Medical Laboratory Techniques Department
Lec. Cell organelles

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Cell Organelles

An organelle is the unusual compartment suspended in the cytoplasm of a eukaryotic cell with specific function and maintains specific environment for the biochemical reactions.

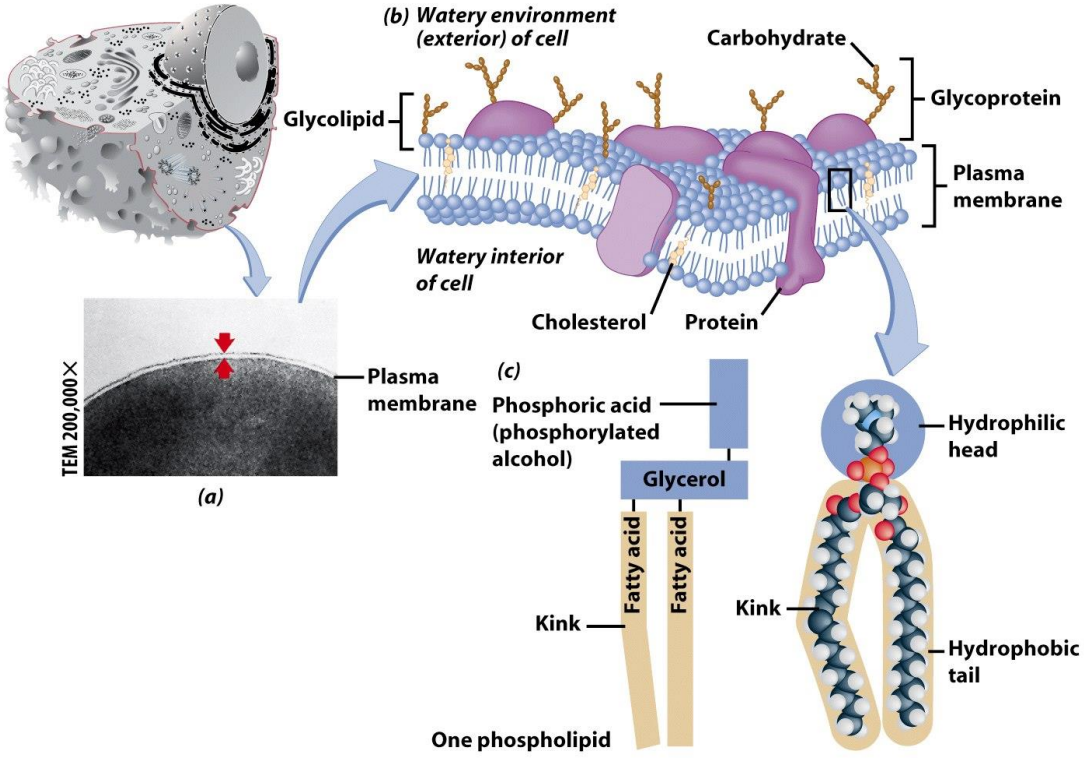
1- Plasma Membrane

• Composed of double layer of phospholipids, proteins and carbohydrate.

• Surrounds outside of all cells

• Controls what enters or leaves the cell

• Living layer



Phospholipids

Phospholipids, arranged in a bilayer, make up the basic fabric of the plasma membrane. They are well-suited for this role because they

