General Physiology
Cell and Cell Structures
Lecture-1
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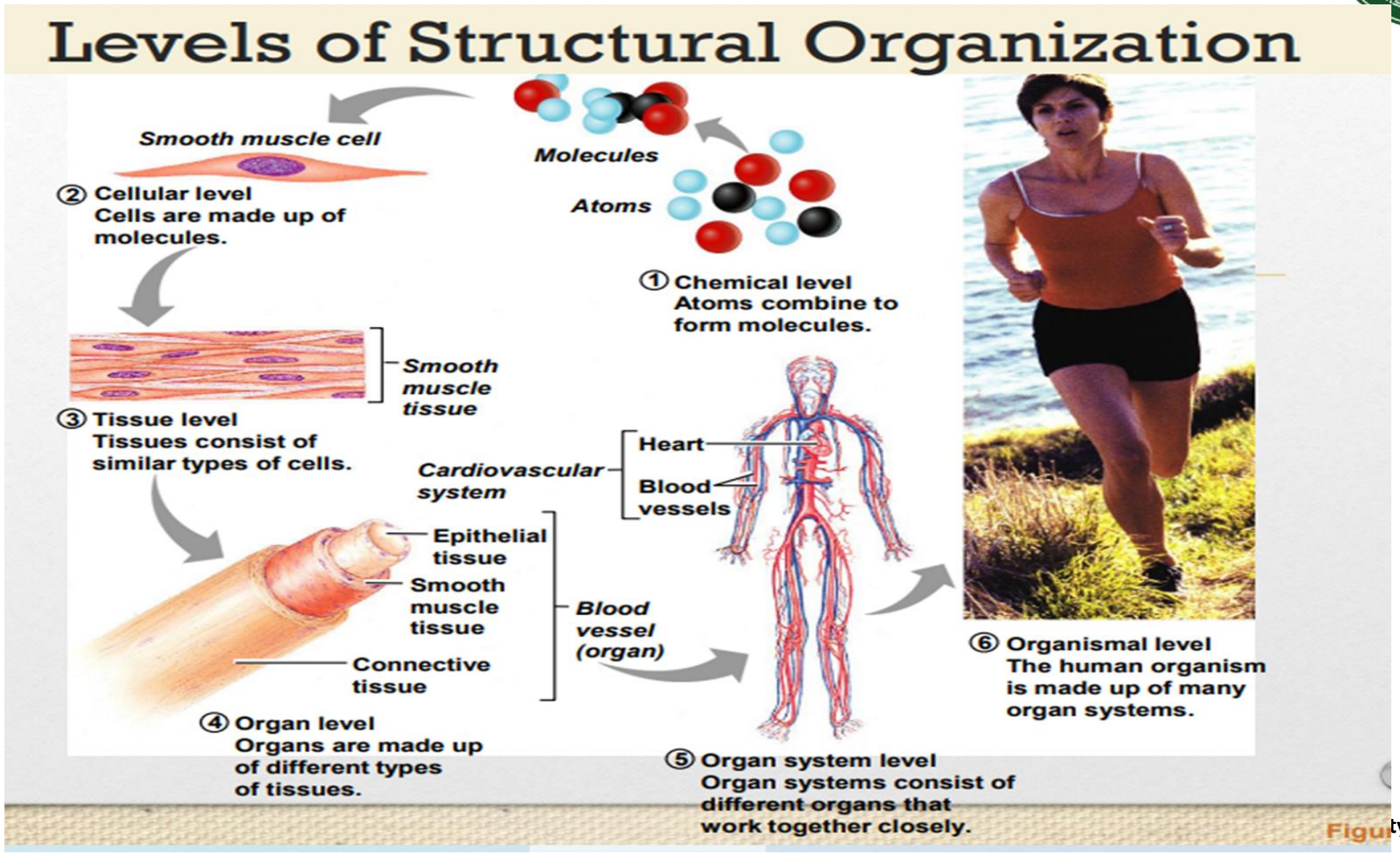
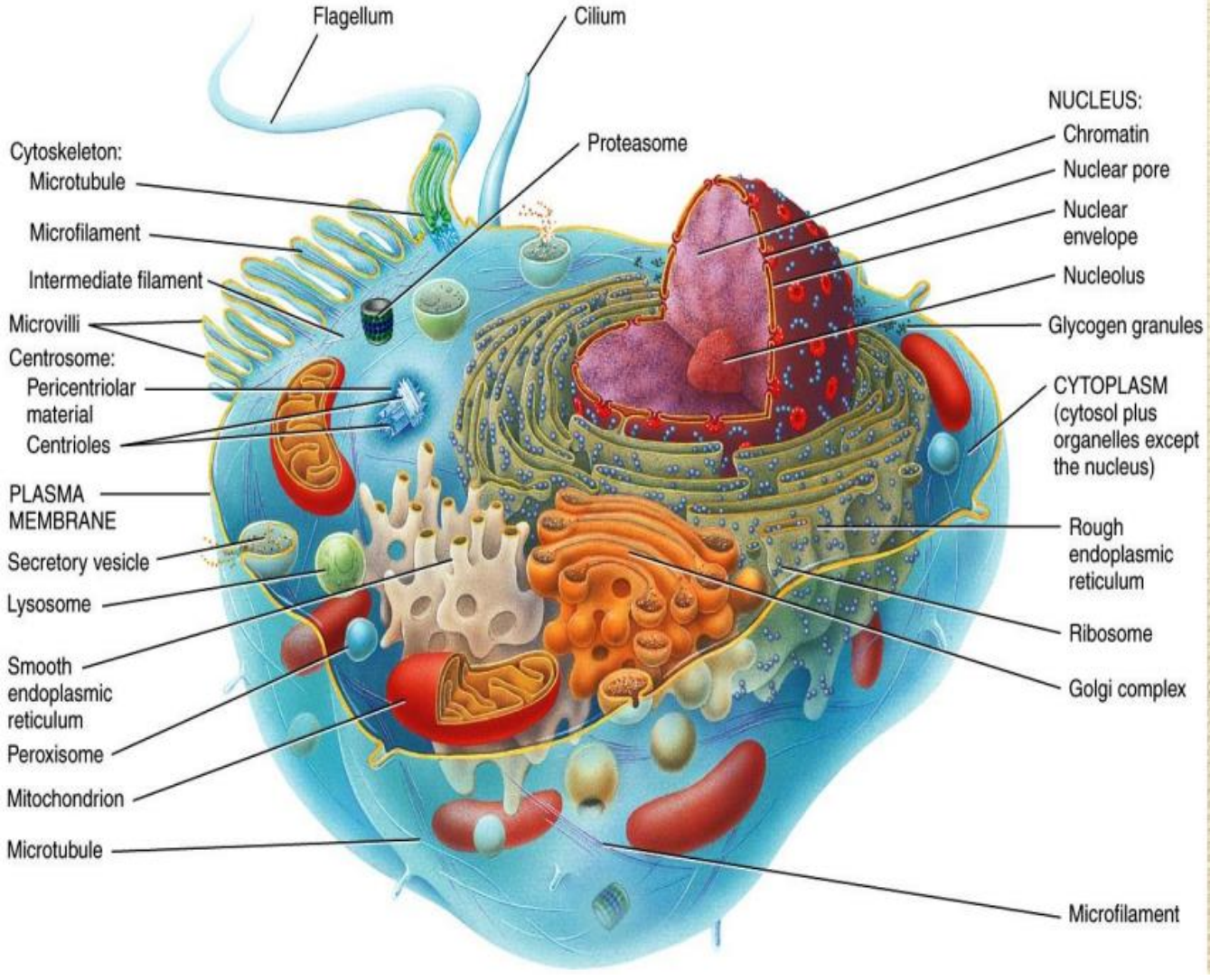
- Physiology: It is the study of the functions of the body`s structural machinery.



