



# University of Al-Qadisiyah College of Medicine



## Medical Chemistry/ Part 1-Biochemistry

1st year / (2022-2023) / 1st Semester



### L 1 - Introduction to the Cell and the Macromolecules of Biochemistry



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**PhD. Medical Biochemistry**



# Introduction to the Cell and the Macromolecules of Biochemistry

**Definitions and terms: Cell, Carbohydrates, Proteins, Lipids, Enzymes, Hormones, Nucleic Acids and Clinical value.**

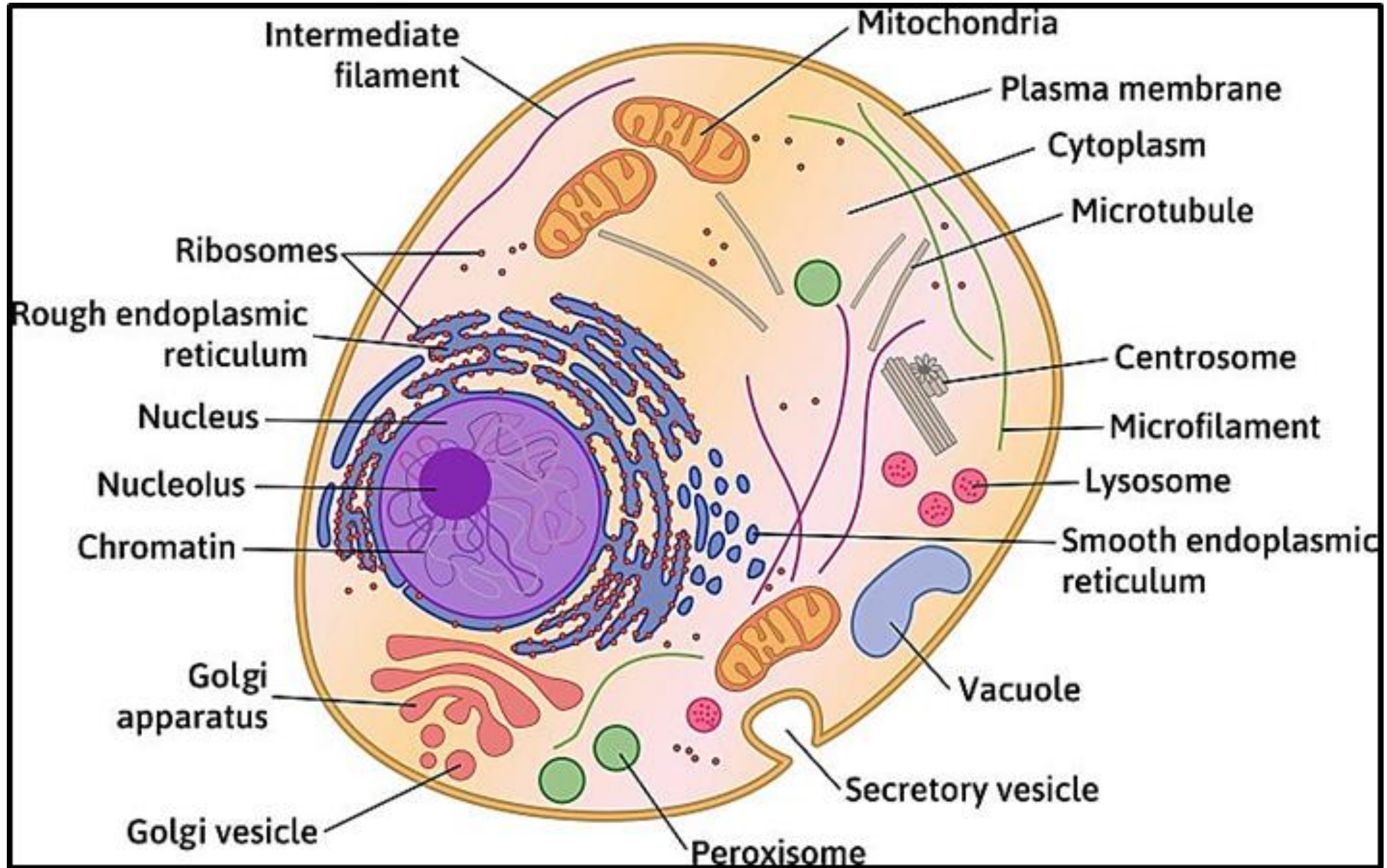
**The Cell:** is the basic structural, functional, and biological unit of all known organisms. A cell is the smallest unit of life. Cells are often called the "building blocks of life".

