



جامعة المستقبل
AL MUSTAQBAL UNIVERSITY
كلية العلوم

قسم الأنظمة الطبية الذكية

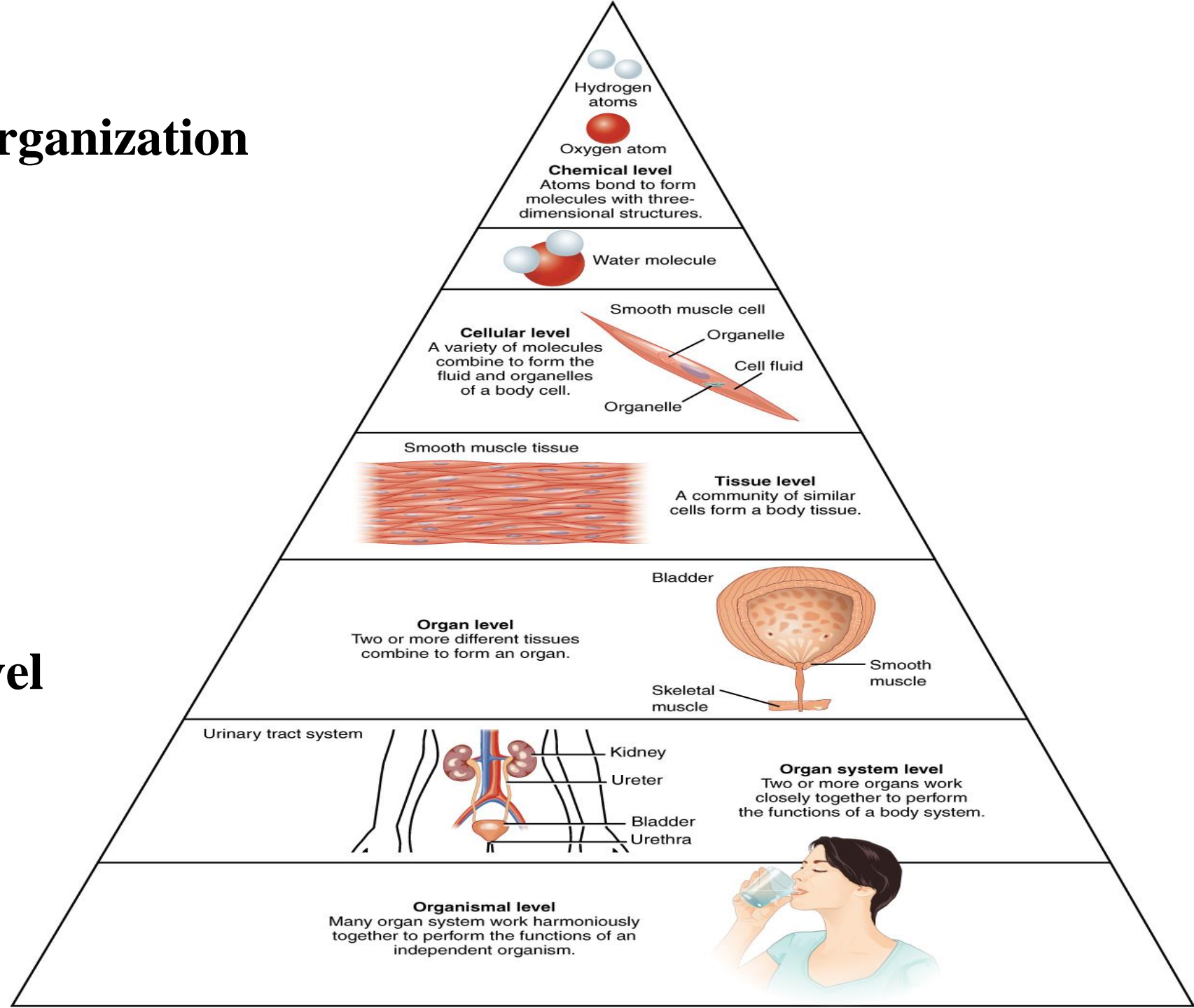
General Anatomy and Physiology

(L2) Introduction to Physiology: The Cell and General Physiology

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- There are six levels of organization (from smallest to largest):

1. The chemical level
2. The cellular level
3. The tissue level
4. The organ level
5. The organ system level
6. The organism level

