



## Concepts of cell biology:

The cell biology is a branch of biology deals with the study of living cells. The **cell** (came from Latin *cella*, meaning "small room" ) is the basic structural, functional and biological unit of all known living organisms. Organisms can be classified as unicellular (consisting of a single cell; including most bacteria) or multi-cellular (including plants and animals). While the number of cells in plants and animals varies from species to species, humans contain about 100 trillion ( $10^{14}$ ) cells.

### Cells Theory:

Cell Theory is one of the basic principles of biology , Credit for the formulation of this theory is givento German scientists Theodor Schwann, Matthias Schleiden, and Rudolph Virchow.

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### The Cell Theory states:

- ☐ All living organisms are composed of cells. They may be unicellular or multicellular.
- ☐ The cell is the basic unit of life.
- ☐ Cells arise from pre-existing cells (They are not derived from spontaneous generation).

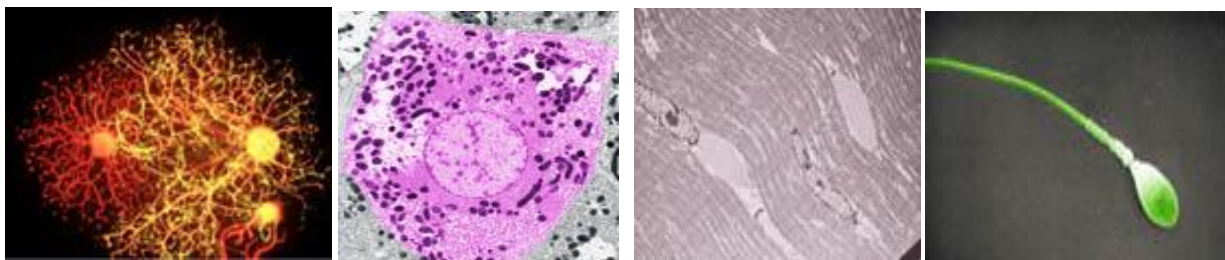
### Function cell biology

They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions. Cells also contain the body's hereditary material and can make copies of themselves. Cells have many parts, each with a different function.



## Shapes and sizes of cells:

All cells are similar to each other in structure because they all have the same basic structure inside. They all have a membrane that encloses the jelly-like cytoplasm and a nucleus that controls the cell. But apart from these similarities, cells can be very different from each other. There are more than 200 different shapes and sizes of cell in your body doing many different jobs (Fig. 1).



A : Nerve cells  
B: Gland cells  
C : Muscle cells  
D : Sperm cells

**Fig. 1: Different types of cells with different shapes and sizes.**

**Nerve** cells in the brain have lots of branches spreading out to make connections with as many other nerve cells as they can.

**Gland** cells that make a hormone for your body or oil for your skin have ruffled surfaces so that they can pump out their product as quickly as possible.

**Muscle** cells are stretchy so they can squeeze and release and change their size and shape.

**Sperm** cells need to swim long distances so they have a wiggly tail to propel themselves.



\* Every cell is surrounded by plasma membrane, possesses organelles.

\***Protoplasm** the living substance of the cell is subdivided into two compartments: **cytoplasm**, extending from the plasma membrane to the nuclear envelope and **Karyoplasm**, the substance forming contents of the nucleus.

