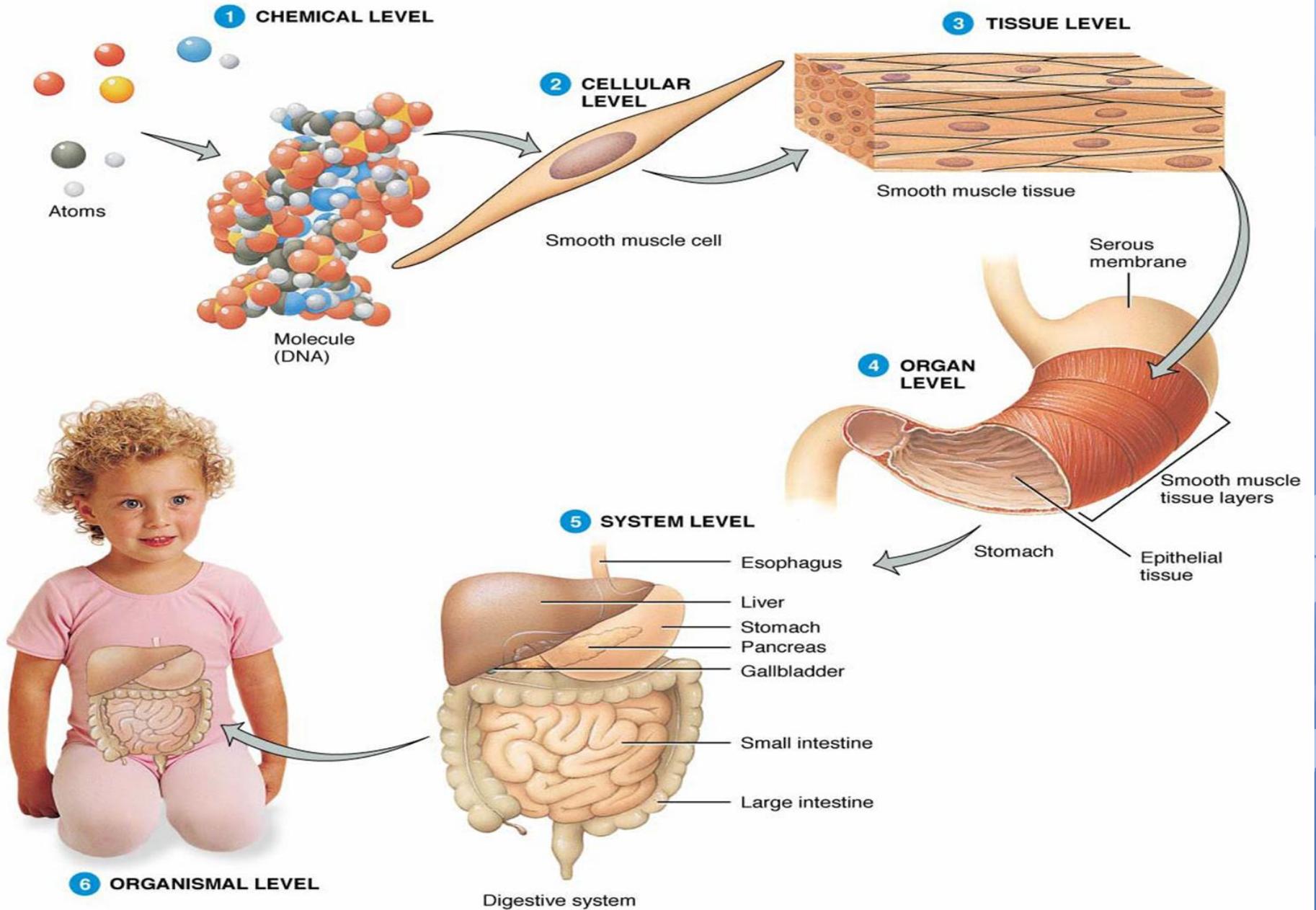


Cell physiology Structure and Function



Introduction to the cell biology

❖ What is a Cell ?

- **Cells** : are the microscopic fundamental units of all living things.
- Every living thing has cells: bacteria, protozoans, fungi, plants, and animals are the main groups (**Kingdoms**) of living things.
- Some organisms are made up of just **one cell** (e.g. **bacteria and protozoans**).
- But animals, including **human beings**, are **multicellular**.
- An adult human body is composed of about **100 trillion** cells! Each cell has basic requirements to sustain it. and the body's organ systems are largely built around providing the many trillions of cells with those basic needs (such as **oxygen, food, and waste removal**).

Introduction to the cell biology

- About **200** different types of **specialized cells** carry out a multitude of functions that help each system contribute to the homeostasis of the entire body.
- At the same time, all cells share key structures and functions that support their intense activity.
- For ease of study, we divide the cell into **three** main parts:
 - 1. plasma membrane**
 - 2. cytoplasm**
 - 3. nucleus**

Human Cell, Structure and Functions:

- **The cell** : is the basic functional in a human meaning that it is a self-contained and fully operational living entity.

Humans are **multicellular** organisms with various different types of cells that work together to sustain life.

Other **non-cellular** components in the body include **water, macronutrients (carbohydrates, proteins, lipids), micronutrients (vitamins, minerals)** and **electrolytes**.

A collection of cells that function together to perform the same activity is known as **tissue**. Masses of tissue work collectively to form an **organ** that performs specific functions in the body. Despite this structural organization, all activity boils down to the cell – a complex unit that makes life possible.



Parts of the Human Cell

The cell contains various structural components to allow it to maintain life which are known as organelles. All the organelles are suspended within a gelatinous matrix, the cytoplasm, which is contained within the cell membrane. One of the few cells in the human body that lacks almost all organelles are the red blood cells.

The main organelles are as follows :

