



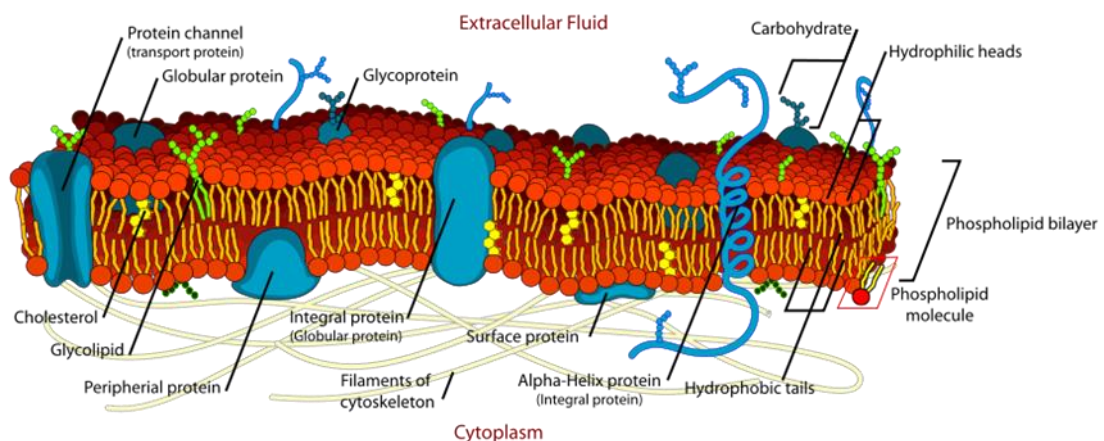
## Lec -2- The Cell

All living things are made up of cells. The cell is the basic unit of structure and function.

The cell structure comprises individual components with specific functions essential to carry out life's processes. These components include- cell wall, cell membrane, cytoplasm, nucleus, and cell organelles.

### Components of cell

- **Cell wall:** extra layer of protection and gives structural support (only found in plant cells).
- **Cell membrane:** The biological structure that separates the interior of a cell from its outer environment, all living cells, prokaryotic and eukaryotic, are surrounded by a plasma membrane.



### Structure:

Cell membrane is complex structures composed of two layers, known as the phospholipid bilayer that associated integral and peripheral proteins, and carbohydrates.

1. The inner layer of the plasma membrane faces the cytoplasm, and the outer layer faces the extracellular environment.



## Department of Anesthesia Techniques

### Title of the lecture:- The cell

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2. The proteins are scattered throughout the membrane; therefore, they form a mosaic pattern. In addition, this description is called the fluid-mosaic model of membrane structure.
3. The phospholipid bilayer contain of
  - A. **The hydrophilic heads** (water loving) polar of the phospholipid molecules attracted to water outside and inside of the cell
  - B. **The hydrophobic tails** (water fearing) nonpolar tails repelled by water areas face away
4. In addition to phospholipids, there are two other types of lipids in the plasma membrane.
  - A. **Glycolipids** have a structure similar to phospholipids except that the hydrophilic head is a variety of sugars joined to form a straight or branching carbohydrate chain.
  - B. **Cholesterol** is another lipid component of animal cell membranes; present in both layers, and **helps maintain the structural integrity of the membrane.**
5. Proteins are found inserted into this lipid bilayer and are classified into **integral proteins and peripheral proteins.**
6. The plasma membrane is asymmetrical: the two halves are not identical. The carbohydrate chains of the glycolipids and proteins occur only on the **outside surface** and the cytoskeletal filaments attach to proteins only on the **inside surface.**

#### **Function of cell membrane:**

- 1- The cell membrane is the interface between a cell and its environment.
- 2- The plasma membrane envelops the cell and maintains its structural and functional integrity.
- 3- It assists in controlling interaction between cells.
- 4- Regulating what goes in and out of the cell.