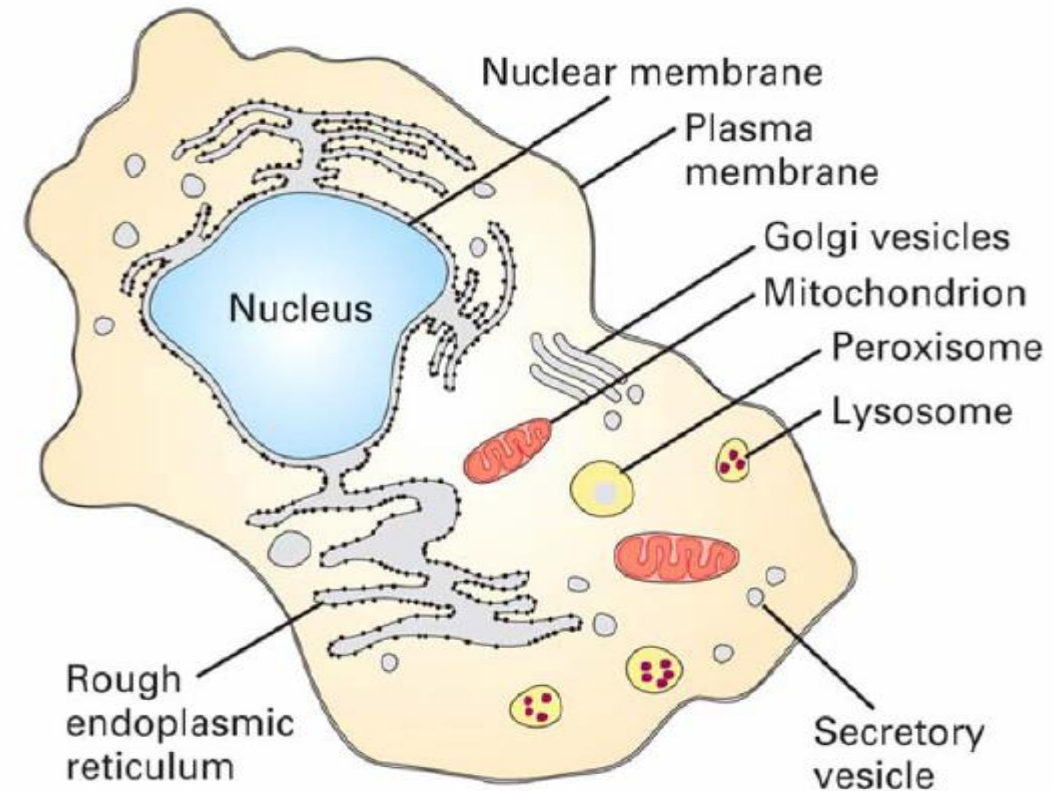


Physiology from Ancient Greek (*physis*) 'nature, origin', and (*-logia*) 'study of') is the scientific study of functions and mechanisms in a living system.

As a sub-discipline of biology, physiology focuses on how organisms, organ systems, individual organs, cells, and biomolecules carry out the chemical and physical functions in a living system.

According to the classes of organisms, the field can be divided into medical physiology, animal physiology, plant physiology, cell physiology,

- The basic living unit of the body is the **cell**. Each **organ** is an **aggregate** of many different cells held together by intercellular supporting structures.
- Each type of cell is specially adapted to perform one or a few particular functions.
- Although the many cells of the body often differ markedly from one another, all of them have certain basic characteristics that are alike.



GENERAL PRINCIPLES

Organization of the Body:

The cells that make up the bodies, exist in an "internal sea" of **extracellular fluid (ECF)**. From this fluid, the cells take up O_2 and nutrients.

In animals with a closed vascular system, the ECF is divided into two components: the **interstitial fluid** and the circulating **blood plasma**. The plasma and the cellular elements of the blood, principally red blood cells, fill the vascular system.

The interstitial fluid is that part of the ECF that is outside the vascular system, bathing the cells.

About a third of the **total body water (TBW)** is extracellular; the remaining two-thirds are intracellular (**intracellular fluid**).

Body Composition :

In the average young adult male, 18% of the body weight is protein and related substances, 7% is mineral, and 15% is fat. The remaining 60% is water.

- Differences Between ECF and ICF

- The **ECF** contains **large** amounts of **sodium, chloride,** and **bicarbonate ions** plus **nutrients** for the cells, such as **oxygen, glucose, fatty acids,** and **amino acids**. It **also** contains **carbon dioxide** that is being **transported** from the cells to the **lungs** to be **excreted**, plus other **cellular waste products** that are being **transported** to the **kidneys** for excretion.
- The **ICF** differs **significantly** from the **ECF**; specifically, it contains **large** amounts of **potassium, magnesium,** and **phosphate ions** instead of the sodium and chloride ions found in the **ECF**.