Nucleus

Cell membrane

Endoplasmic reticulum

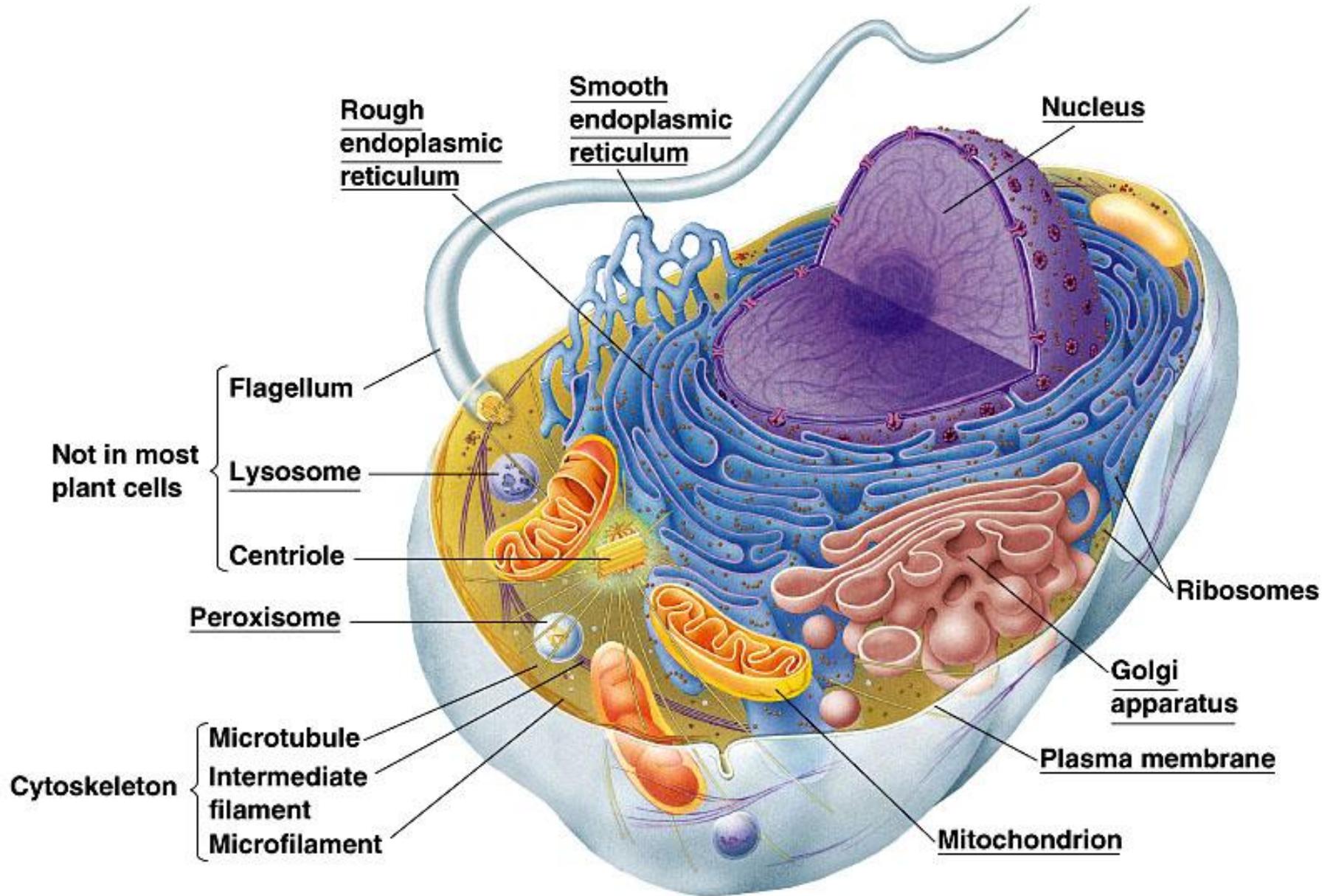
Golgi apparatus

Lysosomes

Peroxisomes

Mitochondria

Microfilaments and microtubules.



➤ Nucleus

The **nucleus** : is the master control of the cell. It contains genes, collections of **DNA**, which determines every aspect of human anatomy and physiology. The DNA which is arranged into chromosomes also contains the blueprint specific for each type of cell which allows for replication of the cell. Within the nucleus is an area known as the **nucleolus**. It is not enclosed by a membrane but is just an accumulation of RNA and proteins within the nucleus. The nucleolus is the site where the ribosomal RNA is transcribed from DNA and assembled.

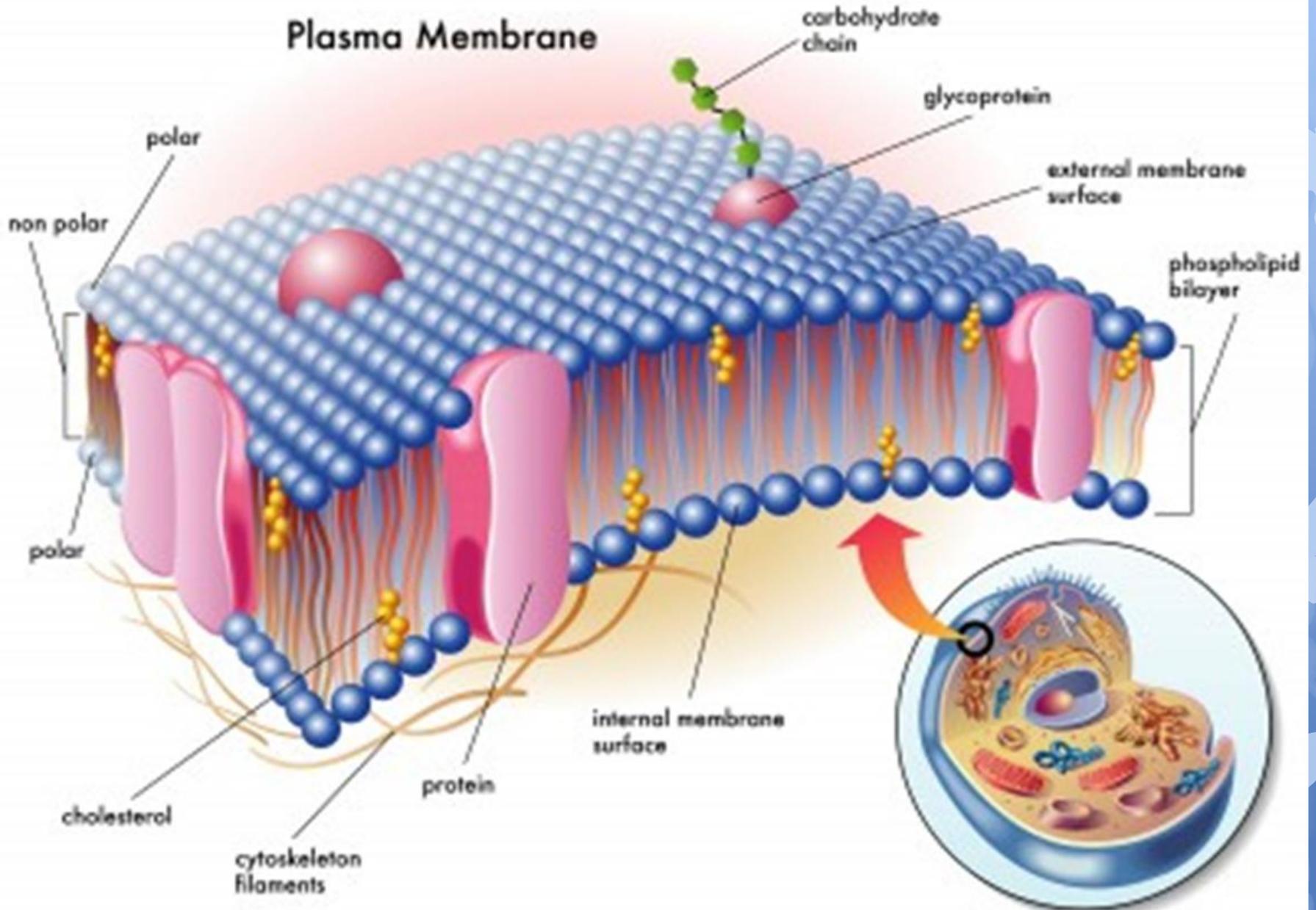
➤ Cell Membrane:

The **cell membrane** is the outer coating of the cell and contains the **cytoplasm, substances within it and the organelle**. It is a **double-layered** membrane composed of **proteins** and **lipids**. The lipid molecules on the outer and inner part (**lipid bilayer**) allow it to selectively transport substances in and out of the cell.