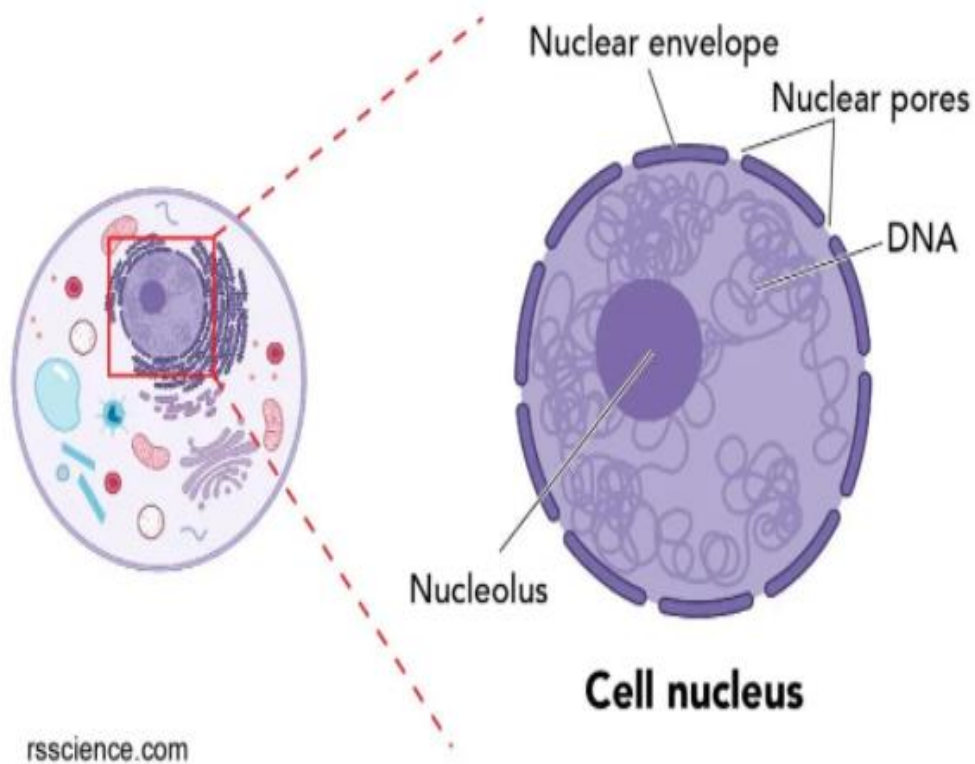
## Cytoplasm

Is a gelatinous semi - transparent fluid that fills most cells. The cytoplasm has three major elements; the cytosol, organelles and inclusions. The **cytosol** is the gooey, semi – transport fluid in which the other cytoplasmic elements are suspended. The **organelles** are the metabolic machinery of the cell and are like little organs themselves. the major organelles that are suspended in the cytosol consists of the **mitochondria , proteins , ribosomes , endoplasmic reticulum , Golgi apparatus , lysosomes and cytoskeleton** .the **inclusions** are chemical substances that store nutrients , secretory products and pigment granules .

## Cell Organelles:

### 1- Nucleus:

Nucleus is a large organelle that stores the cell's DNA (deoxyribonucleic acid). The nucleus controls all of the cell's activities, such as growth and metabolism, using the DNA's genetic information. Within the nucleus is a smaller structure called the nucleolus.