The Cells

- **Cells** are the smallest structural and functional subunits of our body systems
- **Cell Biology** is the study of cells, their internal structures, and the chemical reactions that occur within them
- **Cells has three principal parts:**

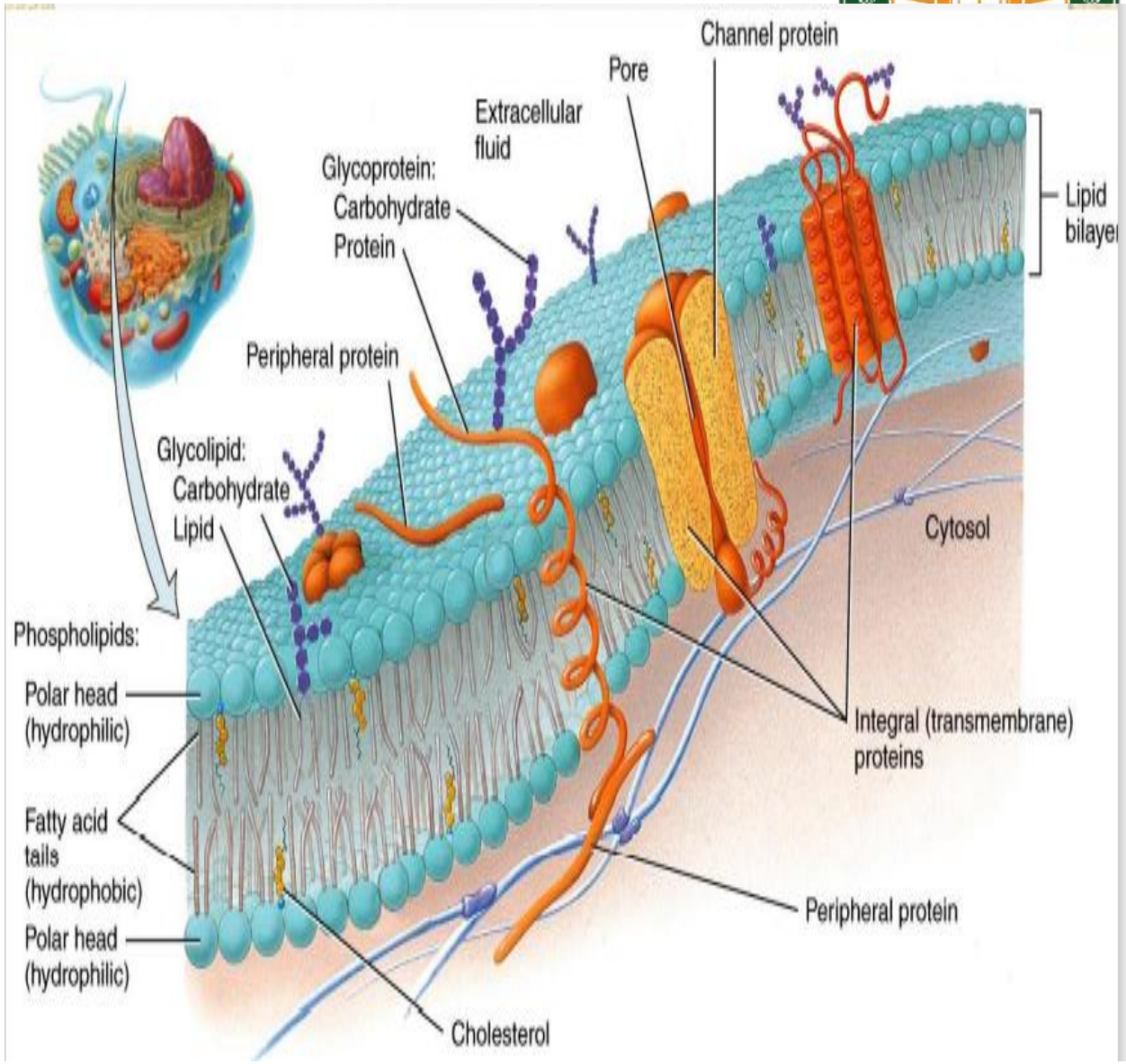
1. The plasma membrane is the flexible outer surface of the cell
2. The cytoplasm contains numerous organelles surrounded by cytosol
3. The nucleus is a large organelle that contains the cells chromosomes



Plasma Membrane

- The plasma membrane is a strong and flexible barrier between the interior and the outside world of the cell.
- It is made of:

1) A phospholipids-bilayer provides a structural foundation
2) A variety of membrane proteins interact with the lipids.
3) The plasma membrane is normally used to communicate with other cells and the environment