Endoplasmic Reticulum:

The endoplasmic reticulum (**ER**) is a membranous structure that contains a network of tubules and vesicles. Its structure is such that substances can move through it and be kept in isolation from the rest of the cell until the manufacturing processes conducted within are completed. There are **two** types of endoplasmic reticulum – **rough (granular)** and **smooth (a granular)**.

Plasma Membrane



➤ **The cytoplasm :**

➤ consists of **all the cellular contents** between the plasma membrane and the nucleus.

➤ This compartment has two components: **cytosol** العصاره الحيوية and **organelles** العضيات.

1. **Cytosol** : means the fluid portion of cytoplasm.

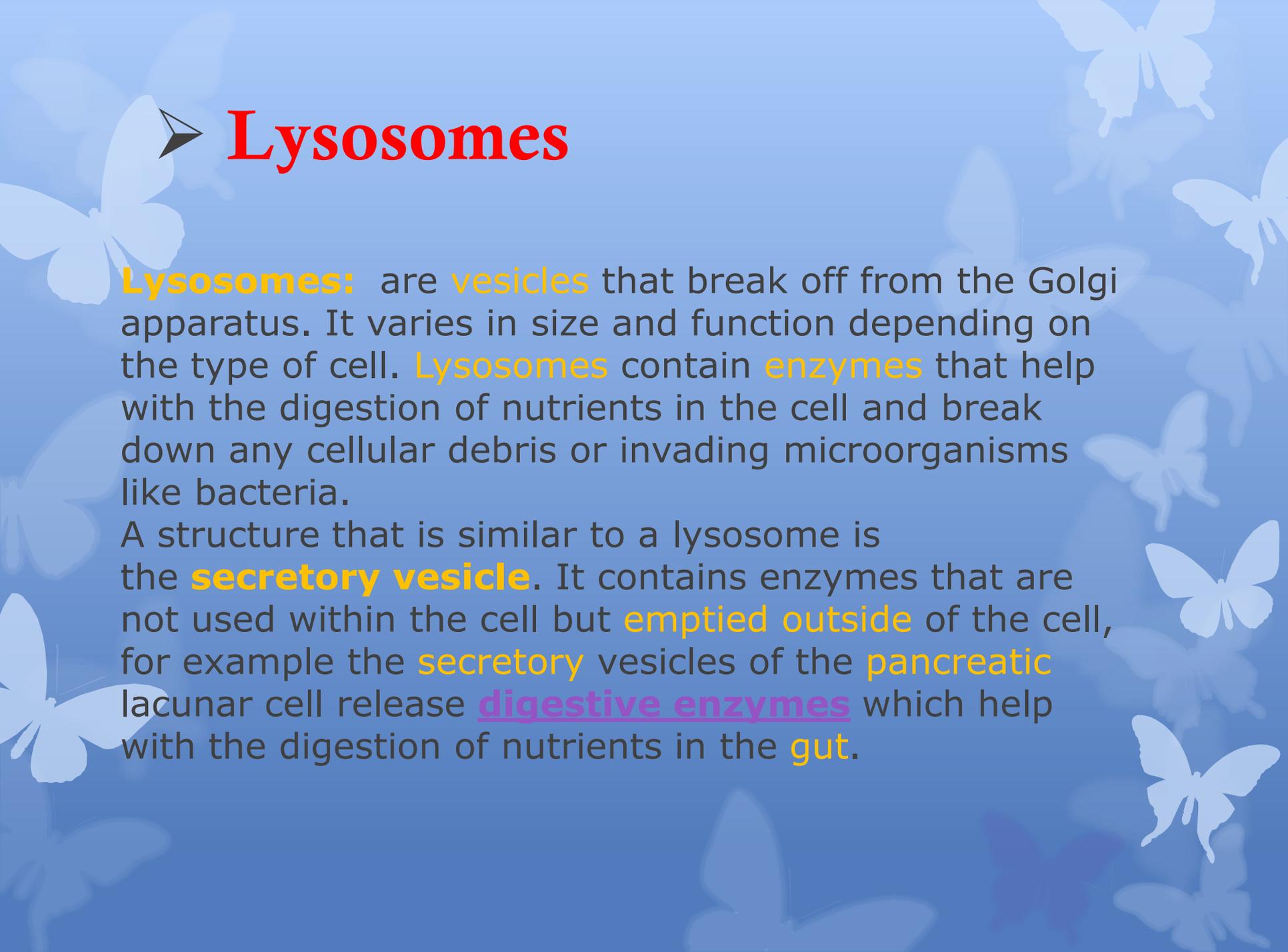
❑ **Contains:** (water, dissolved solutes, and suspended particles). Surrounded by cytosol are several different types of organelles (little organs).

❑ **Each type of organelle has a characteristic shape and specific functions. Examples include:**

❑ (the cytoskeleton , ribosomes , endoplasmic reticulum , Golgi complex , lysosomes , peroxisomes , and mitochondria)

➤ Golgi Apparatus

The Golgi apparatus :is a stacked collection of flat vesicles. It is closely associated with the endoplasmic reticulum in that substances produced in the ER are transported as vesicles and fuses with the Golgi apparatus. In this way, the products from the ER are stored in the Golgi apparatus and converted into different substances that are necessary for the cell's various functions.