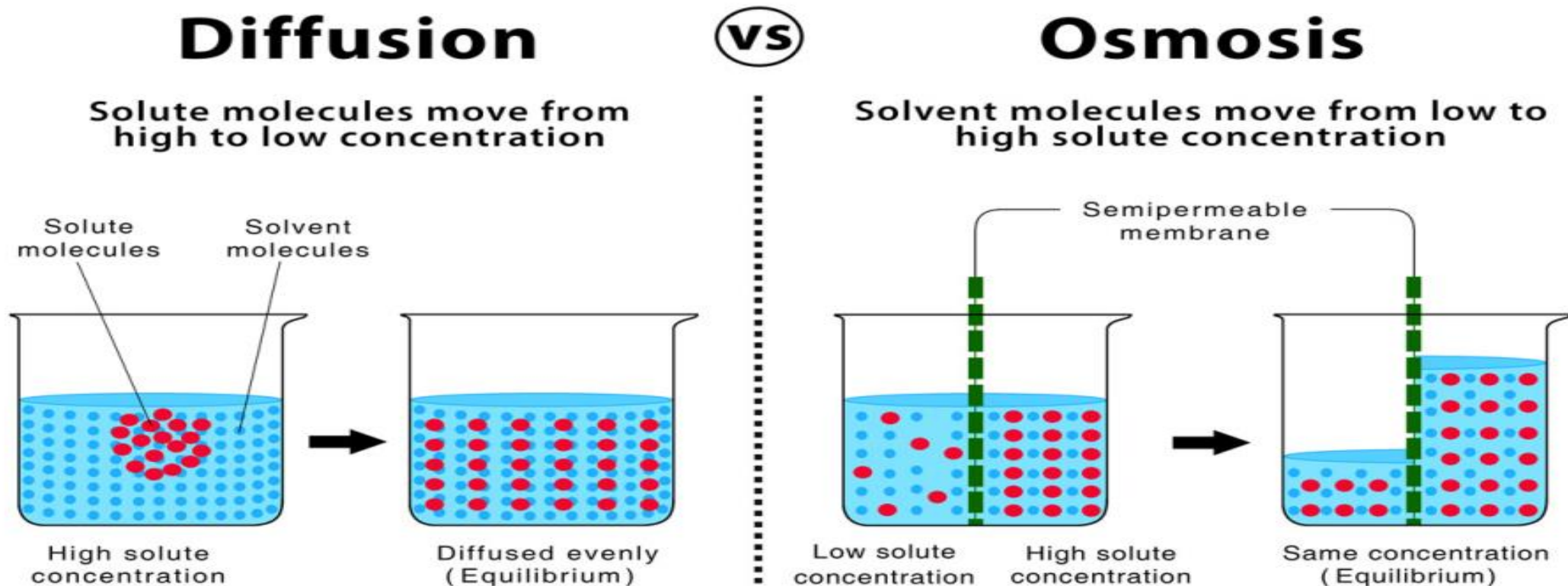
	ECF	ICF
% from total body water	1/3	2/3
Cell environment	Outside the cell (Vascular or extravascular)	Inside the cell
Main ion composition	Na ⁺ , Cl ⁻ , and HCO ₃ ⁻	K ⁺ , Mg ²⁺ , and PO ₄ ²⁻
pH	7.4	7.4
Osmolarity	~ 300mOs/L	~ 300mOs/L
Function	Carry nutrients and gases into the cells and out of the cell	A vehicle for making intracellular solution (cytoplasm)

Homeostasis:

- The term **homeostasis** is used by physiologists to mean *maintenance of nearly constant conditions in the internal environment*.
- Essentially all organs and tissues of the body perform functions that help maintain these constant conditions.