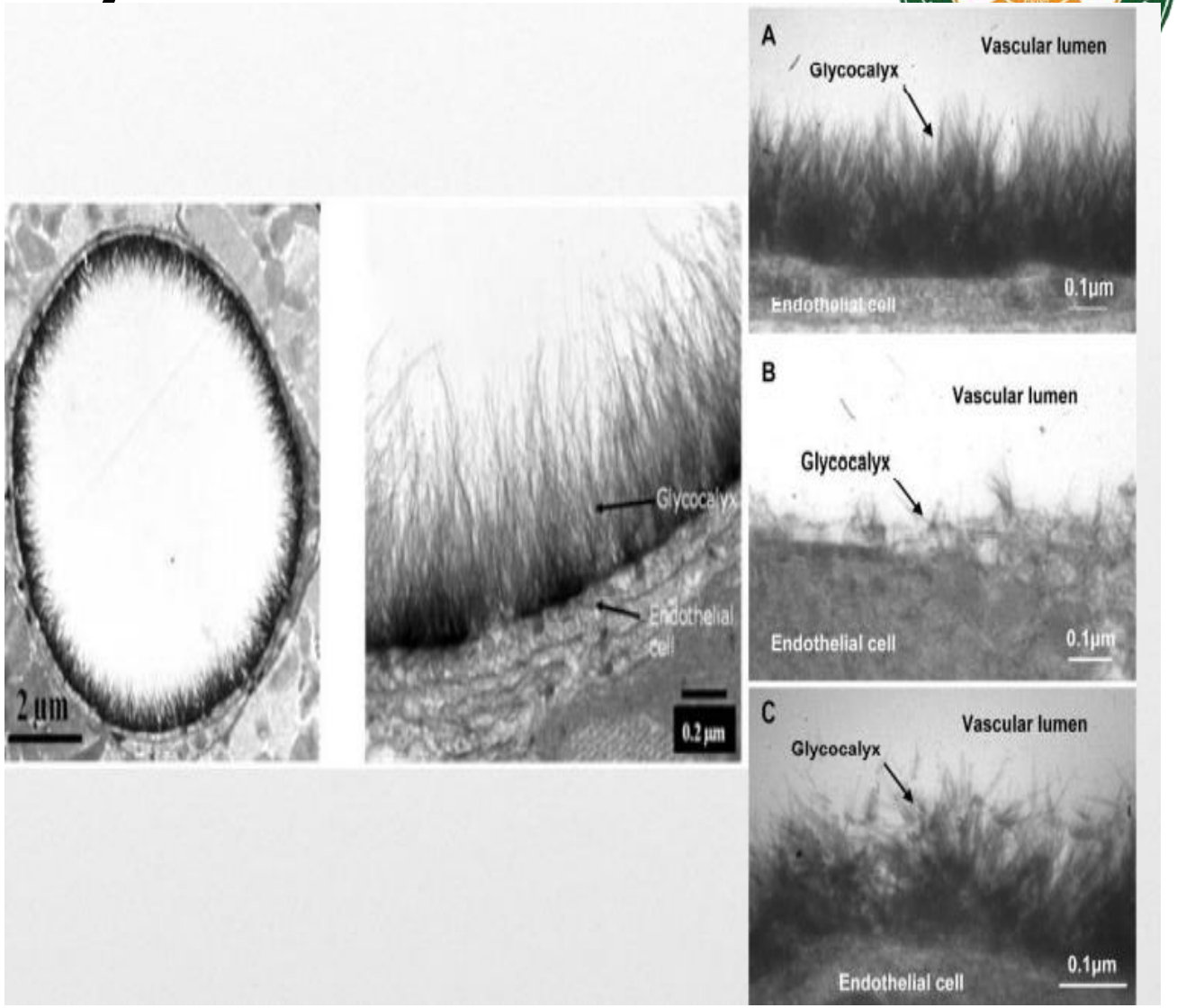


Cell Membrane Lipids

1) Lipids form most of the surface area of the cell membrane.
2) Phospholipid bilayer: The phospholipid molecules in the cell membrane form two layers because of having both a hydrophilic end (the phosphate portion - at the membrane surface) and a hydrophobic end (the lipid portion – on the inside).
3) Contains cholesterol and small quantities of other lipids.

Membrane Carbohydrates

- They are components of complex molecules such as proteoglycans, glycolipids and glycoproteins.
- Forming a layer known as glycocalyx.



Membrane Proteins

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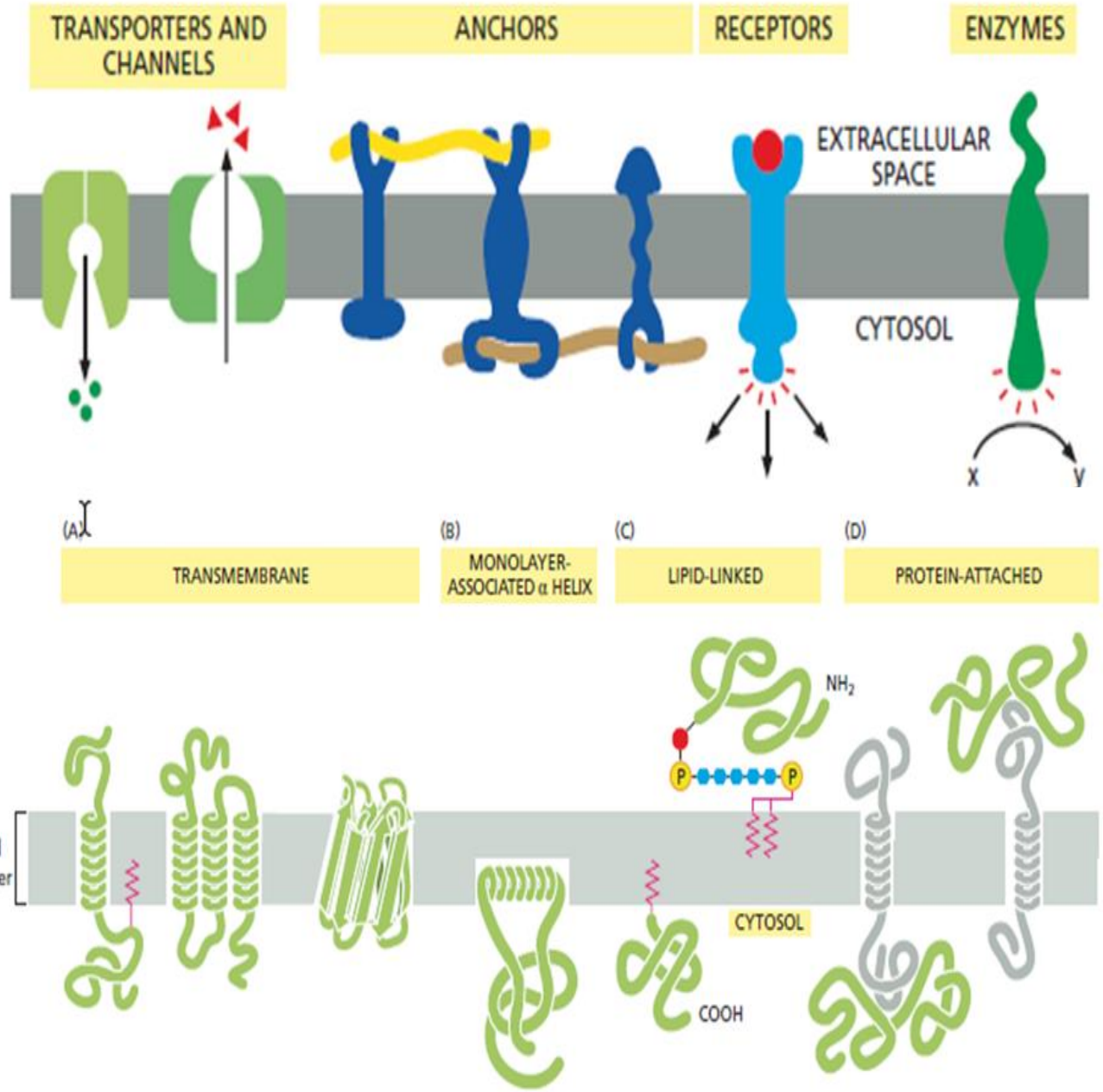
- **Structural classes of membrane proteins:**

1) **Integral proteins** or **transmembrane proteins span the membrane's width** one or more times.
2) **Peripheral proteins** bound to the inner or outer surface of the cell membrane and easily separated from it.