The study of cells is called cell biology, cellular biology, or cytology. Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids.

<https://www.youtube.com/watch?v=URUJD5NEXC8&t=6s>



# Cell Structure



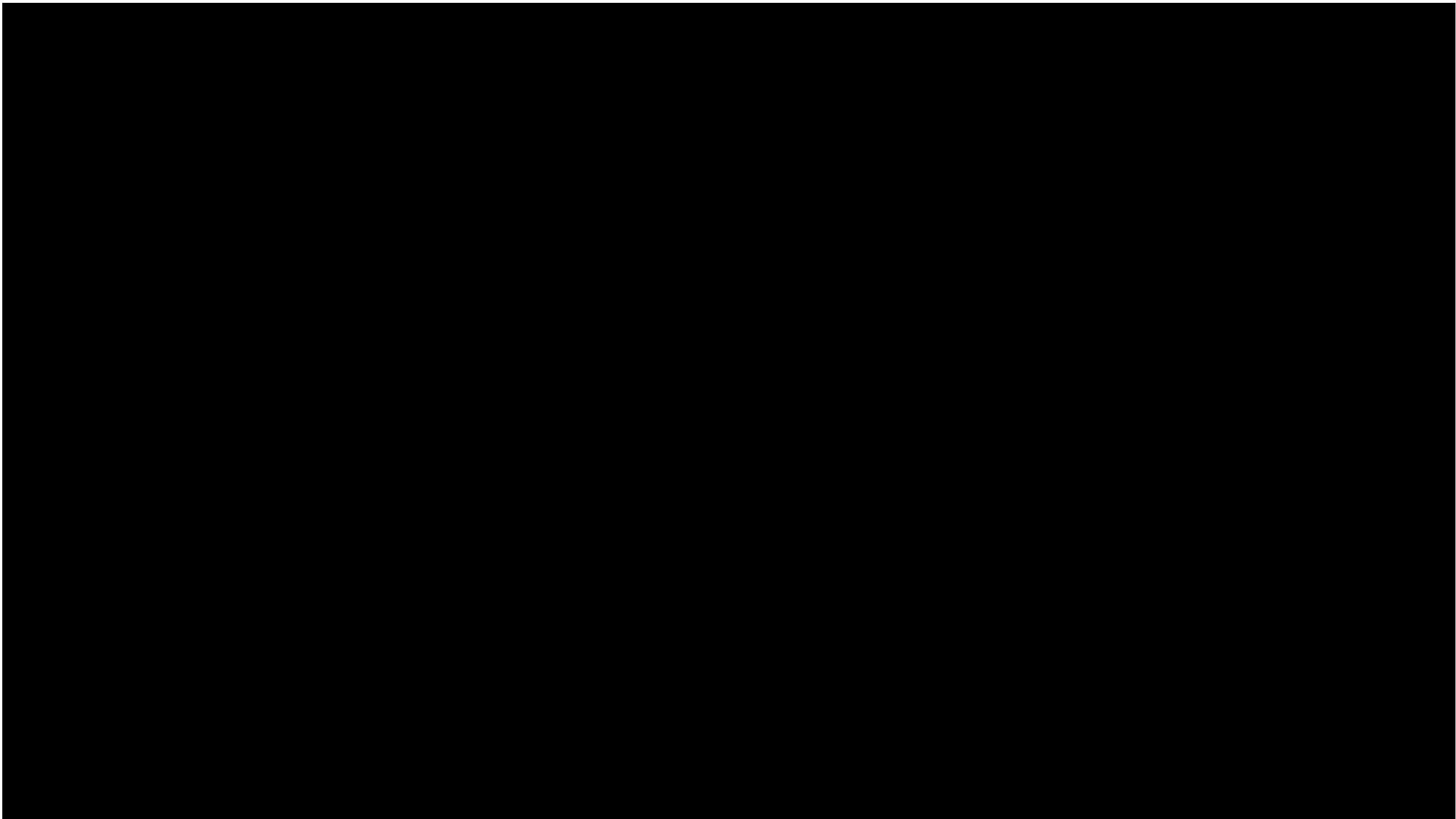