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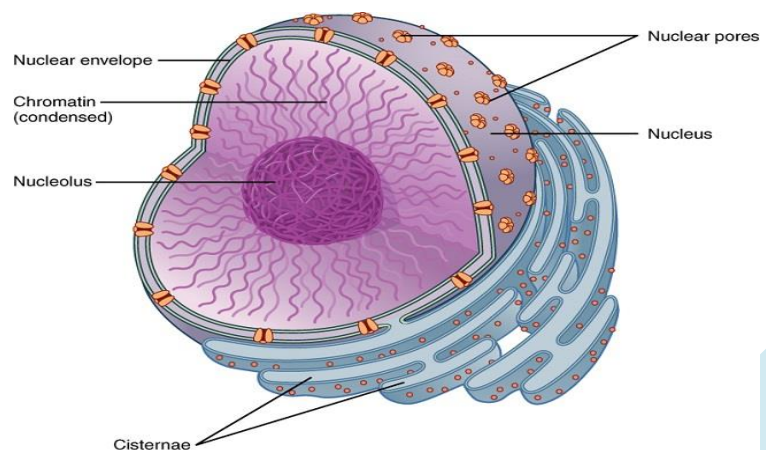
- **Cytoplasm:** is a thick, clear, jelly-like substance present inside the cell membrane. Most of the chemical reactions within a cell take place in this cytoplasm.
- **Nucleus:** is a highly specialized organelle that serves as the information and administrative center of the cell.

**This organelle has two major functions:**

- 1- It stores the cell's hereditary material, or DNA.
- 2- It coordinates the cell's activities, which include intermediate metabolism, growth, protein synthesis, and reproduction (cell division).

### Structure

- The nucleus bounded by a **double membrane called the nuclear envelope in eukaryotic cells**. This membrane separates the contents of the nucleus from the cytoplasm.
- The two nuclear membranes appear to fuse at **nuclear pores**, which material moves between the nucleus and the cytosol.
- **Nucleolus:** is the largest structure in the cell nucleus. The nucleolus is responsible for the production of ribosomes; this process is referred to as the **ribosome biogenesis**. The nucleolus is formed around specific chromosomal regions and it is made up of DNA, RNA and associated proteins (**Chromatin**).





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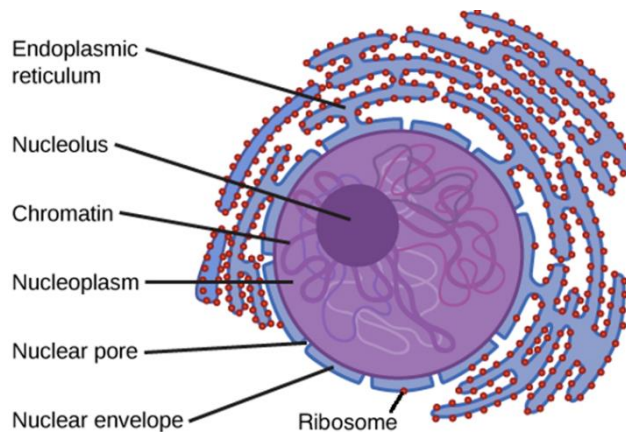
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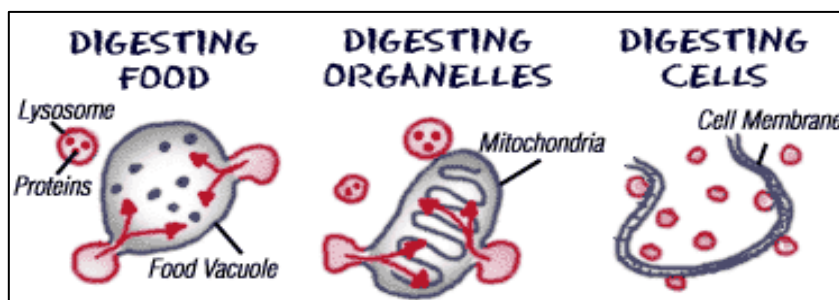
➤ **Endoplasmic reticulum (ER)** is network of membranous canals that shares part of its membrane with that of the nucleus.

1- Endoplasmic reticulum (**rough**) – The rough endoplasmic reticulum is studded with ribosomes. It is major site of membrane protein synthesis.

2- Endoplasmic reticulum (**smooth**) – The smooth endoplasmic reticulum is smooth because it lacks ribosomes. It is major site of lipid synthesis.



➤ **Lysosomes:** are tiny sacs filled with fluid containing enzymes (i.e. proteins that act as biological catalysts) which digest large molecules, also responsible for breaking down and getting rid of waste products of the cell.