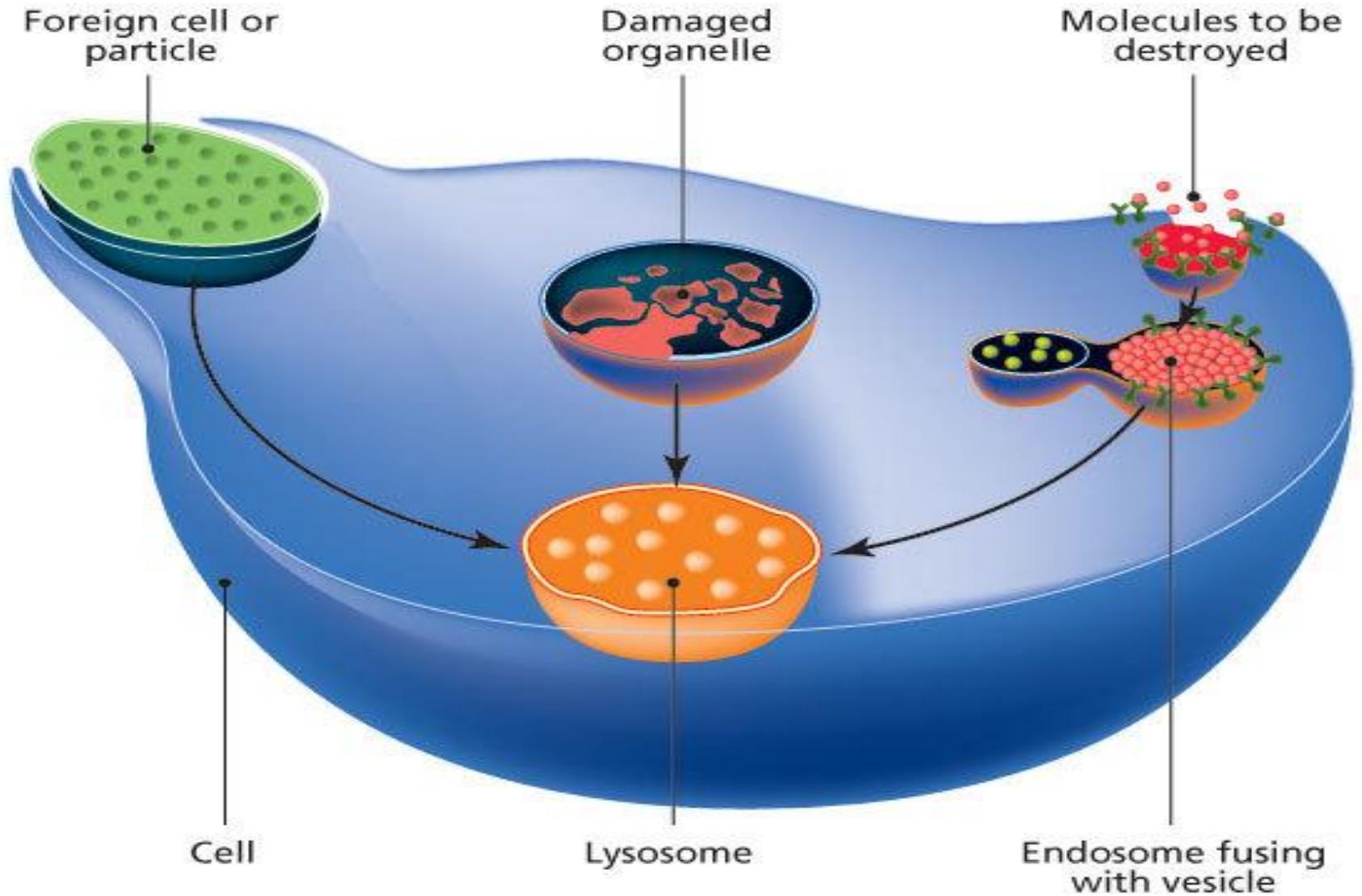


➤ Lysosomes

Lysosomes: are **vesicles** that break off from the Golgi apparatus. It varies in size and function depending on the type of cell. **Lysosomes** contain **enzymes** that help with the digestion of nutrients in the cell and break down any cellular debris or invading microorganisms like bacteria.

A structure that is similar to a lysosome is the **secretory vesicle**. It contains enzymes that are not used within the cell but **emptied outside** of the cell, for example the **secretory** vesicles of the **pancreatic** lacunar cell release **digestive enzymes** which help with the digestion of nutrients in the **gut**.

Lysosomes

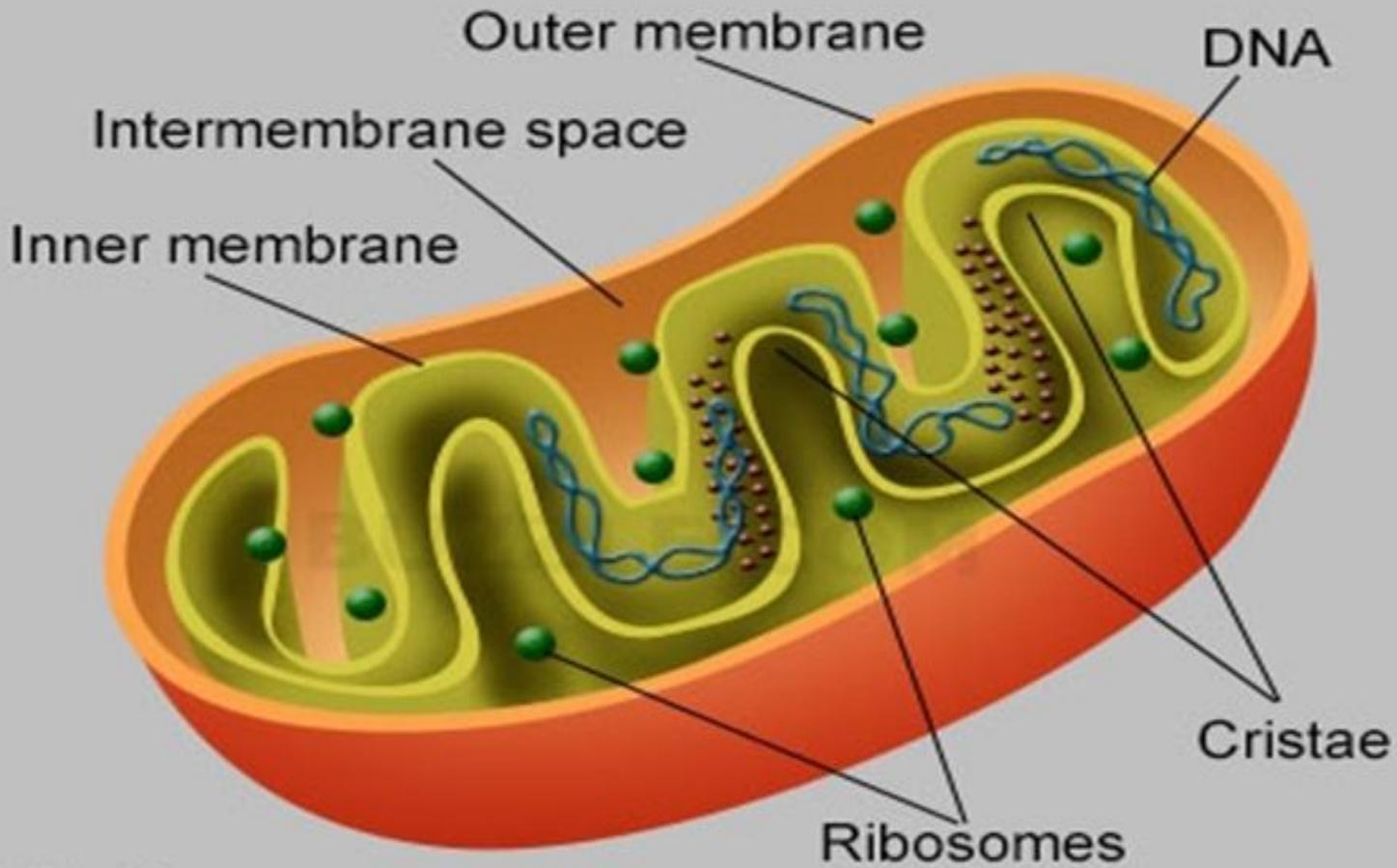


➤ Peroxisomes

These organelles are very similar to the lysosomes and contain enzymes that act together in the form of hydrogen peroxide to neutralize substances that may be toxic to the cell. **Peroxisomes** are formed directly from the **endoplasmic reticulum** rather than from the Golgi apparatus like lysosomes.