• **DIFFUSION** and **OSMOSIS**

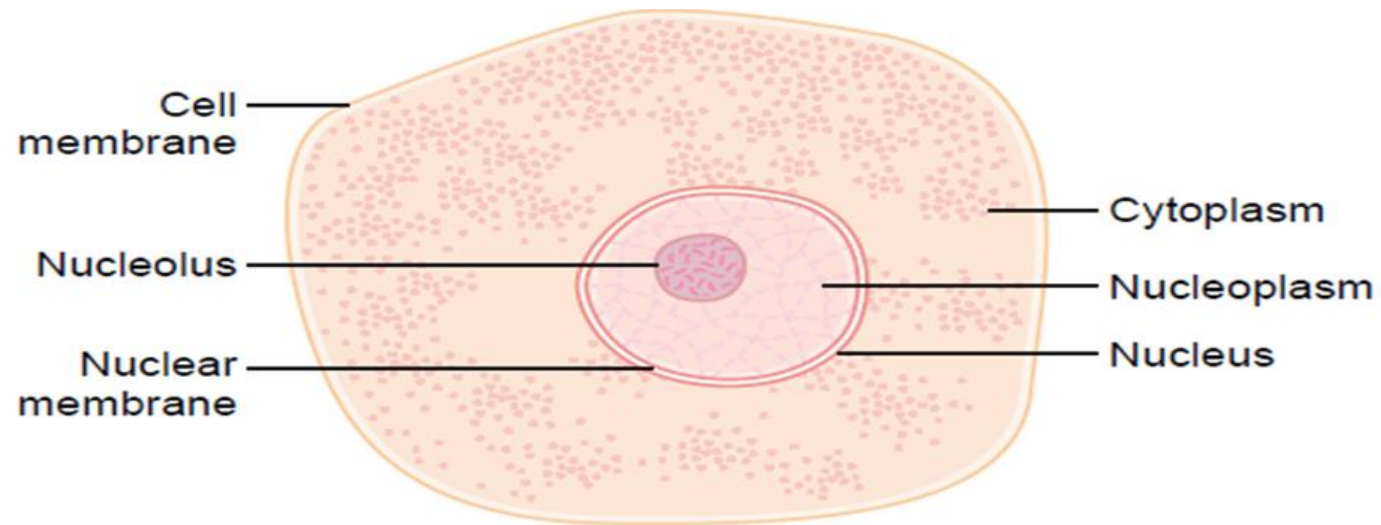
- These are physical phenomena that are very important in physiology.
- Lipid soluble gases and small size unionized solutes cross the biological membranes via diffusion.
- Vascular and cellular volumes are adjusted via osmosis



The Cell and Its Functions

Organization of the Cell

A typical cell, as seen by the light microscope has two major parts, the **nucleus** and the **cytoplasm**. The nucleus is separated from the cytoplasm by a **nuclear membrane**, and the cytoplasm is separated from the surrounding fluids by a **cell membrane**, also called the **plasma membrane**.



The different substances that make up the cell are collectively called: ***protoplasm***.

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Physical Structure of the Cell

The cell is not only contain fluid, enzymes, and chemicals; it also contains highly organized physical structures, called ***intracellular organelles***. The physical nature of each organelle is as important as the cell's chemical constituents for cell function. For instance, without one of the organelles, the **mitochondria**, more than 95 per cent of the cell's energy release from nutrients would cease immediately.

Membranous Structures of the Cell

Most **organelles** of the cell are covered by membranes composed primarily of **lipids** and **proteins**. These membranes include the cell membrane, nuclear membrane, membrane of the endoplasmic reticulum, and membranes of the mitochondria, lysosomes, and Golgi apparatus. The membrane that surrounds the cell is:

Made up of **lipids** and **proteins**. **Semipermeable** (allowing some substances to pass through it and excluding others). Generally referred to as the **plasma membrane**.

- **Membrane Lipids**

The lipids of the membranes provide a barrier that impedes the movement of water and water-soluble substances from one cell compartment to another because water is not soluble in lipids.