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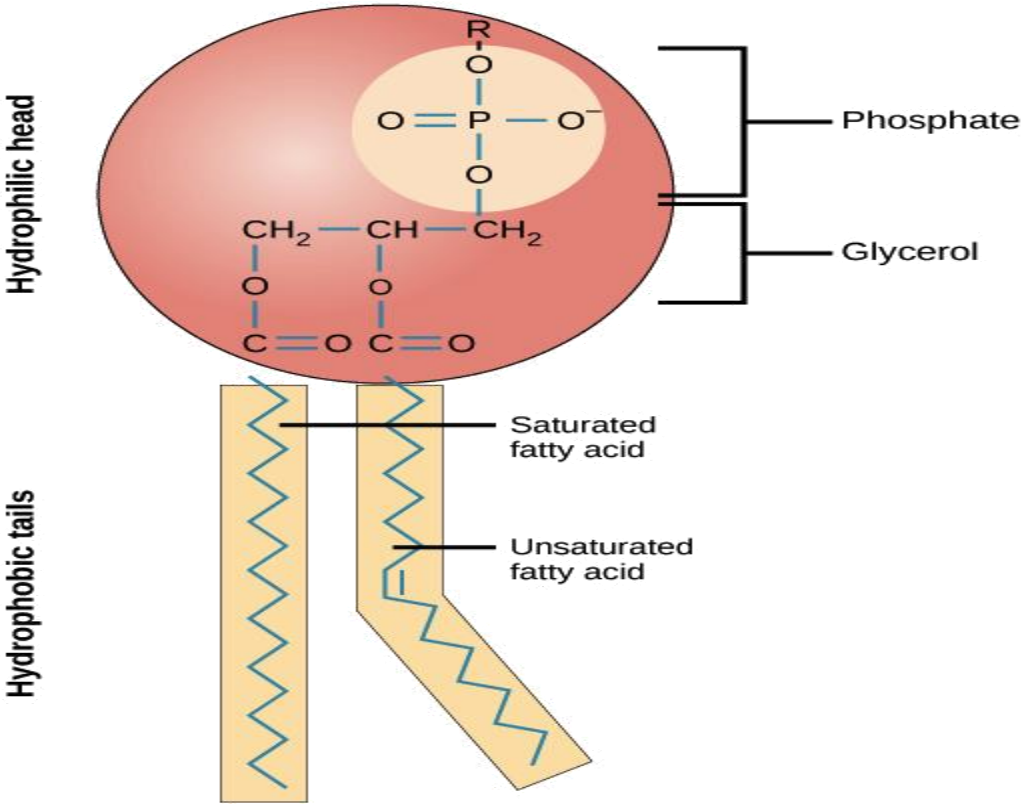
are **amphipathic**, meaning that they have both hydrophilic and hydrophobic regions.



The **hydrophilic**, or "water-loving," portion of a phospholipid is its head, which contains a negatively charged phosphate group, which may also or be charged or polar. The hydrophilic heads of phospholipids in a membrane bilayer face outward, contacting the aqueous (watery) fluid both inside and outside the cell. Since water is a polar molecule, it readily forms electrostatic (charge-based) interactions with the phospholipid heads.

The **hydrophobic**, or "water-fearing," part of a phospholipid consists of its long, nonpolar fatty acid tails. The fatty acid tails can easily interact

with other nonpolar molecules, but they interact poorly with water. Because of this, it's more energetically favorable for the phospholipids to tuck their fatty acid tails away in the interior of the membrane, where they are shielded from the surrounding water. The phospholipid bilayer formed by these interactions makes a good barrier between the interior and exterior of the cell, because water and other polar or charged substances cannot easily cross the hydrophobic core of the membrane.

Membrane proteins

Membrane proteins may extend partway into the plasma membrane, cross the membrane entirely, or be loosely attached to its inside or outside face.

There are two main categories of membrane proteins: integral and peripheral.

- **Integral membrane proteins** are, as their name suggests, integrated into the membrane: they have at least one hydrophobic region that anchors them to the hydrophobic core of the phospholipid bilayer. Some stick only partway into the membrane, while others stretch from one side of the membrane to the other and are exposed on either side. Proteins that extend all the way across the membrane are called **transmembrane proteins**.
- **Peripheral membrane proteins** are found on the outside and inside surfaces of membranes, attached either to integral proteins or to phospholipids.

Carbohydrate

Carbohydrate groups are present only on the outer surface of the plasma membrane and are attached to proteins, forming **glycoproteins**, or lipids, forming **glycolipids**.

