatids move along the spindle to their respective centrioles.



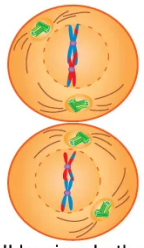
In late anaphase I, the chromatids have almost reached the spindle poles. The cell membrane begins to constrict.



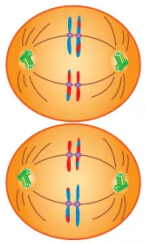
In telophase I, nuclear membranes enclose the separated chromatids. The cell membrane completes its constriction.



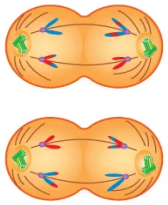
The first meiotic division ends. There are now two cells, each with the same number of chromatids as the parent cell.



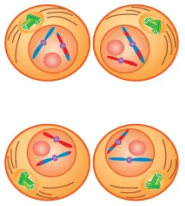
Prophase II begins. In the second meiotic division, homologous chromatids do not duplicate but merely separate.



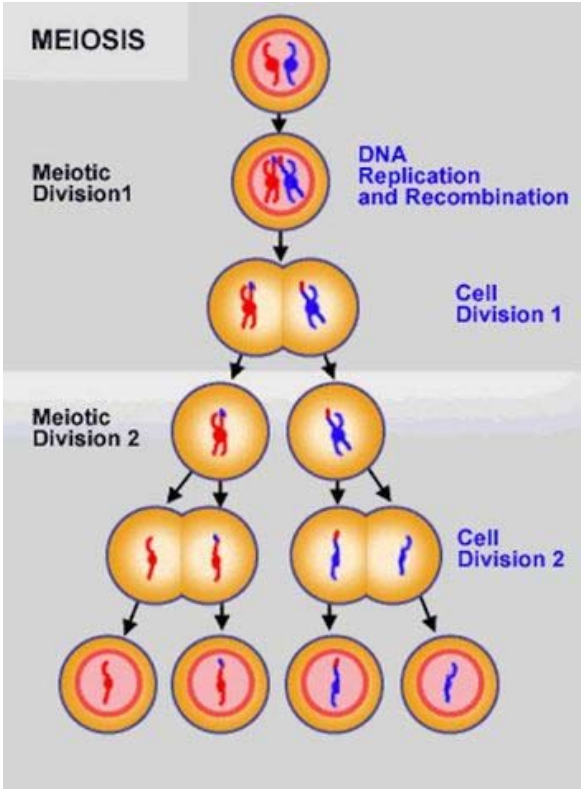
In metaphase II, the chromatids line up at mid-cell. The centrioles and asters are at the poles. A spindle has formed.



In anaphase II, the now-separated chromatids approach their respective poles. The cell membrane begins to constrict.



Telophase II has been completed. There are now four cells, each with half the number of chromosomes of the parent cell.

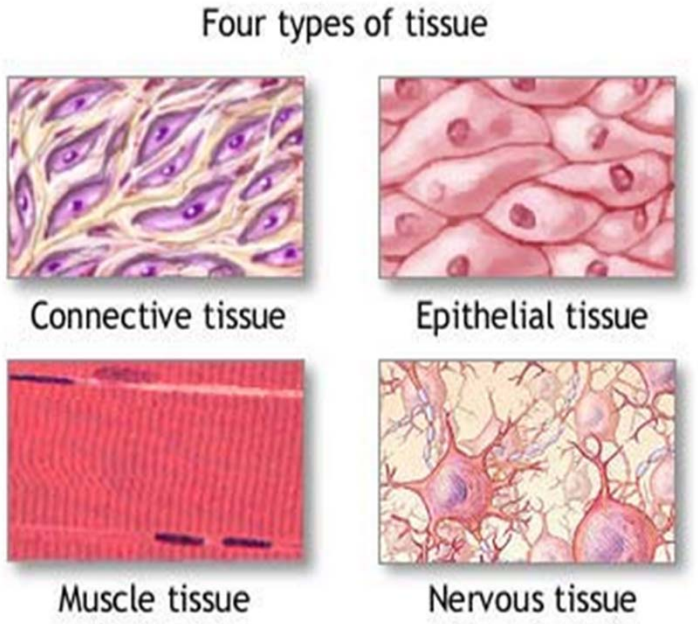


Tissues:

Is a group of cells that have similar structure and that function together as a unit.