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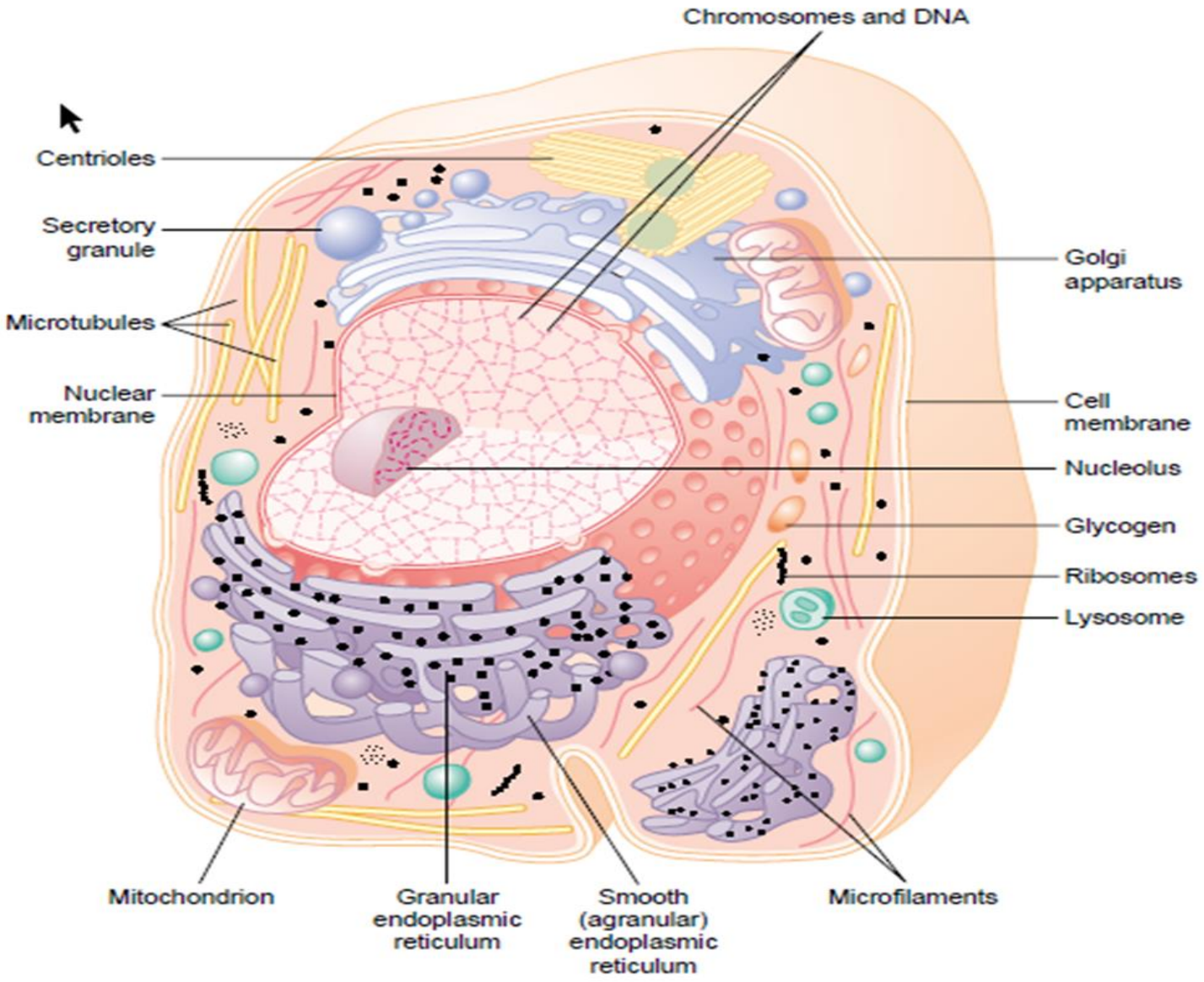
The Organelles

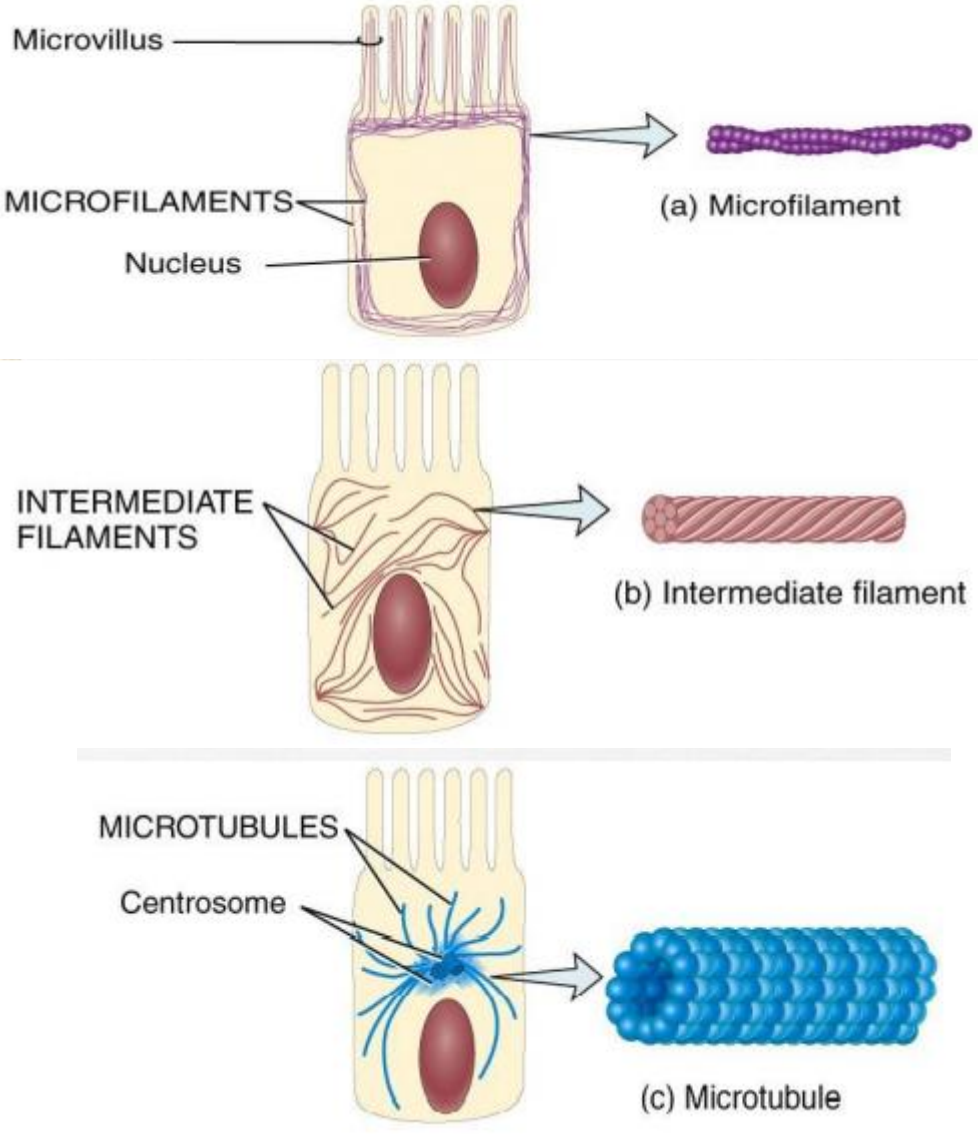
- Organelles are structures within the cell, each performs a specific function to enable the cell to survive.