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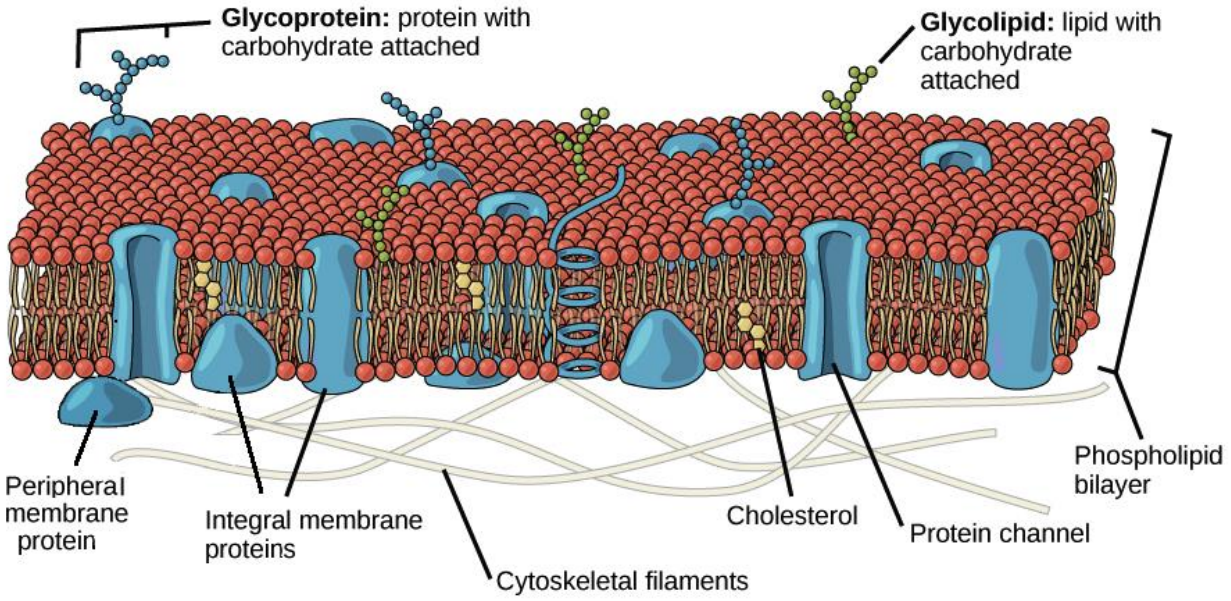

2- Cell Walls

A **cell wall** is a structural layer surrounding some types of cells, just outside the cell membrane. It can be tough, flexible, and sometimes rigid. It provides the cell with both structural support and protection, and also acts as a filtering mechanism.[1] Cell walls are present in most prokaryotes (except mollicute bacteria), in algae, fungi and eukaryotes including plants but are absent in animals.

3-Cytoplasm

The **cytoplasm** is all of the material within a cell, enclosed by the cell membrane, except for the cell nucleus. The main components of the cytoplasm are cytosol (a gel-like substance), the organelles (the cell's internal sub-structures), and various cytoplasmic inclusions. The cytoplasm is about 80% water and usually colorless.

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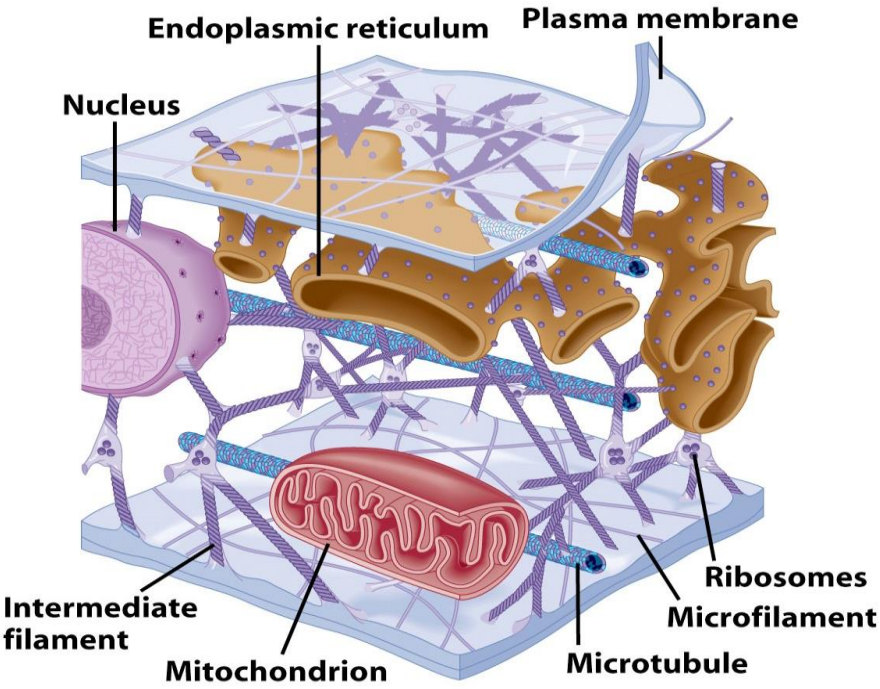


4- Cytoskeleton

A network of fibers extending throughout the cytoplasm.