➤ Mitochondria

These are the **powerhouses** of the cell and break down nutrients to yield **energy**. Apart from producing its own energy, it also produces a high-energy compound called **ATP** (**adenosine triphosphate**) which can be used as a simple energy source elsewhere. Mitochondria are composed of **two membranous layers** – an **outer** membrane that surrounds the structure and an **inner** membrane that provides the physical sites of energy production. The inner membrane has many in folding that form **shelves** where **enzymes** attach and **oxidize nutrients**. The mitochondria also contain **DNA** which allows it to replicate where and when necessary.



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Mitochondria

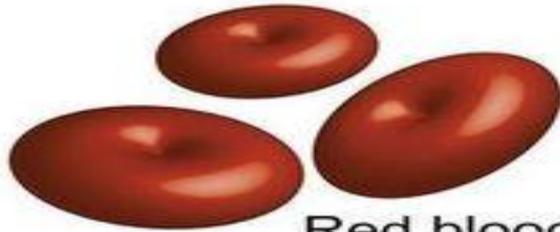
➤ **Microfilaments and Microtubules**

Microfilaments and **microtubules** are rigid protein substances that form the internal skeleton of the cell known as the **cytoskeleton**. Some of these microtubules also make up the **centrioles** and **mitotic spindles** within the cell which are responsible for the division of the cytoplasm when the cell divides. The microtubules are the central component of **cilia**, small hair-like projections that protrude from the surface of certain cells. It is also the central component of specialized cilia like the tail of the sperm cells which beats in a manner to allow the cell to move in a fluid medium.

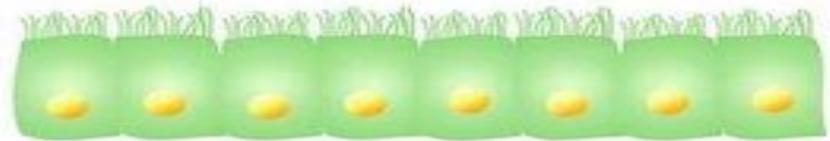
Functions of the Human Cell

- The **functions** of the human cell **varies** based on the **type** of cell and **its location** in the **human body**. All the organelles work together to keep the cell alive and allow it to carry out its specific function. Sometimes these organelles are highly **specialized and can vary in (size, shape and number)**. The organelles are the most basic functional units but it cannot exist and operate without the cell as a whole. Its functions include **intake** of **nutrients** and other **substances**, **processing** of these compounds, **production** of new substances, **cell replication** and **energy production**. In specialized cells that need to be motile, like **sperm cells**, tail-like projections allow for **cellular locomotion**.

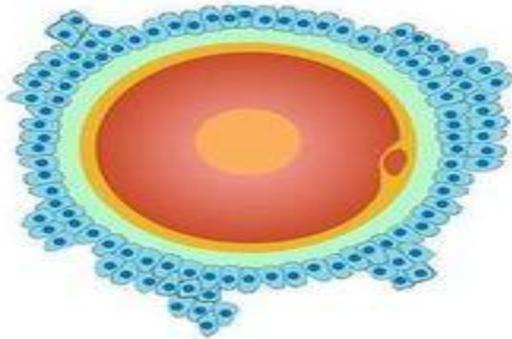
ANATOMY OF HUMAN CELLS



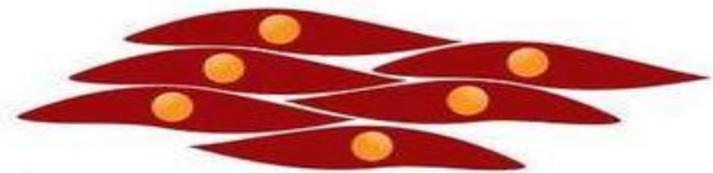
Red blood cell



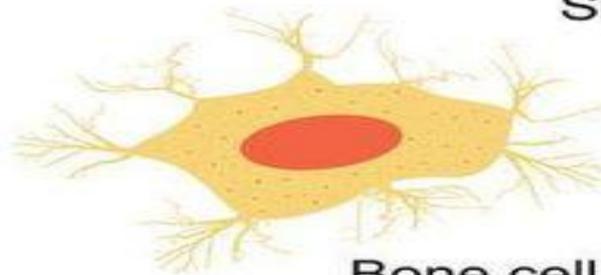
Columnar epithelial cells



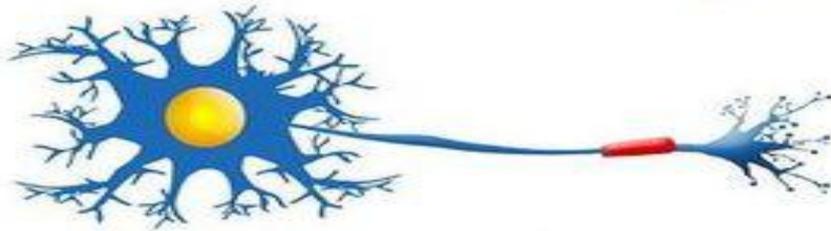
Ovum cell



Smooth muscle cells



Bone cell



Nerve cell



Sperm cell

Functions of the Human Cell

- The function of each organelle has already been discussed but is worth considering in summary:

The **cell membrane** allows substances to **enter** and **leave** the cell.

While certain **substance** like **oxygen** can easily **diffuse** through the cell membrane, others have to **actively** transported through the process of **endocytosis**. **Small particles** are transported by the process of **pinocytosis** while **larger** particles are moved by the process of **phagocytosis**. These functions can become highly specialized to allow cells to perform specific activities, like the **macrophages** that **phagocytosis** invading bacteria to neutralize it.

Small and large substances that **do not dissolve** in the cytoplasm are **contained** within **vesicles**. Lysosomes attach to the vesicles and digest this material.

The **endoplasmic reticulum (ER)** and **Golgi apparatus** synthesize different substances like **protein** and **fats** as required by the cell or designated according to its specific function. It **utilizes** basic **nutrient** molecules that are either **dissolved** in the cytoplasm or specific substances **contained** within **vesicles** .

Type of transporting in cell membrane

➤ Endocytosis

Endocytosis (*endo* = internal, *cytosis* = transport mechanism) is a general term for the various types of active transport that **move particles into a cell by enclosing them in vesicle made out of plasma membrane.**