The Cytoskeleton

- Provides an internal protein framework that gives the cytoplasm strength and stability.
- Includes **microfilaments**, **intermediate filaments** and **microtubules.**
- **Major functions:**

A. Determining cell shape
B. Plays a role in cell metabolic functions
C. Organizing the contents of the cell
D. Moving organelles
E. Moving chromosomes during cell division
F. Creating and moving membrane vesicles (in phagocytosis etc.)

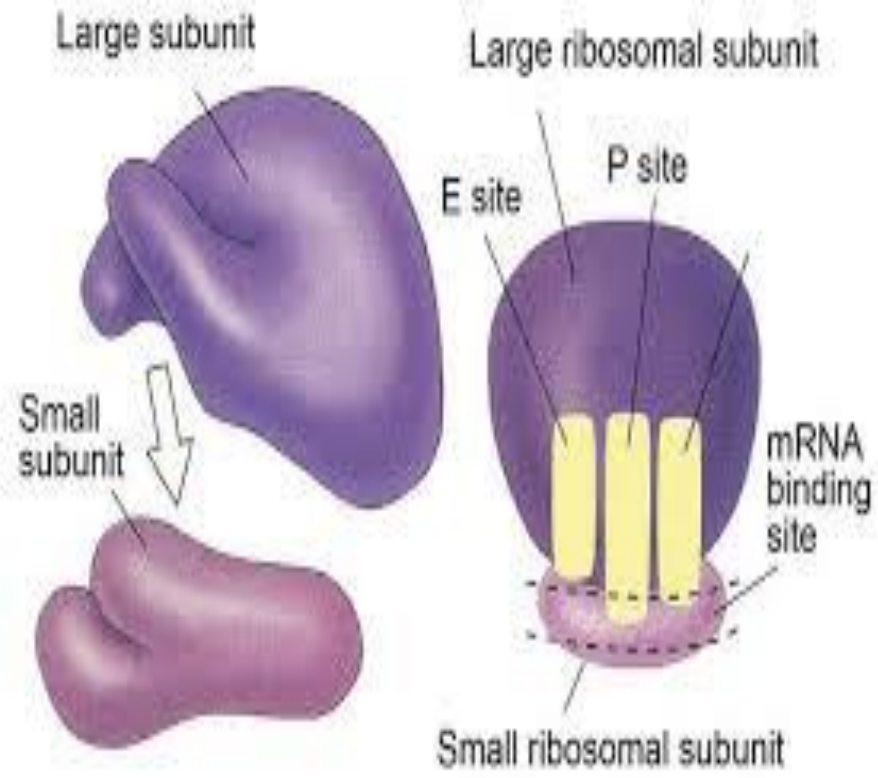


Ribosomes

- Responsible for translation of mRNA to protein.
- Ribosomes have two major subunits, that are normally separated, they are made of both RNA and proteins.
- The subunits are called small ribosomal subunit and Large ribosomal subunits.
- Before protein synthesis, a small and large subunit must join together to form a complete functional ribosome.
- Ribosomes can be divided into two functional types :

i. Free ribosomes make proteins used in the cytosol.

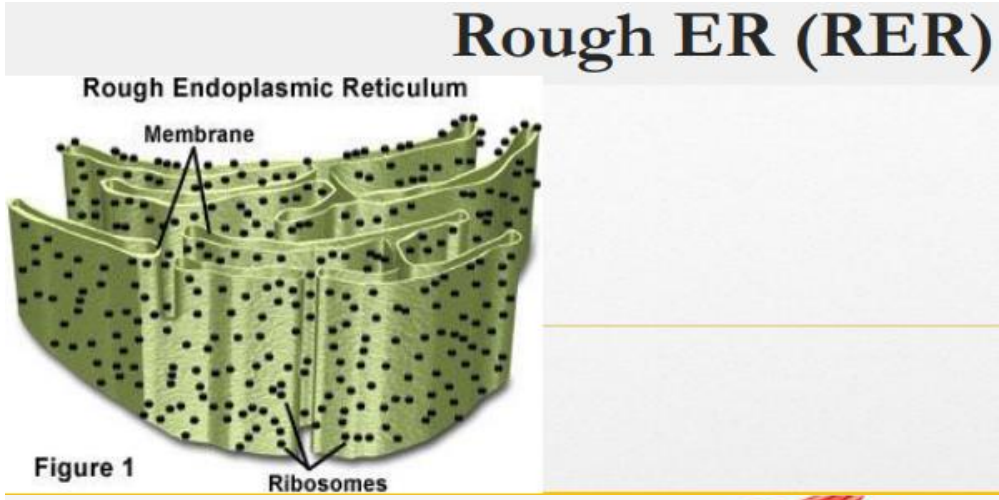
ii. Attached/fixed ribosomes make proteins used in membranes and for export (attached to ER)

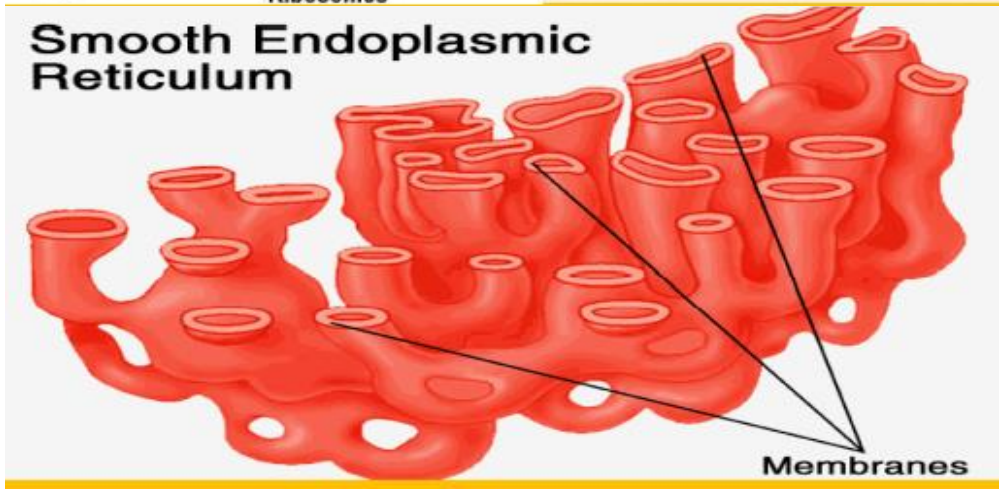


Endoplasmic Reticulum

- ER is a network of intracellular membranes connected to the nuclear envelope (surrounds the nucleus). (Endo=within, plasm=cytoplasm, reticulum=network).
- The ER has 4 major functions:

1) **Synthesis** – proteins, carbohydrates, lipids.
2) **Storage** – storage synthesize materials without affecting cellular operations.
3) **Transport** – materials can travel in the ER.
4) D**etoxification** – drugs or toxins can be absorbed and then neutralized by the enzymes within it.