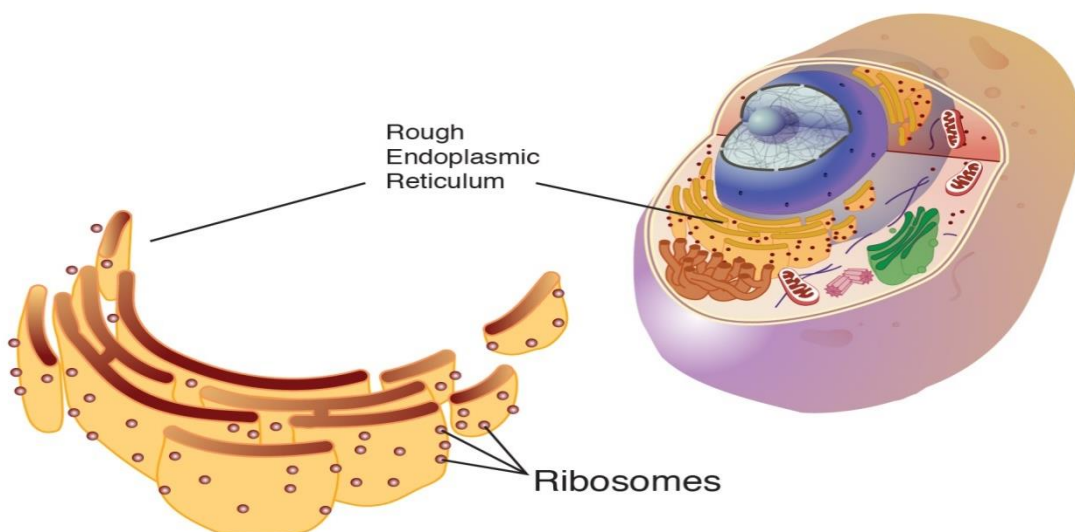
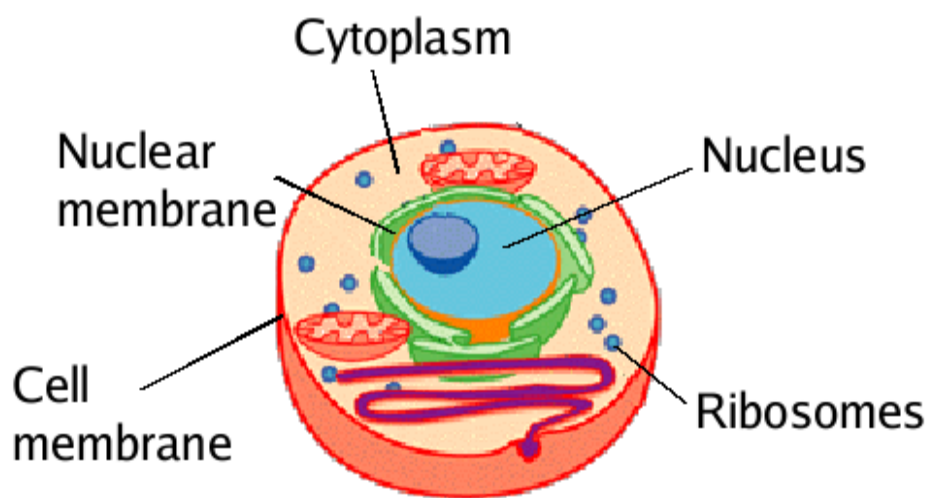


In this figure, the nucleus consists of the nuclear envelope like double-layer membranes with pores ( nuclear pores), DNA, nucleolus (a site for ribosome synthesis, plural: **nucleoli**), nucleoplasm (like cytoplasm of a cell), and the nuclear matrix, a supportive structure like the cytoskeleton supports cells.



## 2- Ribosomes:

are small particles composed of proteins and ribosomal RNA (rRNA), found within all living cells, they can be found floating freely in the cell's cytoplasm or embedded within the endoplasmic reticulum that serves as the primary site of biological protein synthesis .