- **Membrane Proteins**

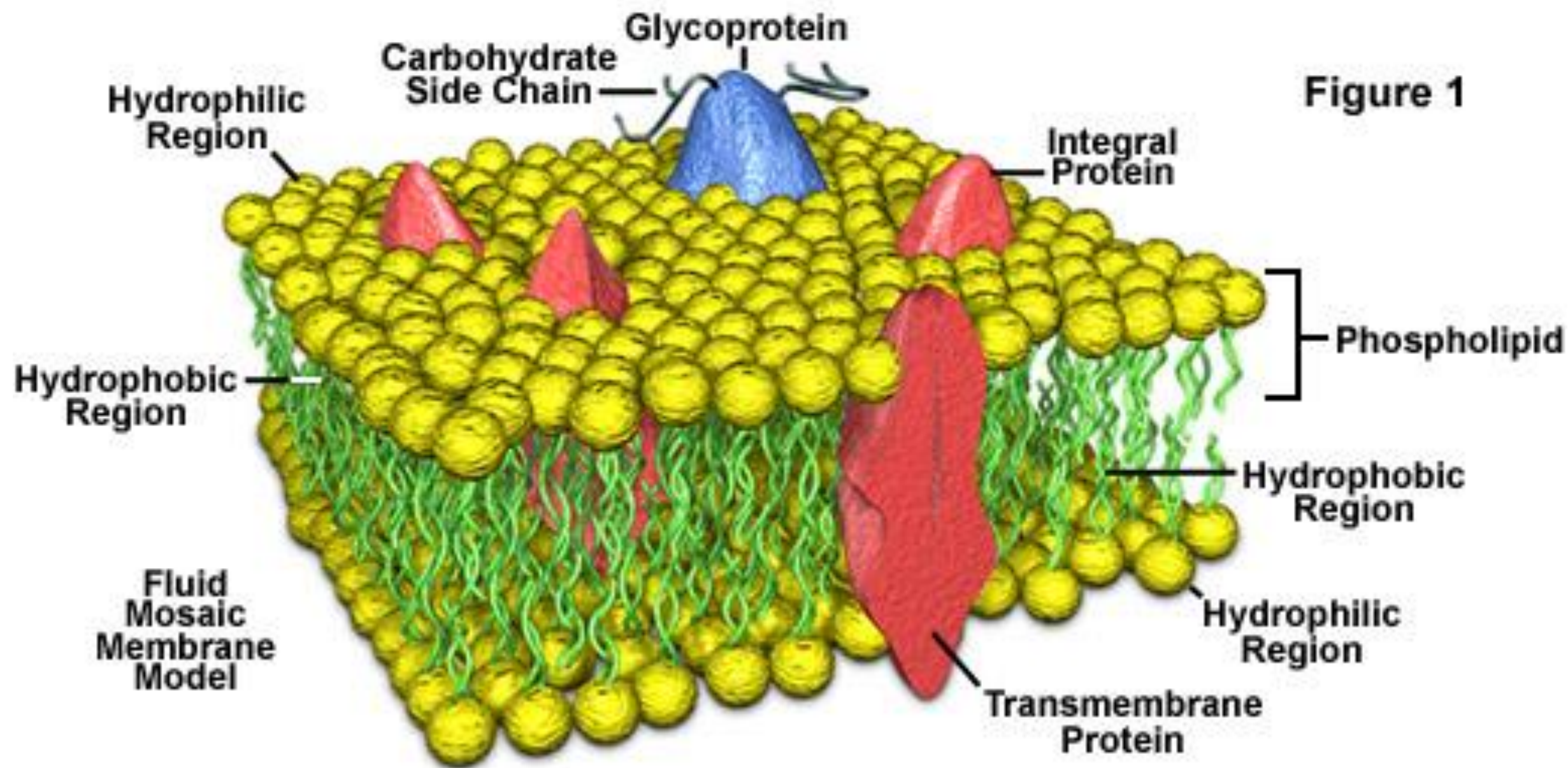
The protein molecules in the membrane often do penetrate all the way through the membrane, thus providing specialized pathways, often organized into *actual pores*, for passage of specific substances through the membrane.

-Many different proteins are embedded in the membrane. They exist as:

✓ *Integral proteins: separate globular units that many pass through or are embedded in one leaflet of the membrane.*

✓ *Peripheral proteins: associated with the inside or outside of the membrane.*

Plasma Membrane Structural Components



FUNCTIONS OF CELL MEMBRANE

- **Protective:-** Forms outermost boundary of the cell organelles.
- **Digestive:-** Takes in food and excretes waste products.
- **Selective Permeability:-**
 - **a)Non-Polar Molecules-** Gases (like O_2 , CO_2 , N_2), Lipids, Steroid Hormones, Alcohols can dissolve in the non -polar regions of the membrane and move rapidly across the membrane.
 - **b)Polar molecules:-** H_2O soluble ions , Glucose, urea etc. have much lower solubility . Therefore Penetrate the membrane much more slowly.

The membrane control the free passage of ions in and out of cell. This property helps in maintaining components in ICF and ECF.