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➤ **Ribosome:**

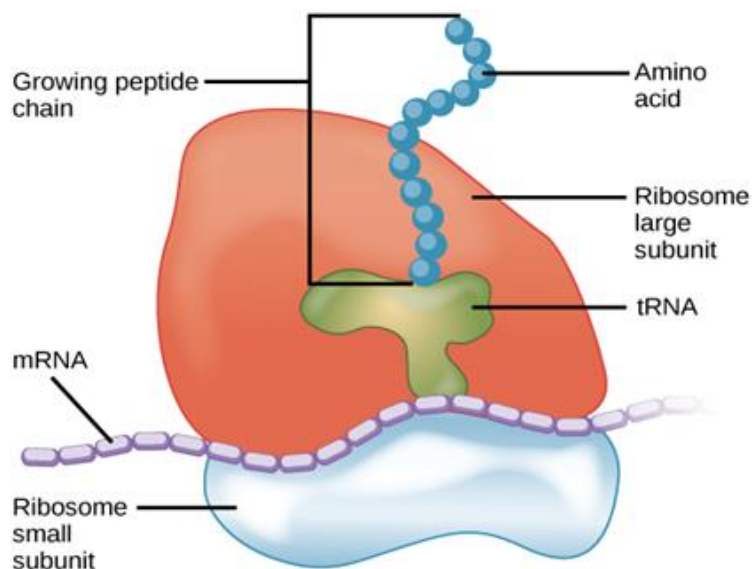
**Structure:** Macromolecular complex of proteins and RNA

Each ribosome consists of **large subunit** and a **small subunit**. Using the templates and instructions provided by two different types of RNA, ribosomes synthesize a variety of proteins that are essential to the survival of the cell.

**Types:**

1. Attached to RER – synthesize membrane, secreted, or organelle proteins.
2. Free in cytoplasm – synthesize other proteins for cytoplasm or other organelles

**Function:** Protein biosynthesis takes place on ribosomes which are small organelles present in all organisms.





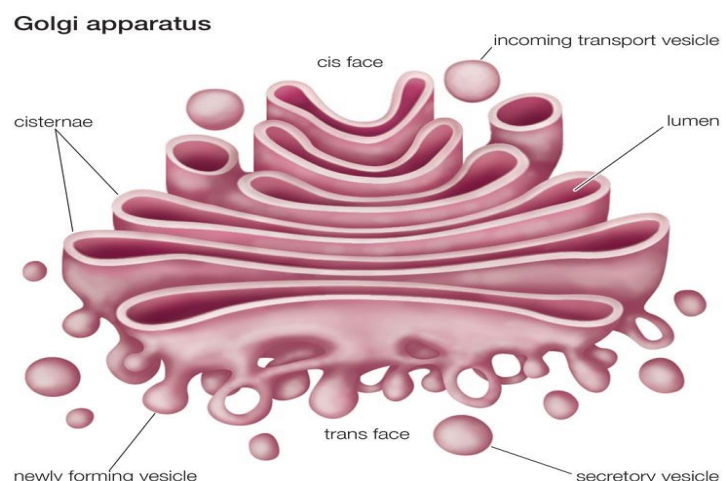
- **Golgi apparatus:** These are tiny vesicles surrounded by a membrane; the simplest unit of the Golgi apparatus is the **cisterna**.

Several minutes after proteins are synthesized in the rough ER, most of them leave the organelle within small membrane bounded transport vesicles. These vesicles, which bud from regions of the rough ER not coated with ribosomes, carry the proteins to another cellular location

**Function:** "Traffic police officer of cell"; modifies, sorts, and transports proteins and membrane components to appropriate cellular location

### Mechanism

- 1- Vesicles that are carrying cellular components bud off ER, travel to the Golgi, and then fuse with cis cisternae
- 2- Various modifications as vesicles bud of one cisterna and carry it to a trans cisterna.
- 3- Modifications include adding functional group tags (frequently sugars) that help sort cell components
- 4- At the trans face of the Golgi, vesicles bud off and either:
  - a) Deliver membrane proteins to various organelles via membrane fusion
  - b) Fuse with the plasma membrane, thereby delivering contents outside of the cell
  - c) Fuses with other organelle membranes, thereby delivering contents into organelle lumen





