



PHYSIOLOGY

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LECTURE 1, PART (2): CELLULAR LEVEL OF ORGANIZATION

Objectives

1. Discuss **cellular level of organization. (Continue in the next lecture)**
2. Describe **transport processes of solutes and water (Next lecture).**

(Pages 60-84 of the reference)

THE CELLULAR LEVEL OF ORGANIZATION

- The cell divides into three main parts: plasma membrane, cytoplasm, and nucleus.
- The plasma membrane:
 1. is the cell's flexible outer surface, separating the cell's internal environment from the external environment.
 2. It plays a key role in communication among cells and between cells and their external environment.

THE CELLULAR LEVEL OF ORGANIZATION

- The cytoplasm:

1. Consists of all the cellular contents between the plasma membrane and the nucleus.
2. It has two components: cytosol (intracellular fluid that contains water, dissolved solutes, and suspended particle) and organelles (include the cytoskeleton, ribosomes, endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, and mitochondria).

THE CELLULAR LEVEL OF ORGANIZATION

- The nucleus:

1. The control center of the cell.
2. Contains DNA or the genetic material that dictates what the cell will do, controlling cellular structure and function.

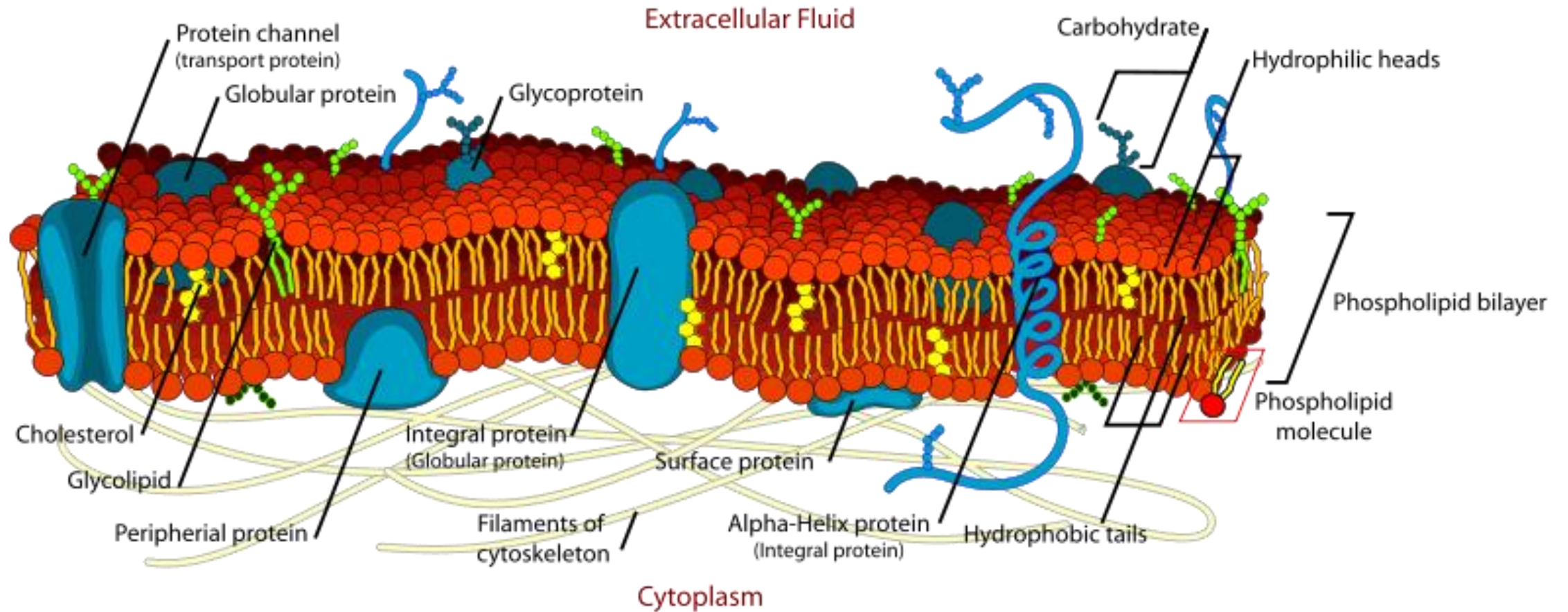
THE PLASMA MEMBRANE

- The basic structural framework of the plasma membrane is the **lipid bilayer (lipid molecules—phospholipids (75%), cholesterol (20%), and glycolipids (5%))**.
- The lipids are amphipathic molecules (polar heads and nonpolar tails).
- Glycolipids appear only in the membrane layer that faces the extracellular fluid, which is one reason the two sides of the bilayer are asymmetric.