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The Golgi Apparatus

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- **It has three major functions:**

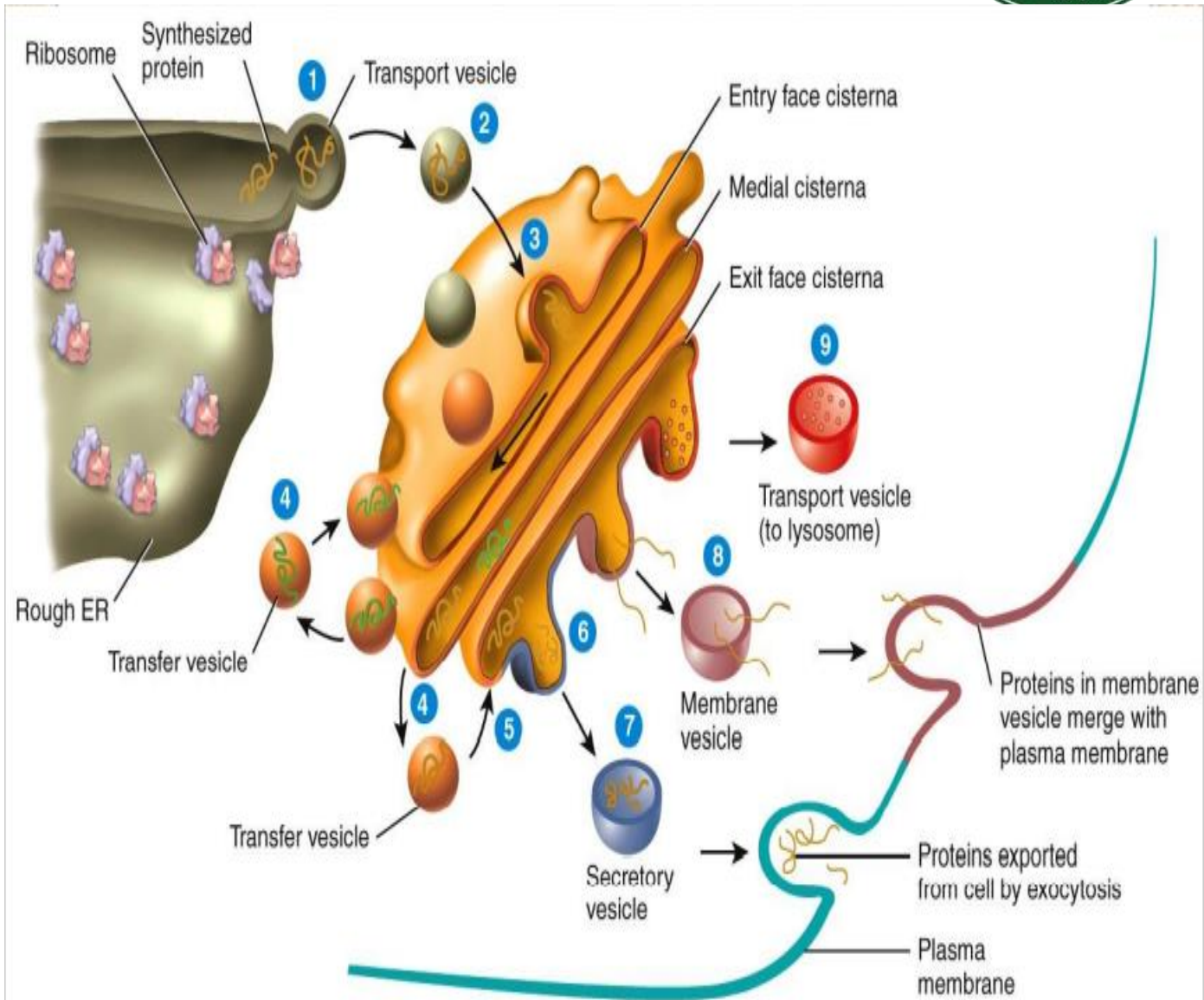
1) modifies and packages secretions, such as hormones and enzymes, for release through exocytosis.
2) renews or modifies the cell membrane.
3) packages special enzymes within vesicles for use in the cytosol.

- GA creates three types of vesicles that carry materials away from the GA:

I. **Secretory vesicles:** they contain secretions that will be discharged from the cell.

II. **Membrane vesicles:** They can alter the sensitivity and functions of the cell according to the materials that binds/fuse with it.