Functions:

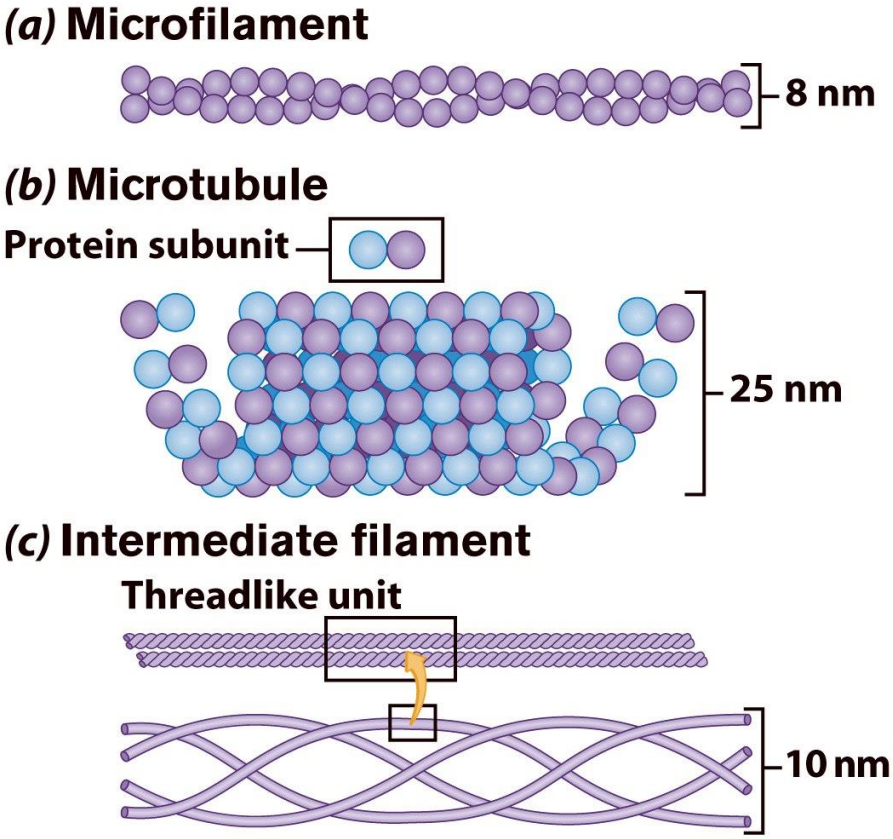
1- mechanical support
2- anchor organelles
3- help move substances

Contains three types of elements:

1. Microfilaments-Actin filaments which support cell shape.

2. Microtubules – tubulin; Actin filaments and microtubules formed from globular protein subunits

3. Intermediate filaments contain fibrous protein subunits



5- Cilia & Flagella

Cilia and flagella are projections from the cell. They are made up of microtubules , and are covered by an extension of the plasma membrane. They are motile and designed either to move the cell itself or to move substances over or around the cell. The primary purpose of cilia in mammalian cells is to move fluid, mucous, or cells over their surface. Cilia and flagella have the same internal structure. The major difference is in their length.

Both flagella and cilia have a 9 + 2 arrangement of microtubules. This arrangement refers to the 9 fused pairs of microtubules on the outside of a cylinder, and the 2 unfused microtubules in the center.