THE PLASMA MEMBRANE

- Membrane proteins are classified as integral or peripheral according to whether they are firmly embedded in the membrane.
1. Most integral proteins are transmembrane proteins (span the entire lipid bilayer and protrude into both the cytosol and extracellular fluid).
 2. Peripheral proteins are attached to the polar heads of membrane lipids or to integral proteins at the inner or outer surface of the membrane.

THE PLASMA MEMBRANE

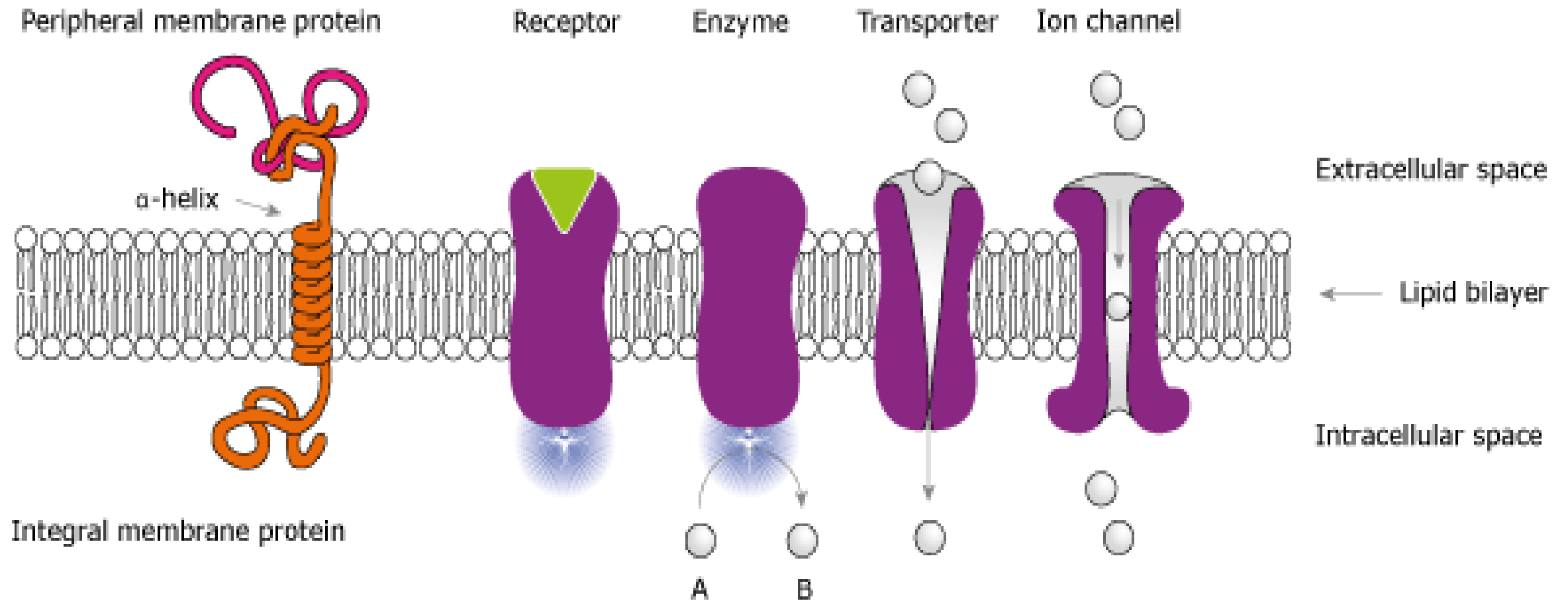


Integral proteins (their functions are important!):

1. Forming ion channels.
2. Acting as carriers or transporters.
3. Are called receptors.
4. Are enzymes.
5. Serving as linkers.
6. Serving as cell identity markers.

Peripheral proteins (their functions are important!):

1. Serve as enzymes and linkers.
2. Support the plasma membrane.
3. Anchor integral proteins.
4. Participate in mechanical activities:
 - Moving materials and organelles within cells.
 - Attaching cells to one another.



Membrane fluidity:

- Membranes are fluid structures.
- Most of the membrane lipids as well as many membrane proteins easily rotate and move sideways in their own half of the bilayer.
- However, it is difficult for hydrophilic parts of membrane molecules to pass through the hydrophobic core of the membrane. This difficulty contributes to the asymmetry of the membrane bilayer.

Membrane permeability:

- The permeability of the plasma membrane to different substances varies.
- **The hydrophobic interior of the plasma membrane allows nonpolar molecules to rapidly pass through, but prevents passage of ions and large, uncharged polar molecules.**
- Because **water and urea** are small polar molecules that have no overall charge, they can **move from one gap** (small gaps appear in the hydrophobic environment of the membrane's interior) to another until they have crossed the membrane without any assistance.
- **Transmembrane proteins that act as channels and carriers** (very selective) increase the plasma membrane's permeability to a variety of **ions and uncharged polar molecules** (need assistance).