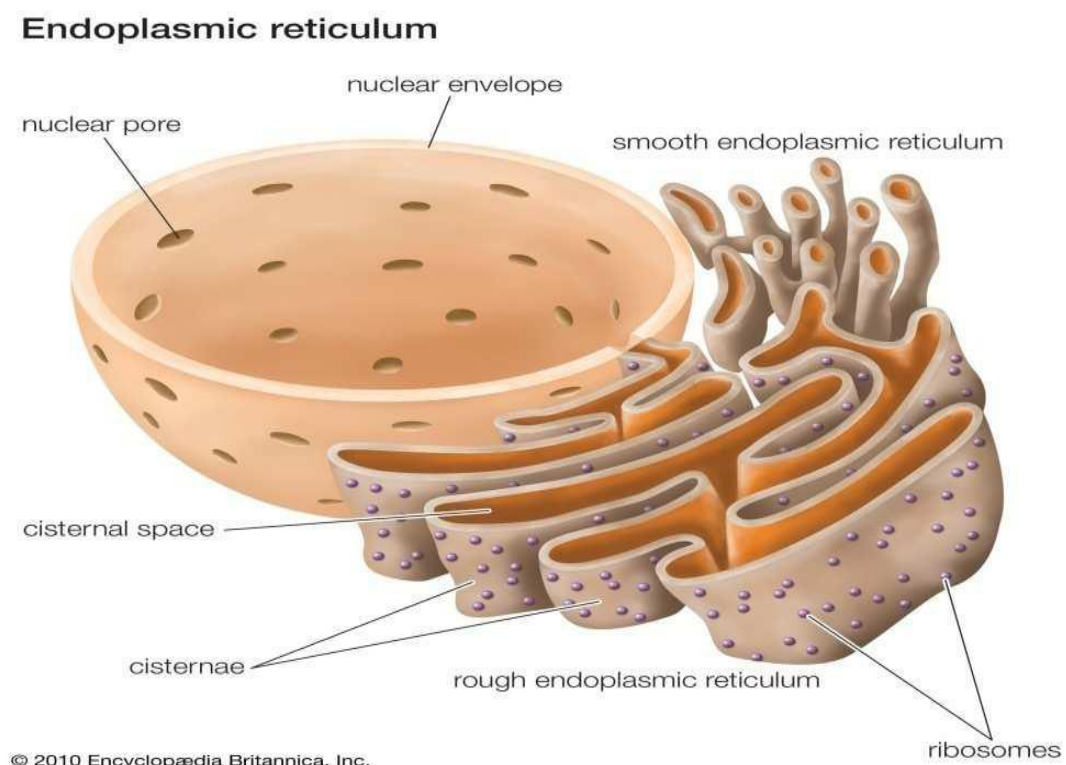


### 3- Endoplasmic reticulum:

The endoplasmic reticulum (ER) is a membranous organelle that shares part of its membrane with that of the nucleus. Some portions of the ER, known as the rough ER, are studded with ribosomes and are involved with protein manufacture .The ER can be classified in two functionally distinct forms: smooth endoplasmic reticulum (SER) and rough endoplasmic reticulum (RER). The morphological distinction between the two is the presence of protein-synthesizing particles, called ribosomes, attached to the outer surface of the RER

a) Rough Endoplasmic Reticulum (RER): Involve with protein synthesis. So that found in large number in protein secreting cells (endocrine gland that secrete protein hormone).

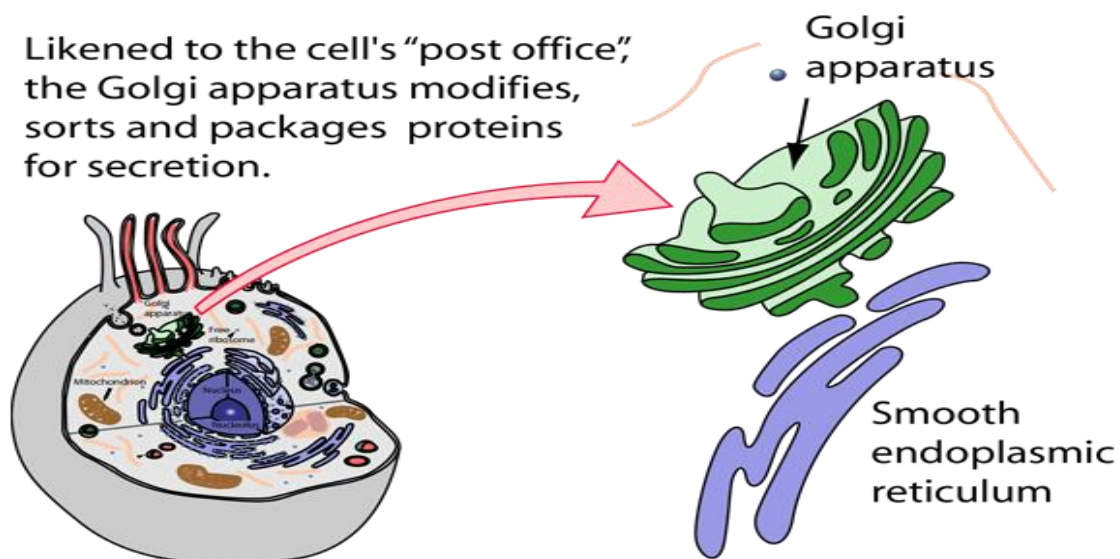
b) Smooth Endoplasmic Reticulum (SRE): Involve in steroidogenesis and detoxification, found in (endocrine gland that secrete steroid hormone).