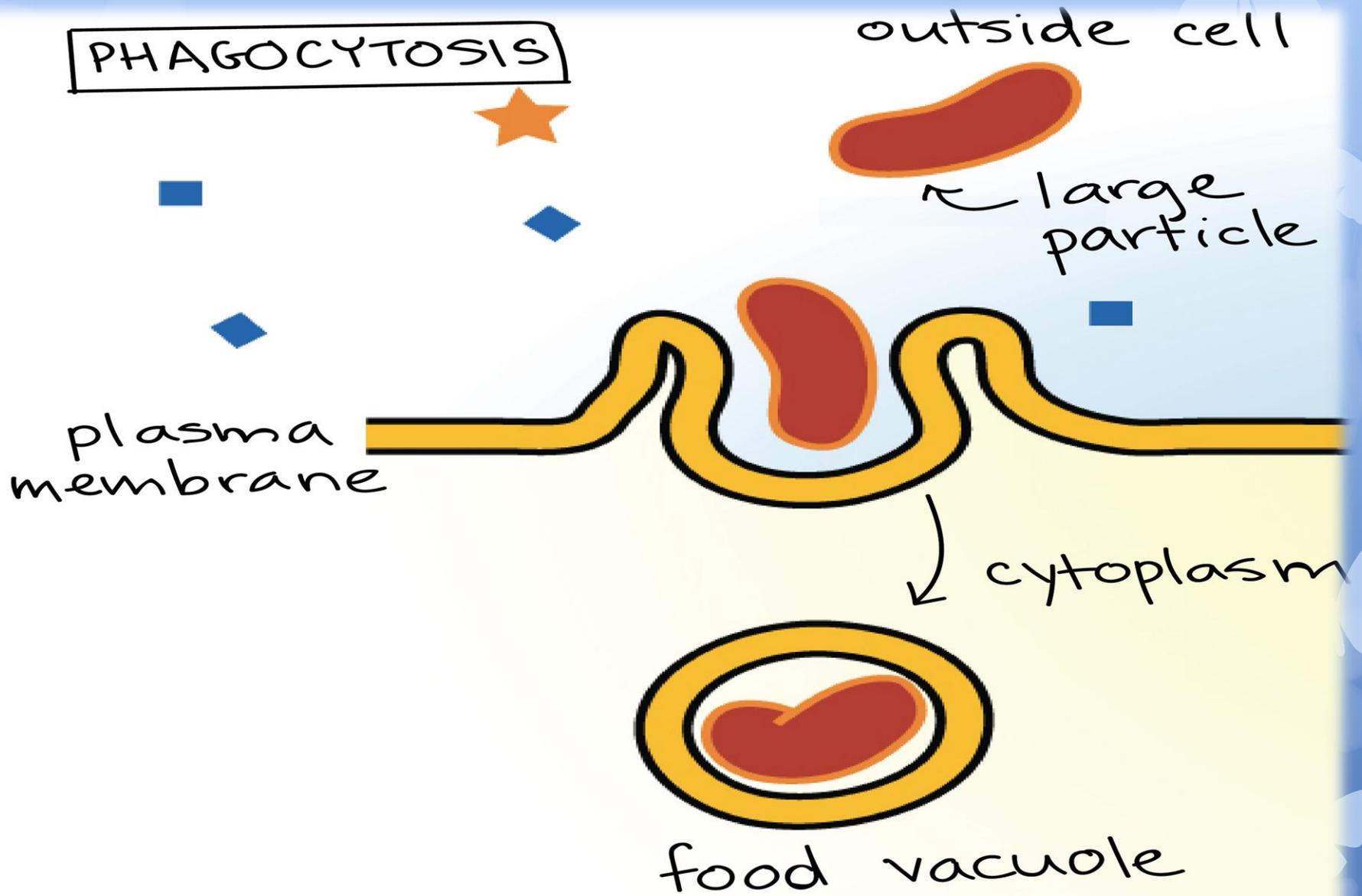
There are variations of endocytosis, but all follow the same basic process. First, the plasma membrane of the cell invaginates (folds inward), forming a pocket around the target particle or particles. The pocket then pinches off with the help of specialized proteins, leaving the particle trapped in in a newly created vesicle or vacuole inside the cell.

Endocytosis can be further **subdivided** into the following categories: **phagocytosis, pinocytosis,** and receptor-m

1. Phagocytosis

Phagocytosis (literally, “**cell eating**”) is a form of **endocytosis** in which large particles, such as **cells** or **cellular debris**, are transported into the cell. We’ve already seen one example of phagocytosis, because this is the type of endocytosis used by the macrophage in the article opener to engulf a pathogen.

PHAGOCYTOSIS

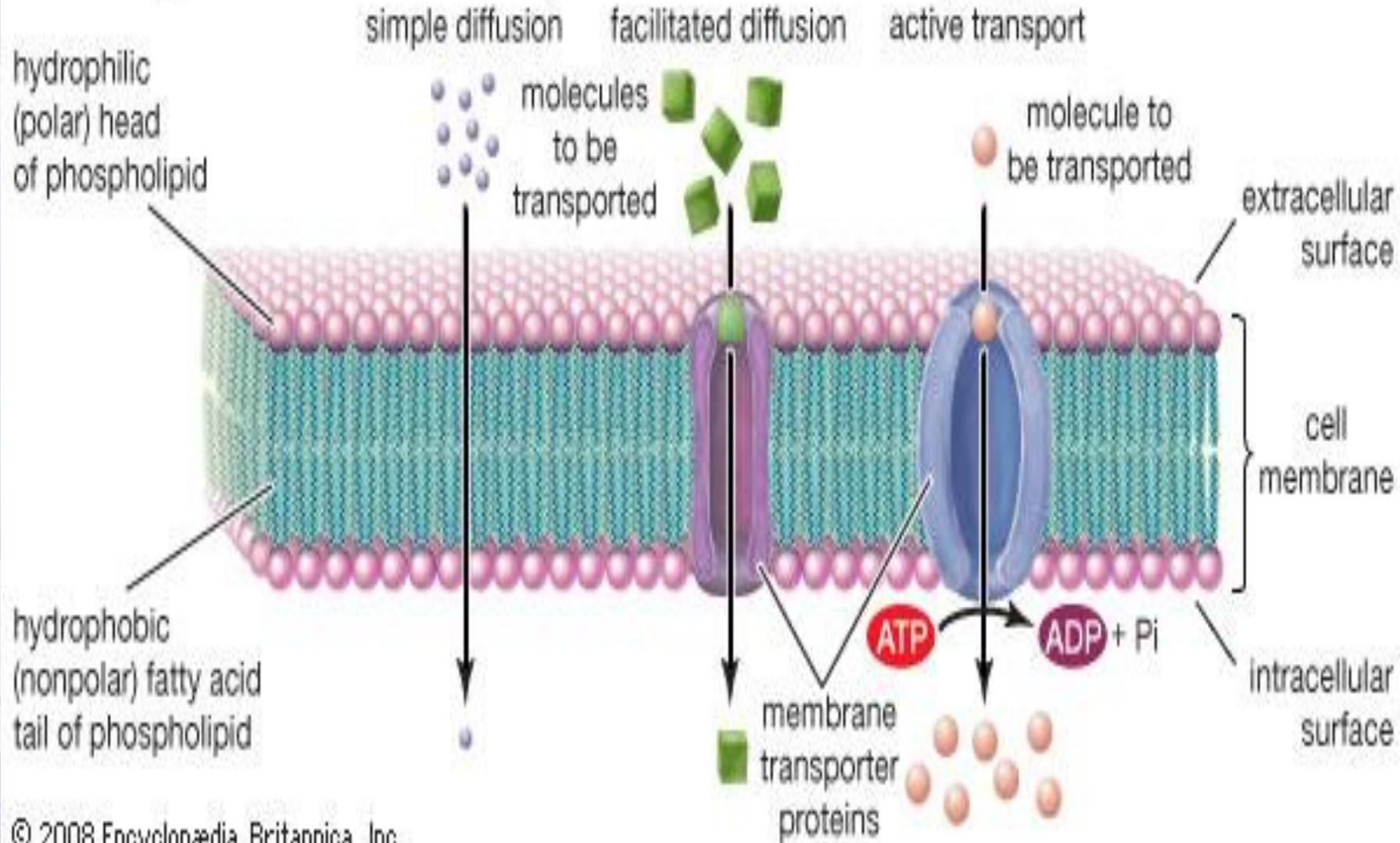


Type of transporting in cell membrane

2- Pinocytosis:

Pinocytosis (literally, “**cell drinking**”) is a **form** of **endocytosis** in which a cell **takes** in small amounts of **extracellular fluid**. Pinocytosis occurs in many cell types and takes place continuously, with the cell sampling and re-sampling the **surrounding fluid to get whatever nutrients and other molecules** happen to be present. Pinocytosed material is held in **small vesicles**, much **smaller** than the **large food vacuole** produced by **phagocytosis**.