CYTOPLASM

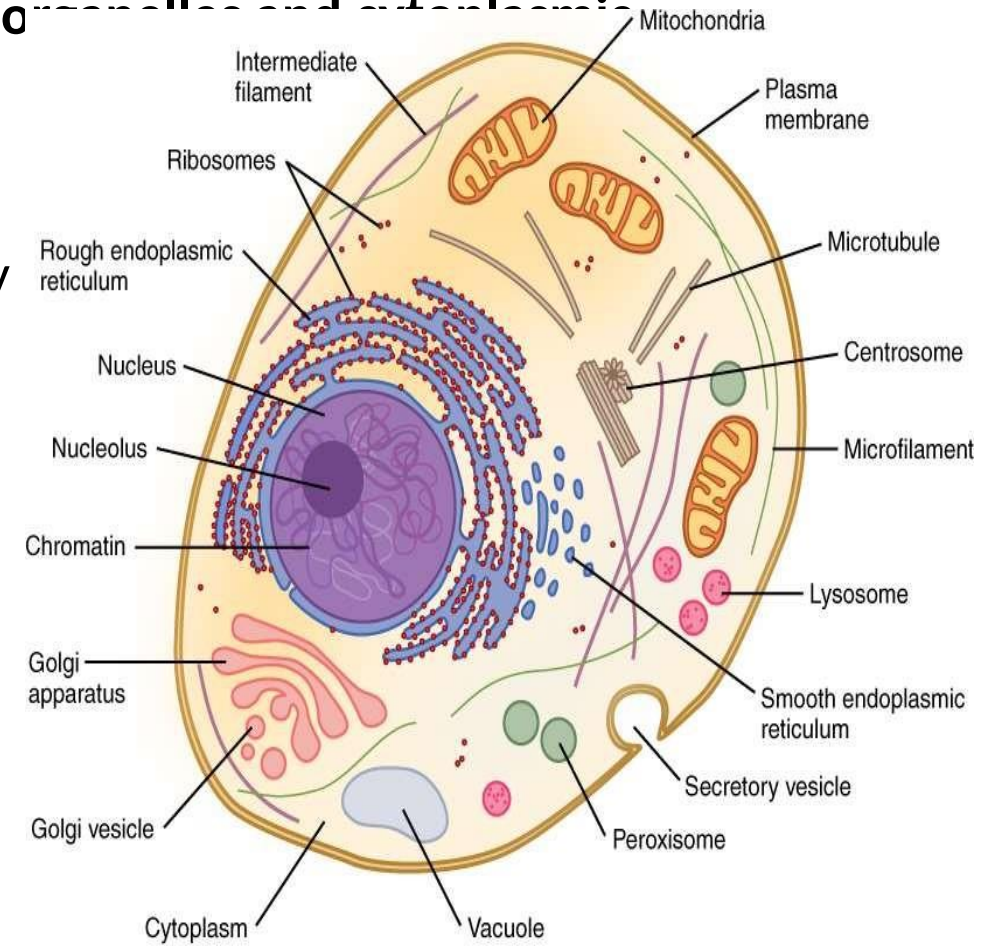
- **Thick, gel-like semitransparent fluid** that is found in both plant and animal cell.

- The constituent parts of cytoplasm are **cytosol, cell organelles and inclusions.**

- Bounded by the plasma membrane, and contains many cell (cell containing membrane bounded nucleus).

- **The cytosol**, the aqueous part of the cytoplasm outside all of the organelles, also contains its own distinctive proteins.

- It accounts for almost 70% of the total cell volume.