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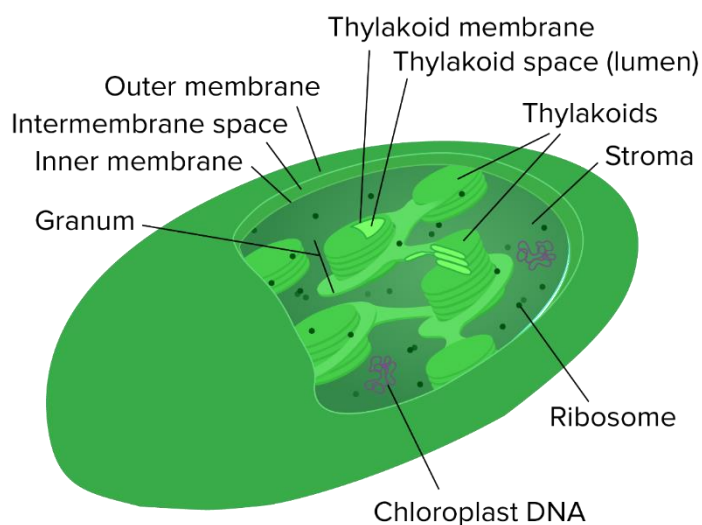
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- **Centrosome:** an associated pair of cylindrical shaped protein structures (centrioles) that organize microtubules, microtubular structures found near the nucleus, and aid in forming the mitotic spindle during cell division in eukaryotes.
- **Chloroplast:** Except for vacuoles, chloroplasts are the largest and the most characteristic organelles in the cells of plants and green algae.

**Structure** are disc-shaped organelles found in the cytosol of a cell. They have outer and inner membranes with an intermembrane space between them, the center, there are membranes discs known as thylakoids, arranged in interconnected stacks called **grana** (singular, granum). **The thylakoid membranes contain green pigments (chlorophylls) and other pigments that absorb light, as well as enzymes that generate ATP during photosynthesis.**

**Function** key organelle for photosynthesis take place.





➤ **Mitochondria:**

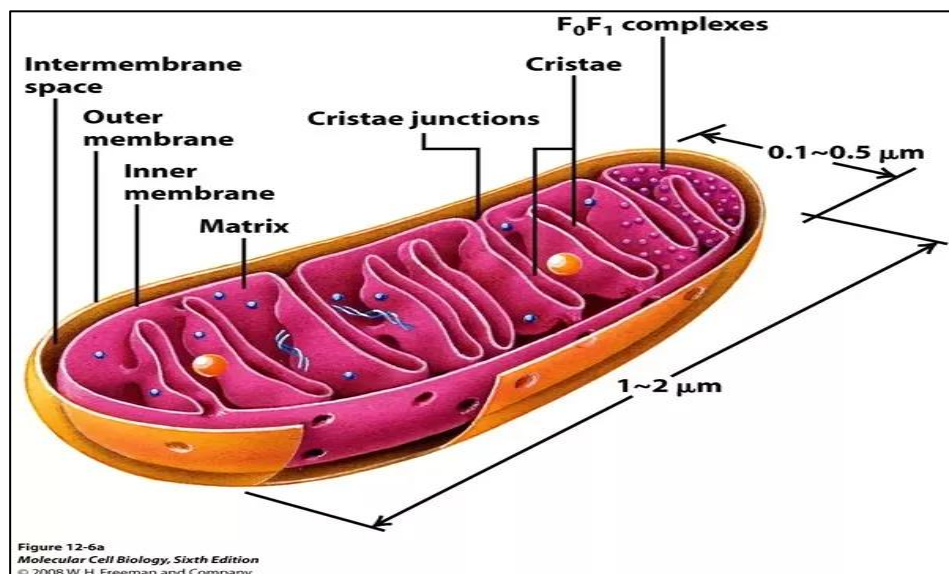
**Structure**

Mitochondria are surrounded by a double-membrane system, consisting of inner and outer mitochondrial membranes separated by an intermembrane space.

The two membranes that bound a mitochondrion differ in composition and function

- The outer membrane, composed of about half lipid and half protein, contains porins that render the membrane permeable to molecules having high molecular weights.
- The inner membrane, which is much less permeable, It increase the surface area of the inner membrane by a large number of **cristae**, that protrude into the matrix, or central space.
- Mitochondrial matrix contains ribosomes, DNA, enzymes for tricarboxylic acid (TCA) cycle.

**Function:** major energy-producing organelle by releasing energy in the form of ATP by the breakdown of carbohydrates and fatty acids, which is converted to ATP by the process of oxidative phosphorylation.