THE CYTOPLASM

- **Cytoplasm** consists of all the cellular contents between the plasma membrane and the nucleus.
- It has two components:
- **(1) the cytosol**, is the fluid portion of the cytoplasm that surrounds organelles.
- **(2) organelles**, are tiny structures that perform different functions in the cell.

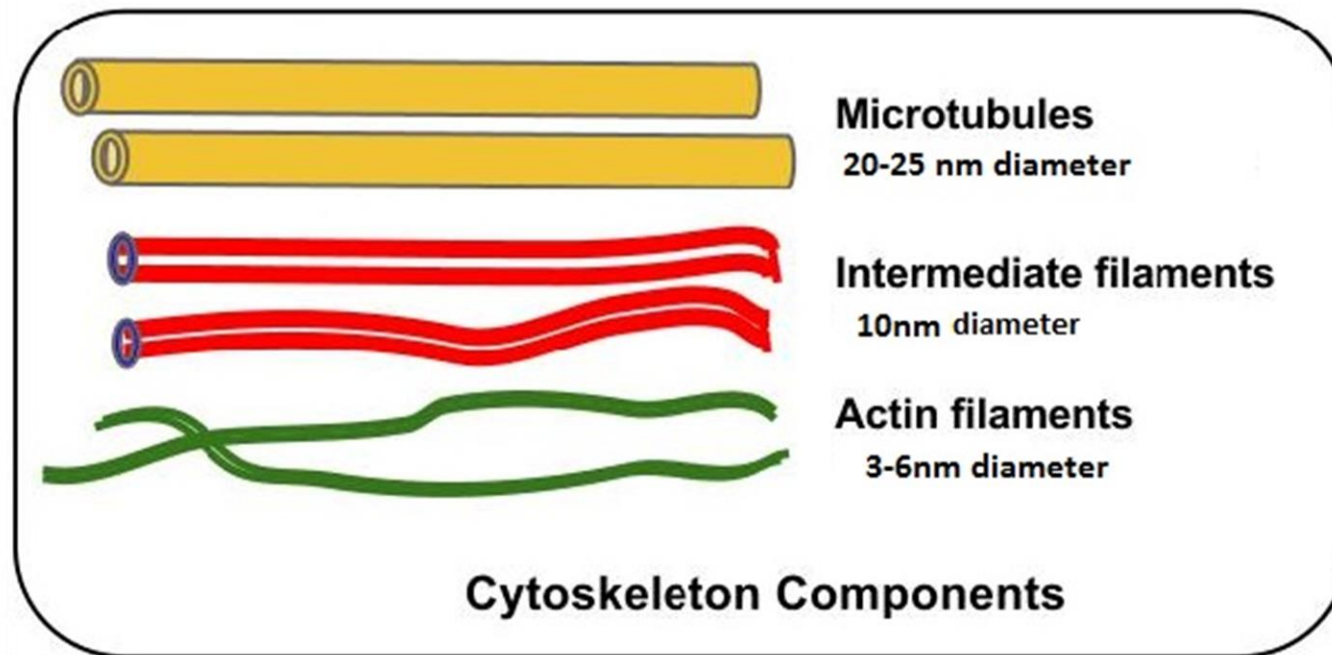
THE CYTOPLASM

- Cytosol:

1. Contains **75–90% water** plus various dissolved and suspended components (i.e. glucose, amino acids, fatty acids, proteins, lipids, ATP, and waste products).
1. It is **the site of many chemical reactions** required for a cell's existence (i.e. glycolysis, maintenance of cell structures and for cell growth).

THE CYTOPLASM

- The **cytoskeleton** is a network of protein filaments that extends throughout the cytosol (**microfilaments, intermediate filaments, and microtubules**).



THE CYTOPLASM

- **Microfilaments:**

1. Are the thinnest elements of the cytoskeleton.
2. They are composed of the proteins actin and myosin.
3. They have two general functions: help generate movement (muscle contraction, cell division, and cell locomotion) and provide mechanical support (basic strength and shapes of cells).

- **Intermediate filaments:**

1. Are thicker than microfilaments but thinner than microtubules.
2. They are found in parts of cells subject to mechanical stress.
3. They help stabilize the position of organelles such as the nucleus and help attach cells to one another.

THE CYTOPLASM

- **Microtubules:**

1. Are the largest of the cytoskeletal components.
2. They are composed mainly of the protein tubulin.
3. They help determine cell shape.
4. They also function in the movement of organelles.



THANK YOU

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