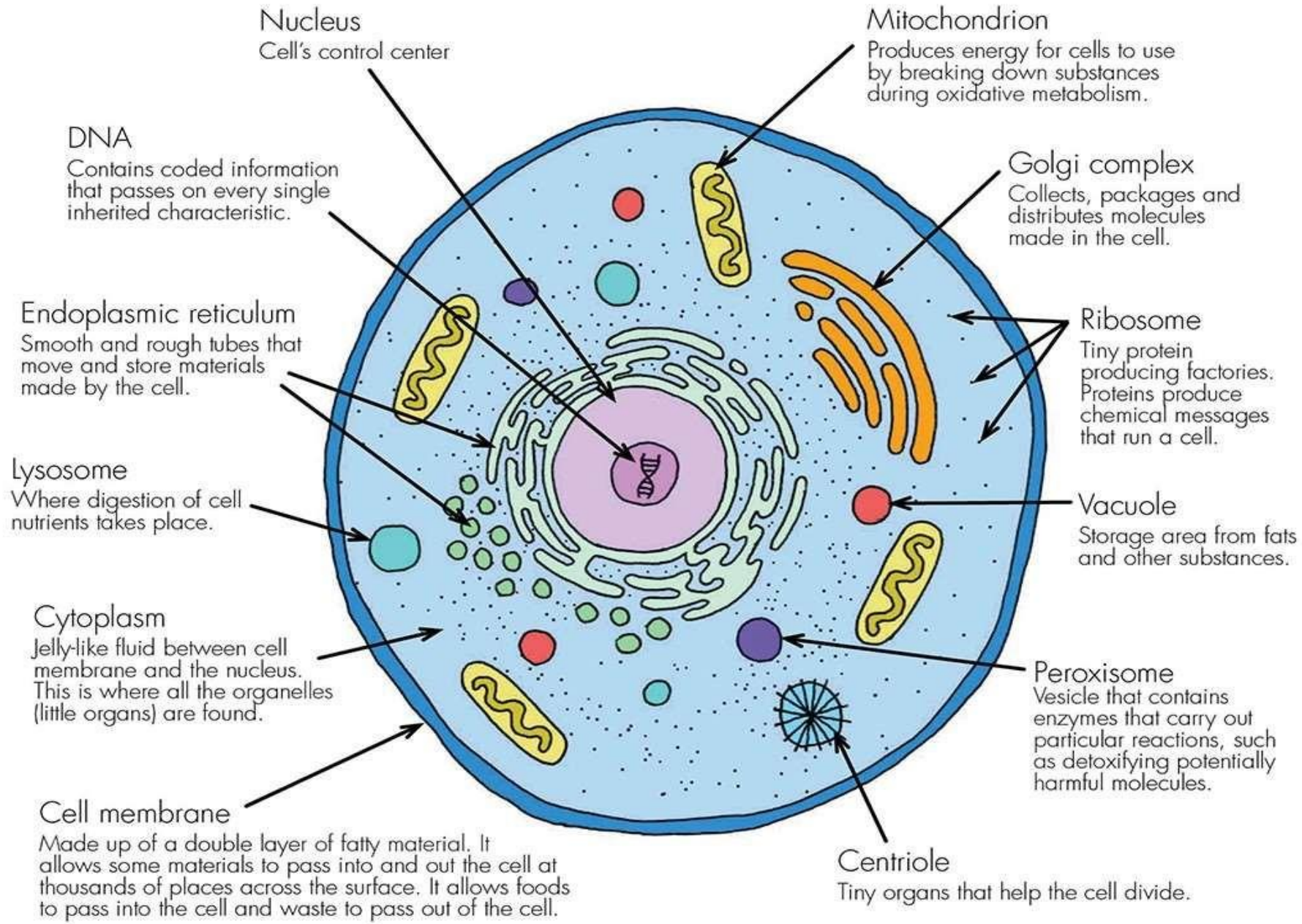


ORGANELLES

- Following organelles are present in the Cytoplasm:-

- i) Mitochondria
- ii) Endoplasmic Reticulum
- iii) Lysosomes
- iv) Golgi Apparatus
- v) Peroxisomes
- vi) Vacuole

- Each organelle is bounded by a lipid membrane, and has specific functions.



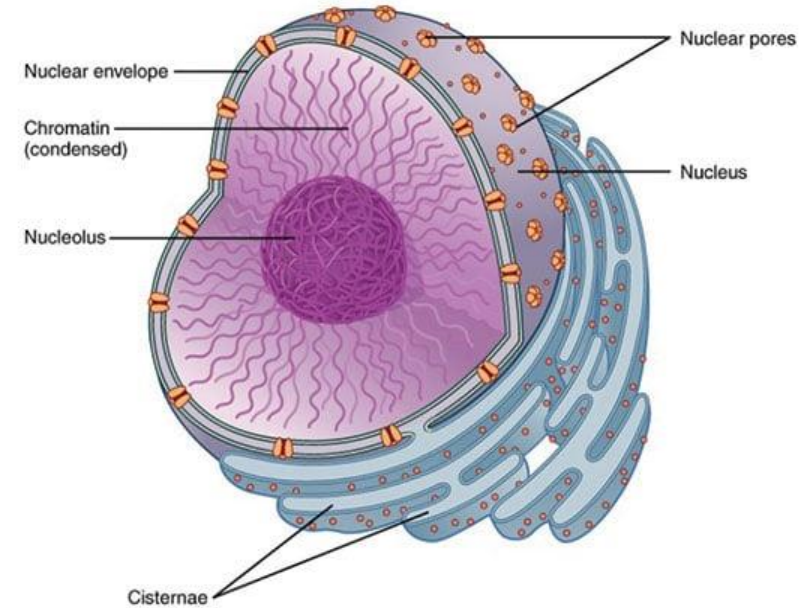
Nucleus

The cell nucleus is a membrane-bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction.

It is the command center of the cell and is commonly the most prominent organelle in a cell. In general, a cell has only one nucleus. However, some cells are enucleated cells (without a nucleus), for example, red blood cells (RBCs).