Different types of membrane transport



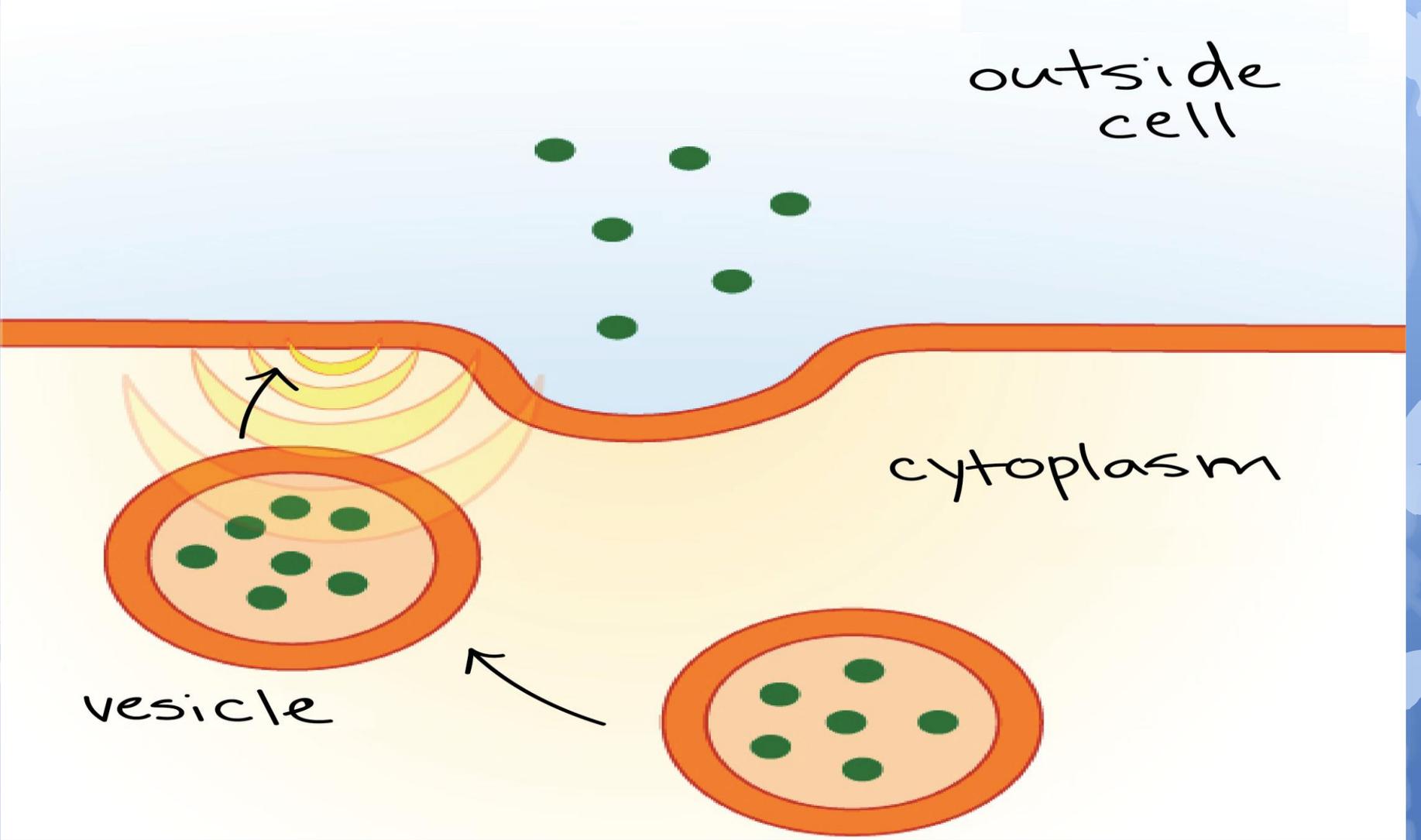
Type of transporting in cell membrane

Exocytosis

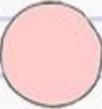
Cells must take in certain molecules, such as nutrients, but they also need to **release** other molecules, such as **signaling proteins and waste products**, to the outside environment.

Exocytosis (*exo* = external, *cytosis* = transport mechanism) is a form of bulk **transport** in which **materials are transported from the inside to the outside** of the cell in membrane-bound vesicles that fuse with the plasma membrane.