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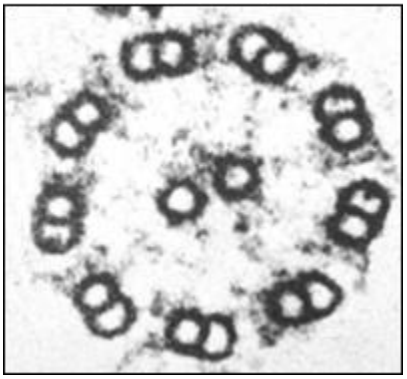
Electron Micrograph of the cross-section of a sperm tail



6- The nucleus

Largest organelle.

Found in all eukaryotic cells (except erythrocytes).

It is surrounded by a nuclear membrane.

The “brain” of the cell.

Houses the genomic DNA or genetic information of the cell within the chromosomes and control of cell divisions.

Controls all the cellular activities.

Within the nucleus is a smaller structure called the nucleolus, which houses the RNA (ribonucleic acid). RNA helps convey the DNA’s orders to the rest of the cell and serves as a template for protein synthesis.

Chromatin is DNA plus the proteins (and RNA).

The **nuclear envelope**, also known as the **nuclear membrane**, is made up of two lipid bilayer membranes which in eukaryotic cells surrounds the nucleus. The

nuclear envelope has many nuclear pores that allow materials to move between the cytosol and the nucleus.

7- **Endoplasmic Reticulum (ER)**

Appearing like a series of interconnected, flattened tubes, it is often observed to surround the nucleus. The outer layer of the nuclear envelope is contiguous with the ER.

Helps move substances within cells (transport of synthesized proteins in vesicles).

There are two different:

1- Rough endoplasmic reticulum
2- Smooth endoplasmic reticulum

Rough endoplasmic reticulum (rER):

Regions of ER where ribosomes are bound to the outer membrane. It has ribosomes all over it giving it a “rough” appearance. Bound ribosomes and the associated ER are involved in the production and modification of proteins

Smooth endoplasmic reticulum(sER):

Regions of ER without attached ribosomes. Surface area for enzymatic reactions.

Shaped slightly tubular.

8- **Golgi Apparatus**

Receives proteins from rough ER and puts finishing touches on them. Involved in secretion of protein out of cell by forming secretory vesicles discharged by exocytosis. Forms new membrane components. Packages lysosomes

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9- Lysosomes

Lysosomes contain potent enzymes known collectively as acid hydrolases. These enzymes are synthesized on ribosomes bound to the ER

Functions of lysosomes:

They function within the acidic environment of lysosomes to hydrolyze or break down macromolecules (proteins, nucleic acids, carbohydrates, and lipids). Also, lysosomal enzymes degrade materials that have been taken up by the cell through endocytosis or phagocytosis.

10- Mitochondria

Consists of double membrane: Outer and inner membrane. Inner membrane contains folding's called cristae. Inner fluid-filled space is mitochondrial matrix. Mitochondrial matrix contains DNA (circular), RNA, ribosomes, proteins.

Functions in ATP production ("energy factory" of cell). Cells active in metabolism (energy usage) have many mitochondria (e.g., muscle). Enzymes for ATP production are located on inner membrane. ATP produced in matrix, must be transported across double-membrane for use in cellular activities.

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Mitochondria Structural Features

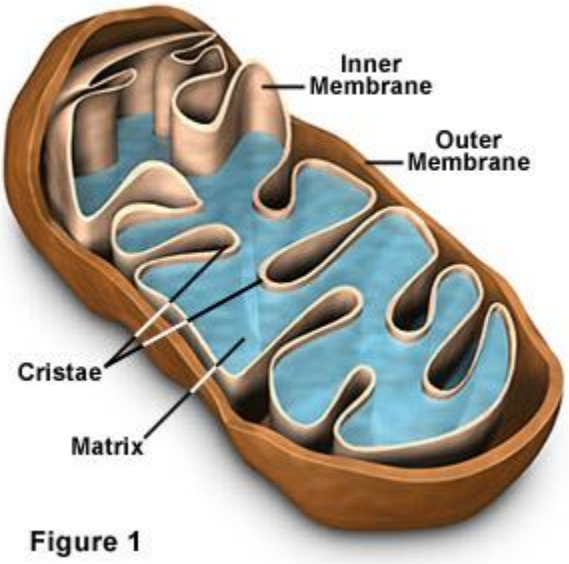

Figure 1