Nucleus

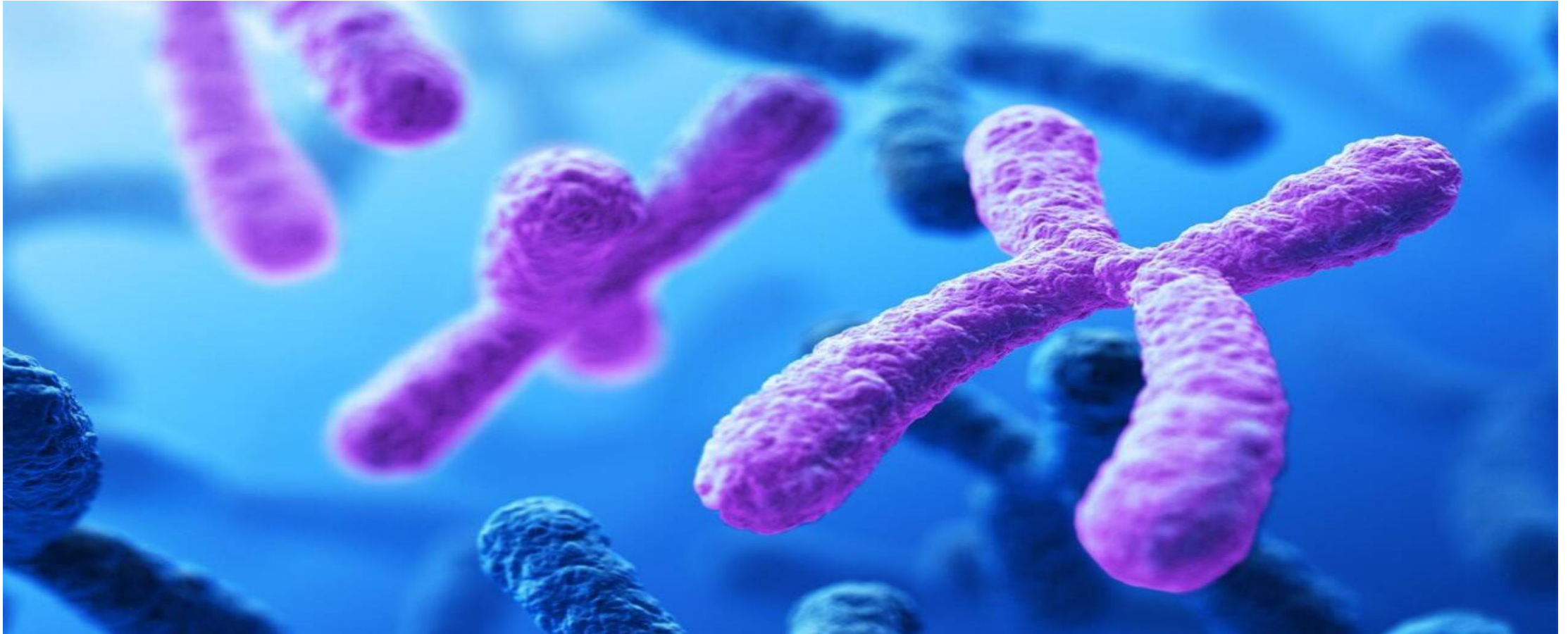
Structure and Functions



Chromosomes

- The nucleus is the organelle that houses chromosomes.
- Chromosomes consist of DNA, which contains heredity information and instructions for cell growth, development, and reproduction.
- Chromosomes are present in the form of strings of DNA and histones (protein molecules) called chromatin.

Chromosome



Nucleic Acids:

Found in all living cells except RBC

DNA- Deoxyribonucleic acid

DNA- is in nucleus

Function- Storage and transmission of genetic material and control ,direct all protein synthesis

RNA- Ribonucleic acid

RNA- is in cytoplasm

SUMMARY

COMPARTMENTS

- Plasma Membrane
- Cytosol

- Mitochondria
- Endoplasmic Reticulum
- Golgi apparatus
- Lysosomes
- Peroxisomes
- Cytoskeleton
- Nucleus

MAJOR FUNCTIONS

- Transport of ions and molecules
- Metab. of carbohydrate, lipids and amino acids

- Energy production
- Synthesis of proteins and lipids
- Modification and sorting of proteins
- Cellular digestion
- Utilisation of H_2O_2
- Cell Morphology and cell motility
- DNA synthesis and Repair



THANK YOU!