EXOCYTOSIS

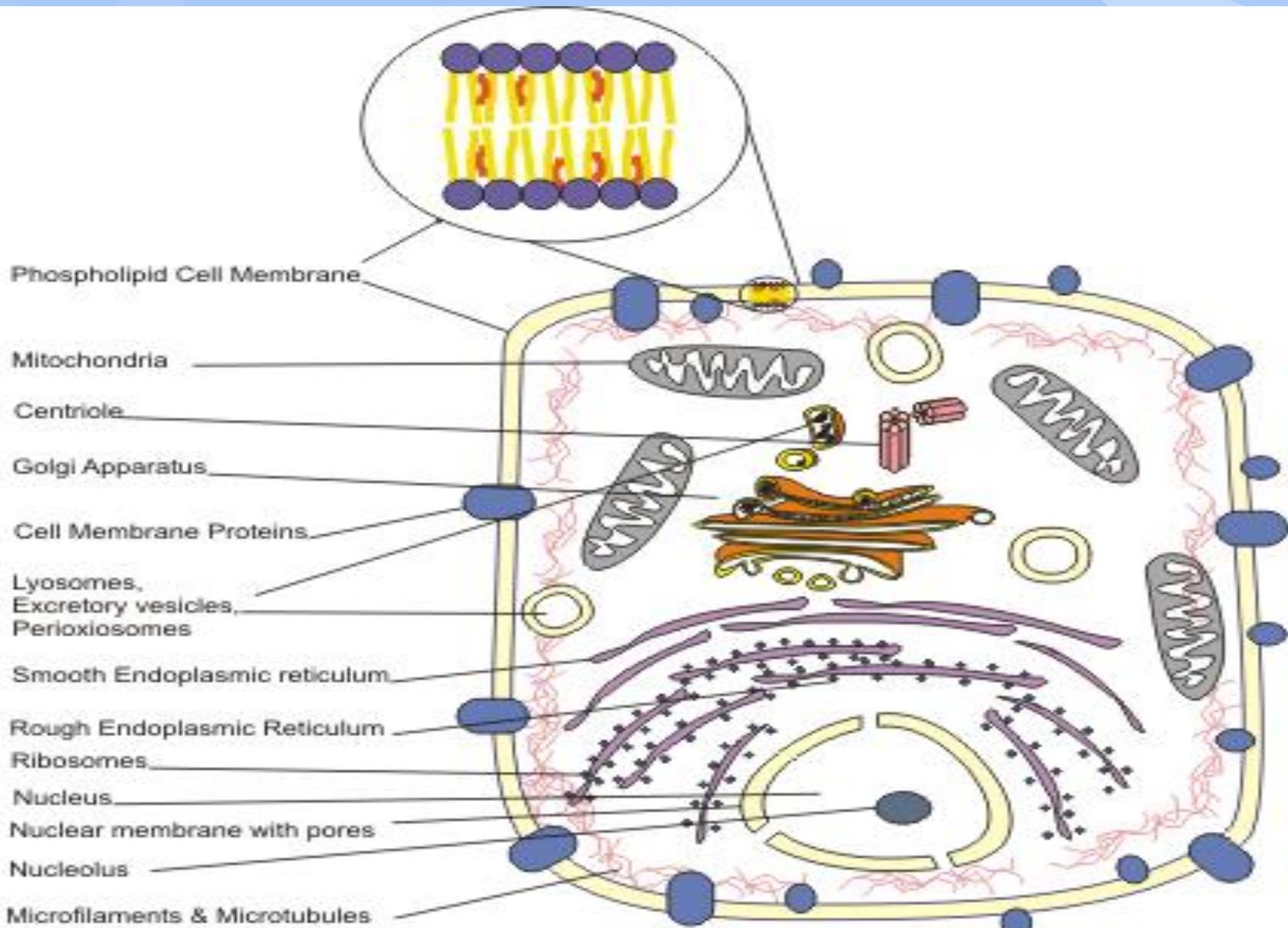


Cell Parts Chart

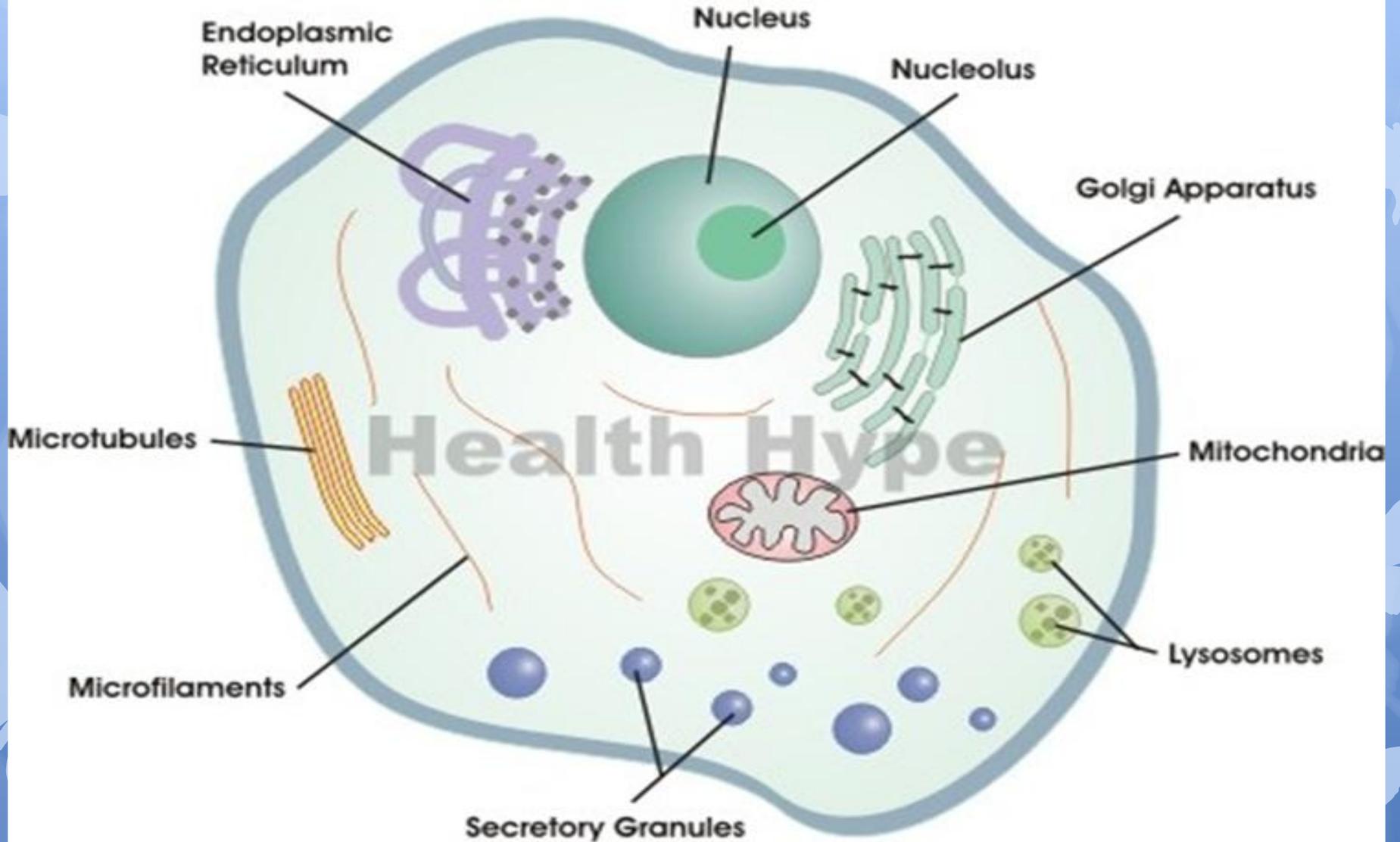
| Name | What does it do? | Picture |
|-----------------------|---|---|
| Nucleus | Directs all the activities of the cell |  |
| Cell Membrane | Protects the cell and allows nutrients to come into the cell. |  |
| Cytoplasm | The gel-like fluid that holds the organelles. |  |
| Ribosomes | Produces proteins that helps the cell grow. |  |
| Endoplasmic Reticulum | Passages that transports materials. |  |

Cell Parts Chart

| | | |
|--------------|--|---|
| Mitochondria | Produce energy |  |
| Golgi bodies | Packages materials to be sent or received. |  |
| Lysosomes | Breaks down food and waste materials. |  |
| Vacuoles | Stores food, water, and nutrients. |  |
| Cell Wall | Provides shape for plant cells. |  |
| Chloroplasts | Uses sunlight energy to make food (glucose). |  |



The Human Cell



<https://www.youtube.com/watch?v=o2abDVq4M84>

The background is a solid light blue color with several white butterfly silhouettes scattered across it. The butterflies are of various sizes and orientations, some appearing to fly towards the center. The text is centered and reads:

**THANK YOU
FOR
LISTENING**