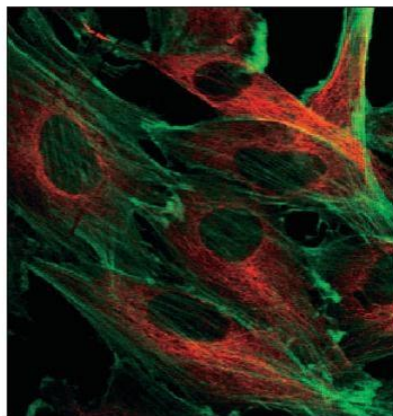
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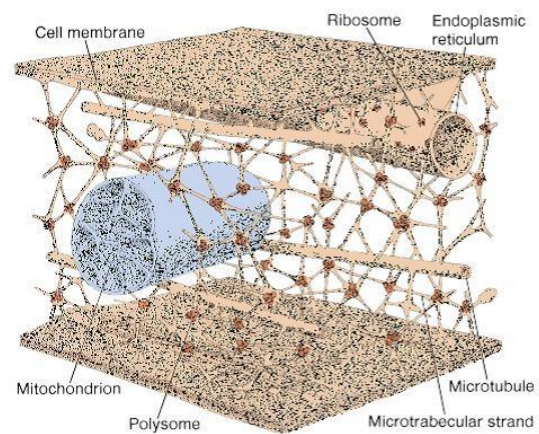
- **Microvilli:** increases surface area for absorption of nutrients from surrounding medium.
- **Vacuole:** A vacuole is an organelle found in plant, fungi cells, animals and many single-cell organisms. A membrane, called the **tonoplast**, and storage material, surrounds the single large vacuole of the cell.
- **Peroxisomes** – a very small organelle that uses oxygen to breakdown and detoxify long fatty acids and other molecules.
- **Cytoskeleton:** is a structure that helps cells maintain their shape and internal organization, and it also provides mechanical support that enables cells to carry out essential functions like division and movement.

### Structure

The cytoskeleton of a cell is made up of microfilaments, microtubules, and intermediate filaments. These protein structures together maintain cell shape, anchor organelles, and cause cell movement.



(a)

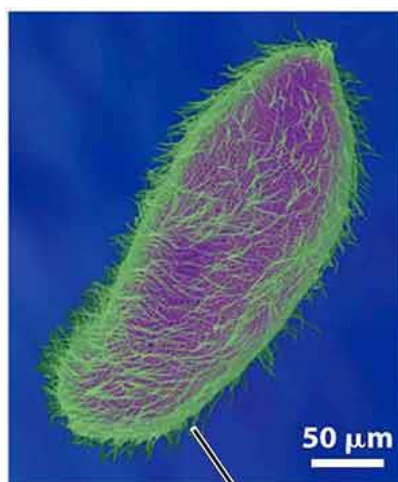


(b)

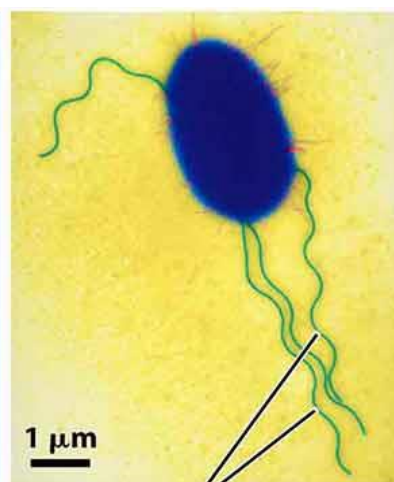


- **Pili** – Also, called fimbria is used for conjugation and sometimes movement.
- **Cilia and Flagella**

BASIS FOR COMPARISON	CILIA	FLAGELLA
<b>Meaning</b>	Cilia are short, hair like appendages extending from the surface of a living cell.	Flagella are long, threadlike appendages on the surface of a living cell.
<b>Found in</b>	Eukaryotic cell.	Prokaryotic cell as well as in eukaryotic cells.
<b>Length</b>	Short.	Longer.
<b>Type of motion</b>	Cilia show rotational motion like a motor; they are very fast moving.	Flagella show slow, wave-like.
<b>Role</b>	They play their primary role in locomotion, aeration (respiration), etc.	They are helpful in locomotion only.
<b>Occurs in</b>	It occurs all over the cell surface.	It is present at both the ends or sometimes all over the surface.



**Cilia**



**Flagella**

**Animal Cell (cutaway view of generalized cell)**