III. **Lysosomes:** They contain digestive enzymes.



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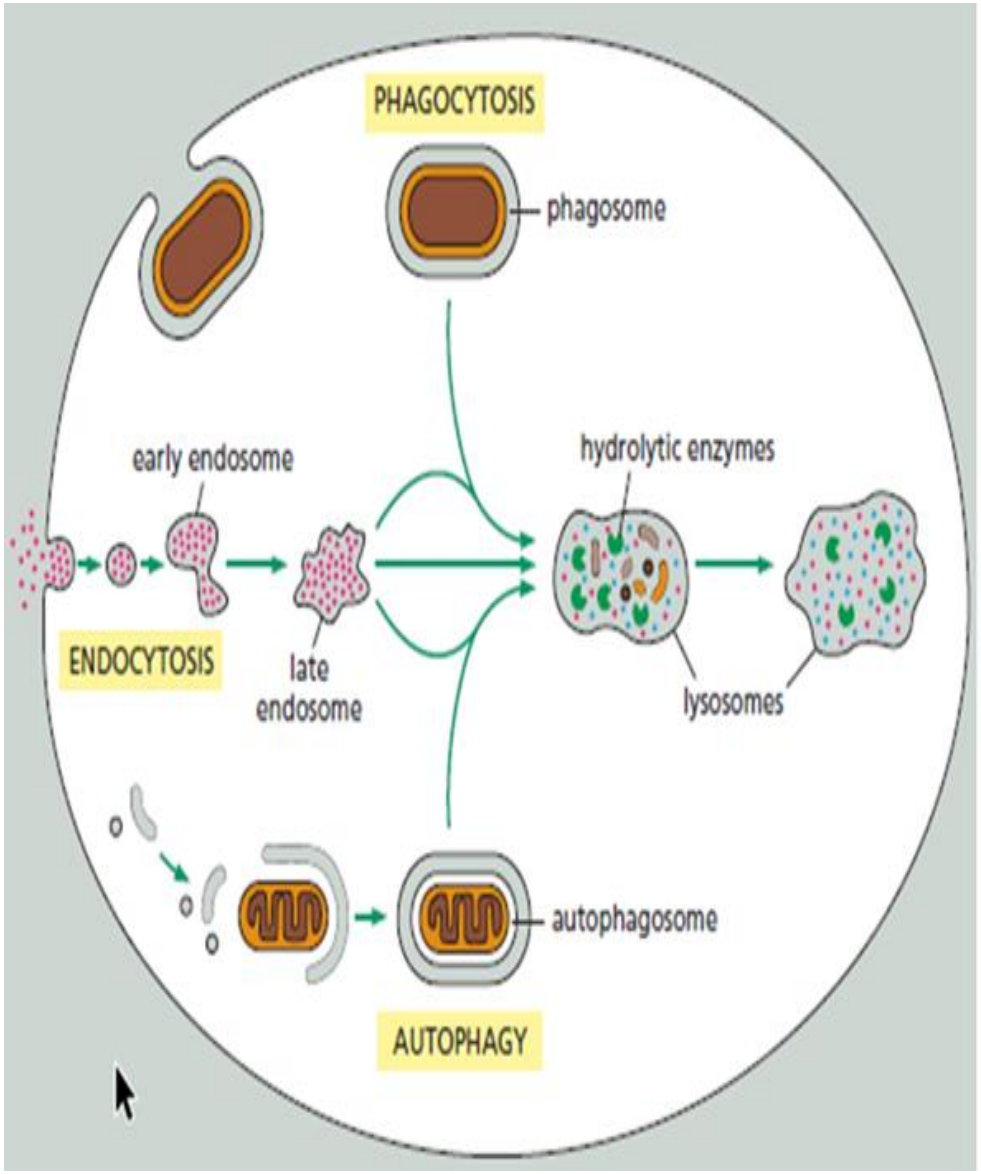
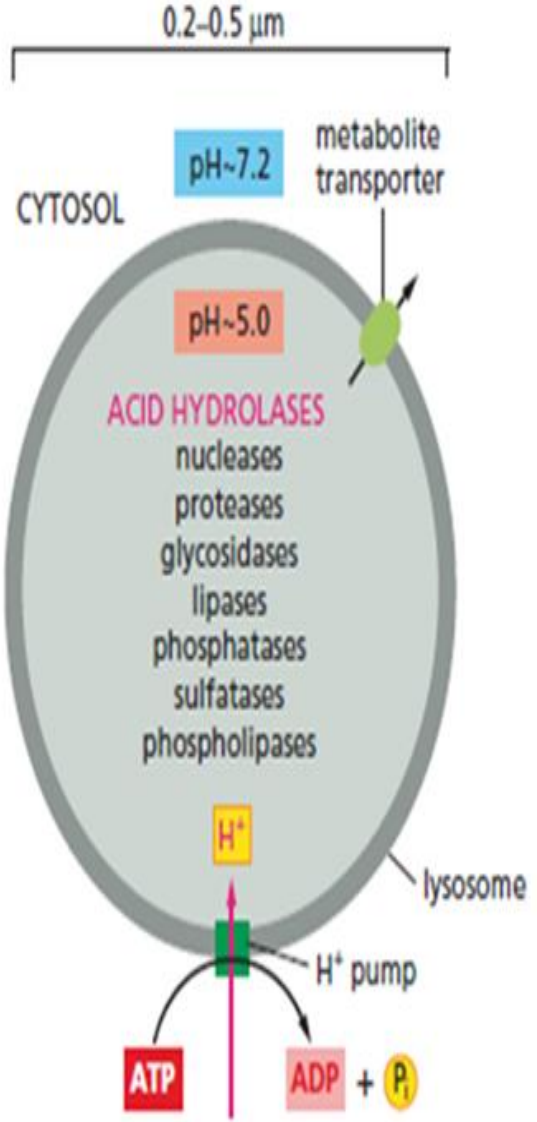
Lysosomes

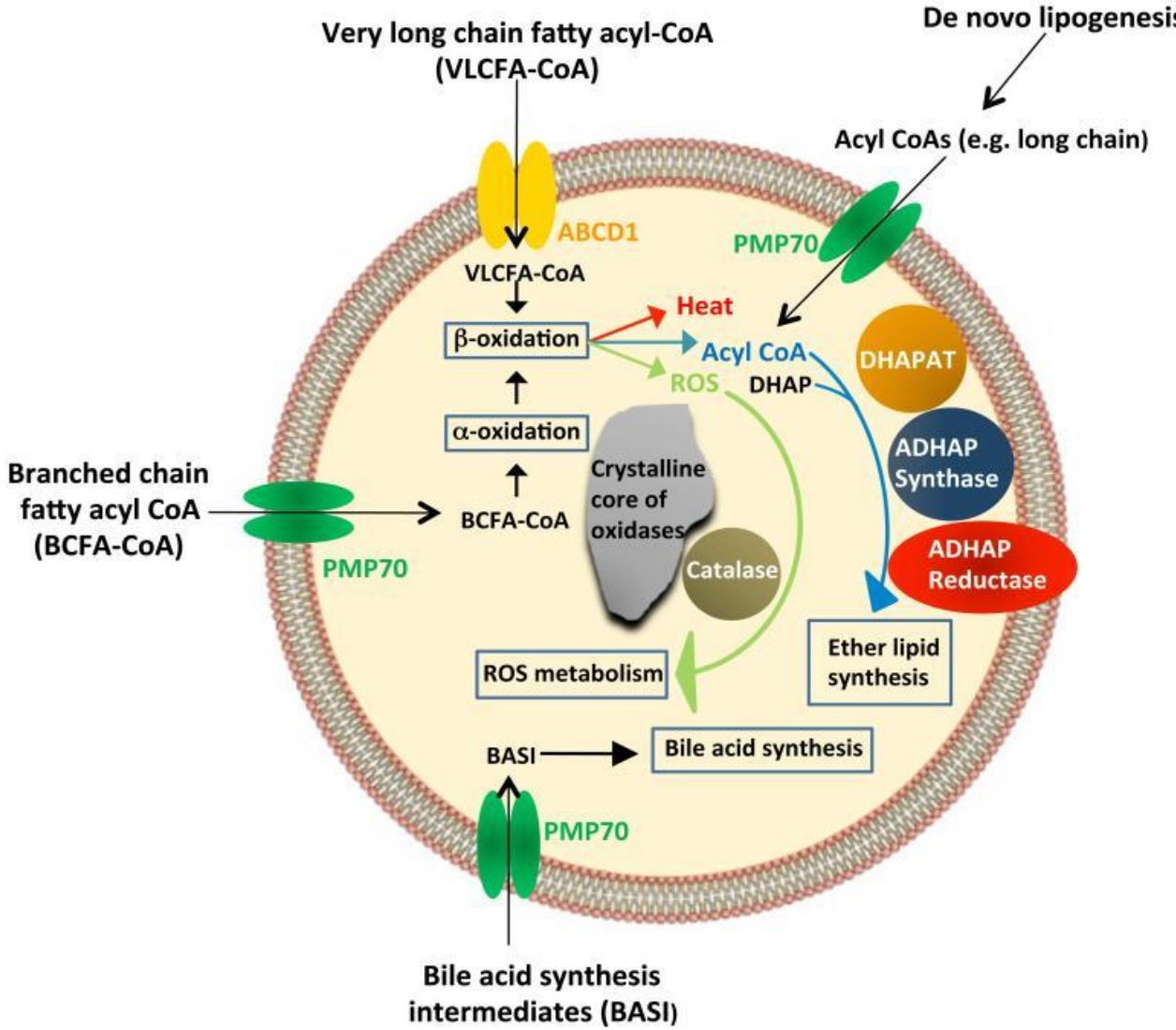
They are membrane-limited vesicles, have an acidic pH (~4.5). Lysosome contain a wide variety of hydrolytic enzymes, called hydrolases that include proteases, nucleases, glycosidases, lipases, and more, which are sufficient to degrade almost any naturally occurring macromolecule to its monomeric constituents.