- ❖ Main types of tissues:

- ❑ Epithelial tissue
- ❑ Connective tissue (cartilage, blood, bone)
- ❑ Muscle tissue (cardiac, skeletal and smooth muscle tissue)
- ❑ Nervous tissue (neurons and neuroglia)



Epithelial tissue or epithelium: consists of cells arranged in continuous sheets, in either single or multiple layers. Because the cells are closely packed and are held tightly together by many cell junctions, there is little intercellular space. Epithelial tissue may be divided into two types.

(1) **Surface epithelium**, forms the outer covering of the skin and some internal organs. It also forms the inner lining of blood vessels, ducts, body cavities, and the interior of the respiratory, digestive, urinary, and reproductive systems.
(2) **Glandular epithelium** makes up the secreting portion of glands such as the thyroid gland, adrenal glands, sweat glands, and digestive glands.

Functionally, epithelial tissue protects, secretes (mucus, hormones, and enzymes), absorbs (nutrients in the gastrointestinal tract), and excretes (various substances in the urinary tract)

Classification of Epithelial Tissue

1. **Arrangement of cells in layers**: The cells are arranged in one or more layers depending on function:

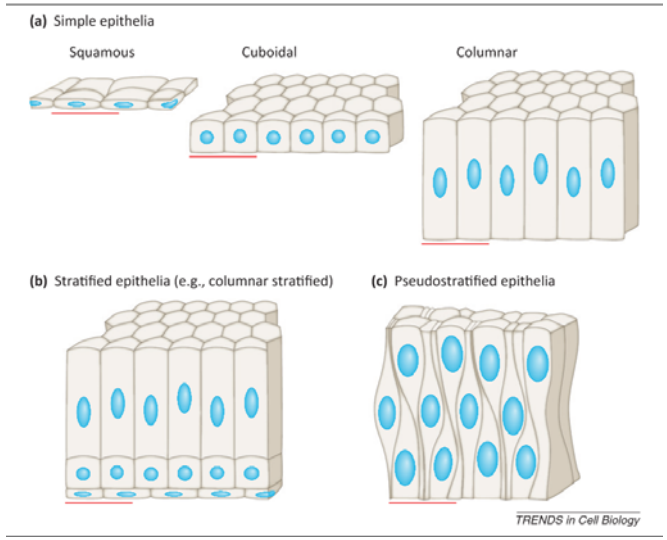
   a. **Simple epithelium:** is a single layer of cells that functions in diffusion, filtration, secretion, or absorption.
   b. **Stratified epithelium :** consists of two or more layers of cells that protect underlying tissues in locations where there is considerable wear and tear.
   c. **Pseudostratified epithelium:** appears to have multiple layers of cells because the cell nuclei lie at different levels.

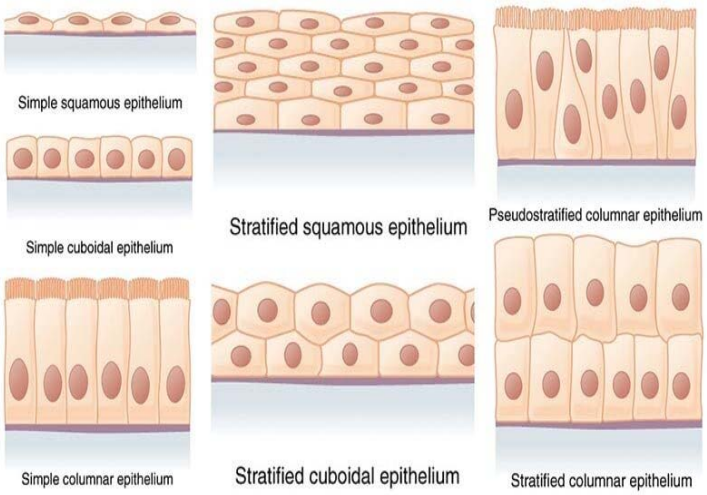
2. Cell shapes: Epithelial cells vary in shape depending on their function:

a. Squamous cells
b. Cuboidal cells
c. Columnar cells
d. Transitional cells

When we combine the two characteristics (arrangements of layers and cell shapes), we come up with the following types of epithelial tissues:

1. Simple squamous epithelium
2. Simple cuboidal epithelium
3. Simple columnar epithelium
4. Pseudostratified columnar epithelium
5. Stratified squamous epithelium
6. Stratified cuboidal epithelium
7. Stratified columnar epithelium
8. Transitional epithelium or urothelium (lines most of urinary tract)





Connective Tissue

- Is one of the most abundant and widely distributed tissues in the body. In its various forms, connective tissue has a **variety of functions:**
- It binds together, supports, and strengthens other body tissues.
- serves as the major transport system within the body (blood).
- primary location of stored energy reserves (adipose, or fat, tissue).
- main source of immune responses.

Connective tissue cells vary according to the type of tissue and include the following:

1. Fibroblasts: are large flat cells that move through connective tissue and secrete fibers and ground substance
2. Macrophages: develop from monocytes and destroy bacteria and cell debris by phagocytosis.
3. Plasma cells (plasmocytes): develop from B lymphocytes, they secrete antibodies that attack and neutralize foreign substances.
4. Mast cells (mastocytes): are abundant along blood vessels. They produce histamine, which dilates small blood vessels during inflammation and kills bacteria.
5. Adipocytes: are fat cells that store fats. They are found below the skin and around organs (heart, kidney).
6. Leukocytes (white blood cells): are not found in significant numbers in normal connective tissue. However, in response to certain conditions they migrate from blood into connective tissue. For example, neutrophils gather at sites of infection, and eosinophils migrate to sites of parasitic invasions and allergic responses

Classification of Connective Tissue:

1. **Loose connective tissue:** The fibers of loose connective tissue are loosely arranged between cells.

a. **Areolar connective tissue:** is one of the most widely distributed connective tissues; consists of fibers (collagen, elastic, reticular) and several kinds of cells (fibroblasts, macrophages, plasma cells, adipocytes, mast cells, and a few white blood cells)).

Location: in subcutaneous layer deep to skin; dermis of skin; around blood vessels, nerves, and body organs.
Function: Strength, elasticity, support.

a. **Adipose tissue :** has cells derived from fibroblasts (called adipocytes) that are specialized for storage of triglycerides (fats) as a large, centrally located droplet.

Location: subcutaneous layer deep to skin, around heart and kidneys, around joints and behind eyeball in eye socket.
Function: Reduces heat loss through skin; serves as an energy reserve; supports and protects organs.

c. **Reticular connective tissue:** is a fine interlacing network of reticular fibers (thin form of collagen fiber) and reticular cells.

Location: spleen, lymph nodes; red bone marrow; around blood vessels and muscles.
Function: binds smooth muscle tissue cells; filters and removes worn-out blood cells in spleen and microbes in lymph nodes

2. **Dense connective tissue** contains more fibers, which are thicker and more densely packed, but have considerably fewer cells than loose connective tissue.

a. **Dense regular connective tissue:** forms shiny white extracellular matrix; mainly collagen fibers regularly arranged in bundles with fibroblasts in rows between them

Location: Forms tendons (attach muscle to bone), most ligaments (attach bone to bone), and aponeuroses (sheetlike tendons that attach muscle to muscle or muscle to bone).
Function: Provides strong attachment between various structures.

b. **Dense irregular connective tissue:** is made up of collagen fibers; usually irregularly arranged with a few fibroblasts.

Location: joint capsules, membrane capsules around various organs (kidneys, liver, testes, lymph nodes); also in heart valves.
Function: Provides tensile (pulling) strength in many directions.

c. **Elastic connective tissue:** contains predominantly elastic fibers with fibroblasts between them.

Location: Lung tissue, walls of elastic arteries, trachea, bronchial tubes and some ligaments between vertebrae.
Function: Allows stretching of various organs; is strong and can recoil to original shape after being stretched. Elasticity is important to normal functioning of lung tissue (recoils in exhaling) and elastic arteries (recoil between heartbeats to help maintain blood flow).

3. Cartilage

a. Hyaline cartilage
b. Fibrocartilage
c. Elastic cartilage

4. Bone tissue

a. Compact bone
b. Spongy bone

5. Blood and Lymph