#### 4- Golgi apparatus (Golgi complex).

A major organelle in most eukaryotic cells is the structure of membrane-bound sacs called the Golgi apparatus (or Golgi body, Golgi complex, dictyosome). It acts to process and package the macromolecules such as proteins and lipids that are synthesized by the cell. It has been likened to the cell's post office. A major function is the modifying, sorting and packaging of proteins for secretion. It is also involved in the transport of lipids around the cell, and the creation of lysosomes..





## 5- Mitochondria:

**Mitochondria** are oval-shaped organelles found in most eukaryotic cells. As the site of cellular respiration, mitochondria serve to transform molecules such as glucose into an energy molecule known as ATP (adenosine triphosphate). ATP fuels cellular processes by breaking its high-energy chemical bonds. Mitochondria are most plentiful in cells that require significant amounts of energy to function, such as liver and muscle cells.

### structure of mitochondria:

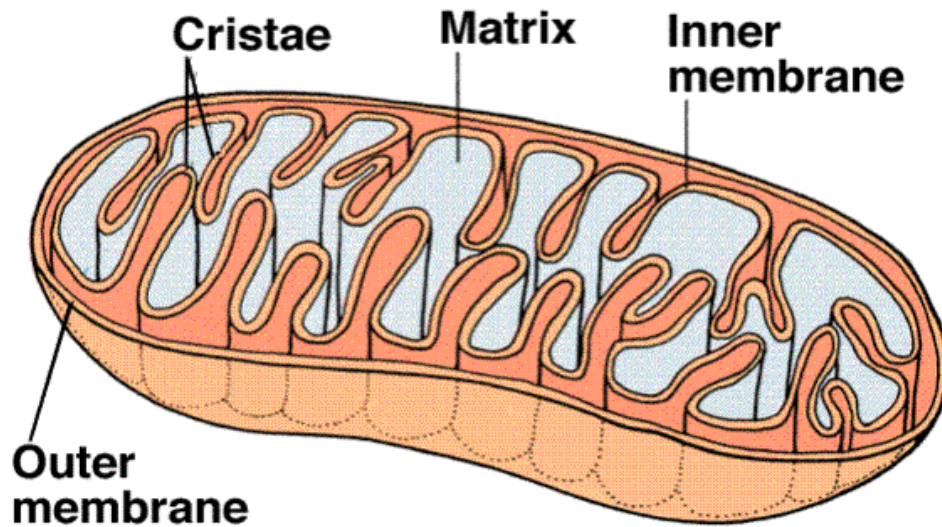
A mitochondrion contains outer and inner membranes composed of phospholipid bi-layers and proteins. There are five distinct parts to a mitochondrion:

1. The outer mitochondrial membrane,
2. The intermembrane space (the space between the outer and inner membranes,
3. The inner mitochondrial membrane,
4. The cristae spaces (formed by infoldings of the inner membrane), and
5. The matrix (space within the inner membrane).

### Function of mitochondria:

The most prominent roles of mitochondria are to produce the energy of the cell, ATP (i.e., phosphorylation of ADP), through respiration













The structure of mitochondrion.

## Organelles and Their Functions

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 <p><b>Nucleus</b> the organelle that contains the cell's DNA and is the control center of the cell</p>	 <p><b>Chloroplast</b> the organelle that uses the energy of sunlight to make food</p>
 <p><b>Ribosome</b> the organelle in which amino acids are hooked together to make proteins</p>	 <p><b>Golgi complex</b> the organelle that processes and transports proteins and other materials out of cell</p>
 <p><b>Endoplasmic reticulum</b> the organelle that makes lipids, breaks down drugs and other substances, and packages proteins for Golgi complex</p>	 <p><b>Large central vacuole</b> the organelle that stores water and other materials</p>
 <p><b>Mitochondrion</b> the organelle that breaks down food molecules to make ATP</p>	 <p><b>Lysosome</b> the organelle that digests food particles, wastes, cell parts, and foreign invaders</p>