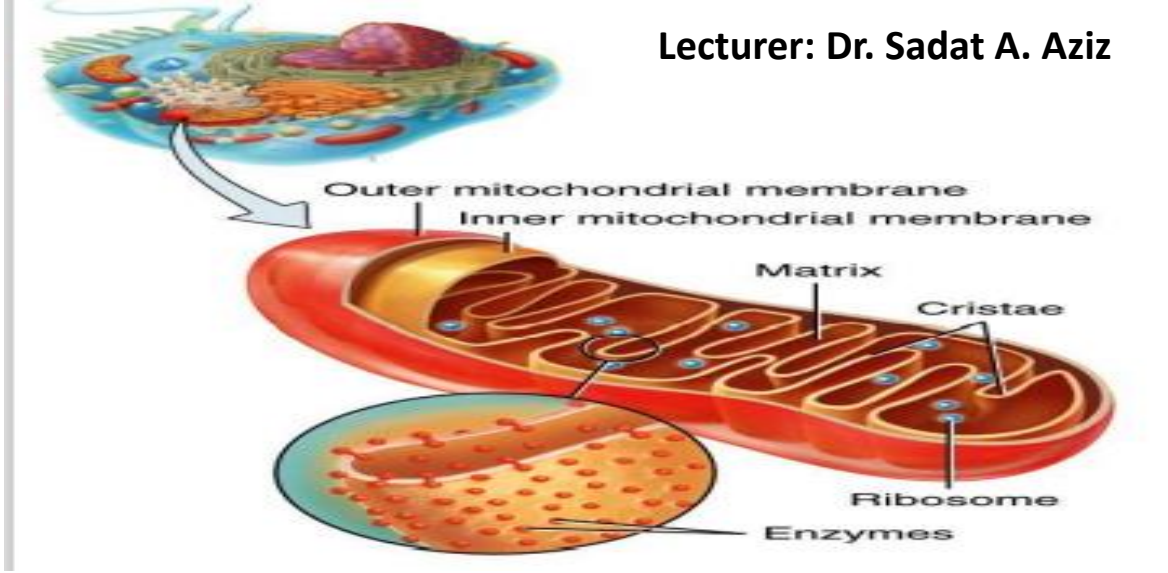
PEROXISOMES

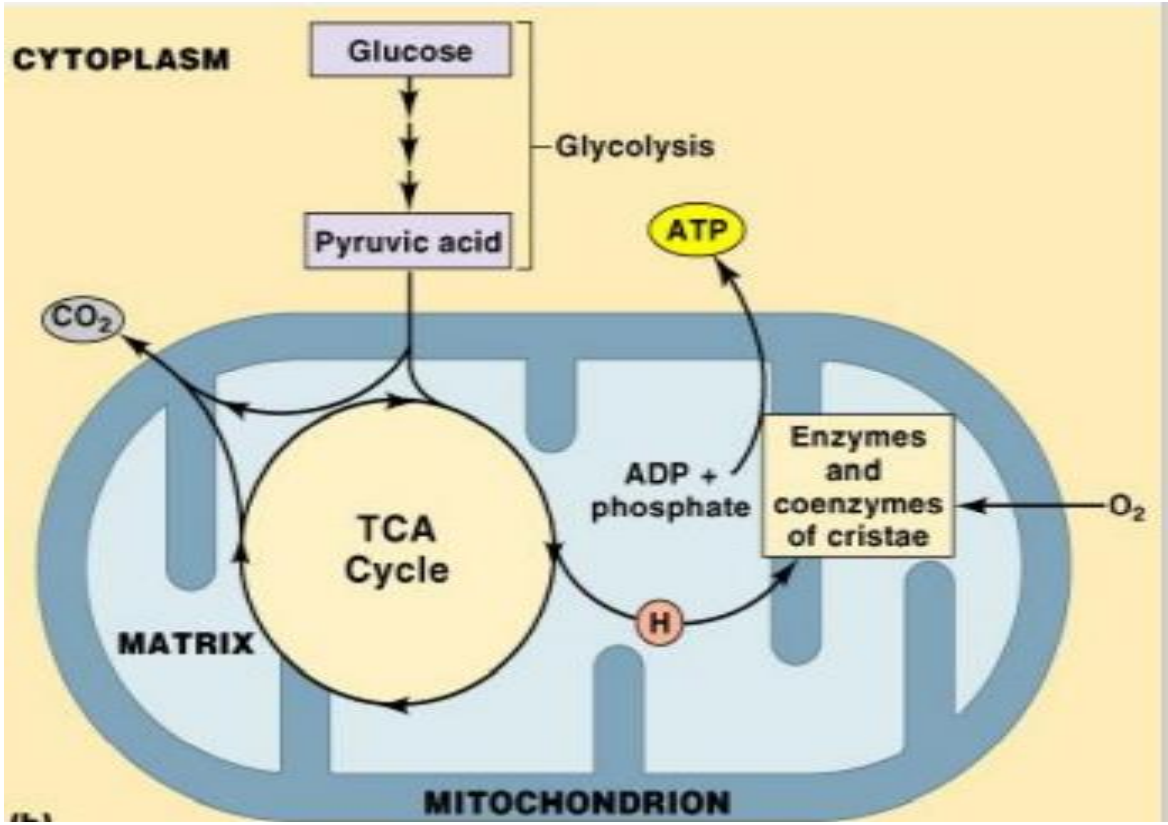
- Peroxisomes are small, ubiquitous organelles with a single membrane. Peroxisomes participate in many different metabolic activities, including the **oxidation of fatty acids**, the **breakdown of purines**, the **biosynthesis of cholesterol**, the **biosynthesis of bile acids**, and **ether lipid biosynthesis**.
- Protect the cell from the potentially damaging effects of free radicals produced during catabolism.



Mitochondria

- The mitochondrion is mainly involved with the cellular respiration and ATP synthesis.
- Mammalian cells typically contain hundreds or thousands of mitochondria; the number of mitochondria per cell appears to depend on the metabolic requirements of that cell.
- Mitochondria contain enzymes that help the cells to produce large amounts of ATP, in a process called **cellular respiration**
- Mitochondria are made of an inner and an outer membrane
- Mitochondria self-replicate, using their own ribosomes and some of their own genes on their DNA





Nucleus

1) The central control centre of a cell.
2) A double-walled **nuclear envelope** separates the nucleus from the cytoplasm.
3) The **nucleolus** is a site within the nucleus that produces new ribosomes.
4) **Nuclear pores** permit the movement of ions and small molecules.
5) **The nuclear matrix** provides structural support and is involved in the regulation of genetic activity.
6) **Chromosomes** are kept in the nucleus, which contains our genes and acts as the source of information for building and running cells.