# Cell Structure

Organisms can be classified as unicellular (consisting of a single cell such as bacteria) or multicellular (including plants and animals). The cells of the living kingdom may be divided into two categories:

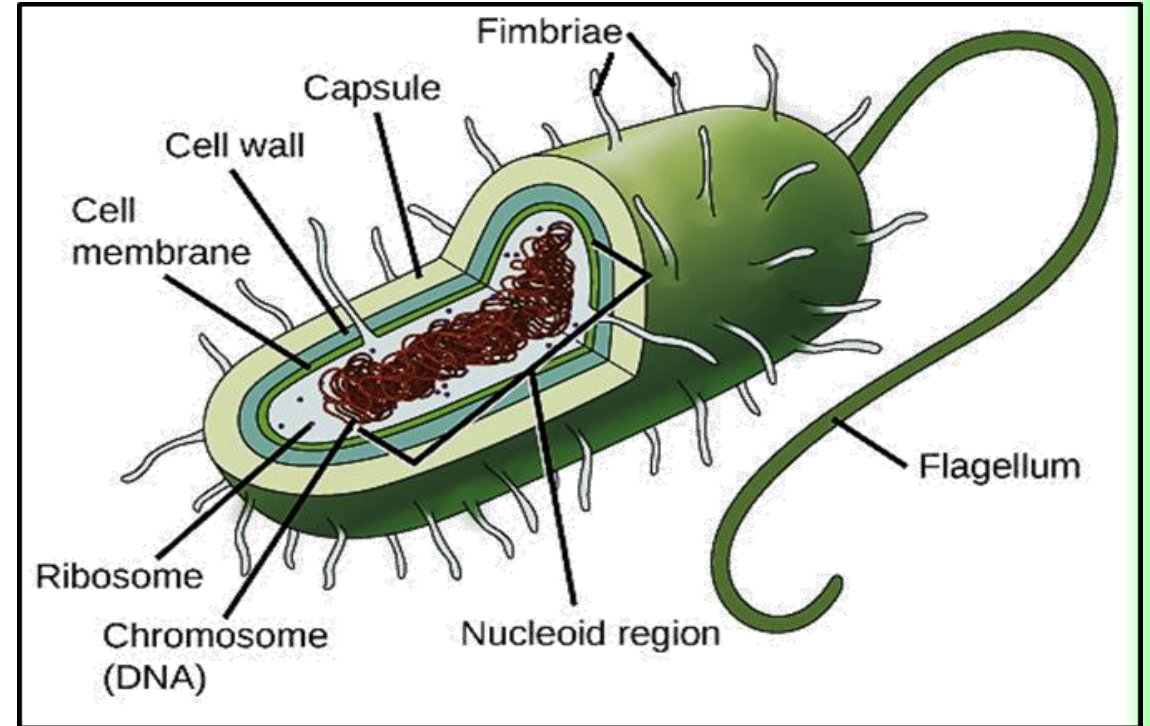
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## Homework:

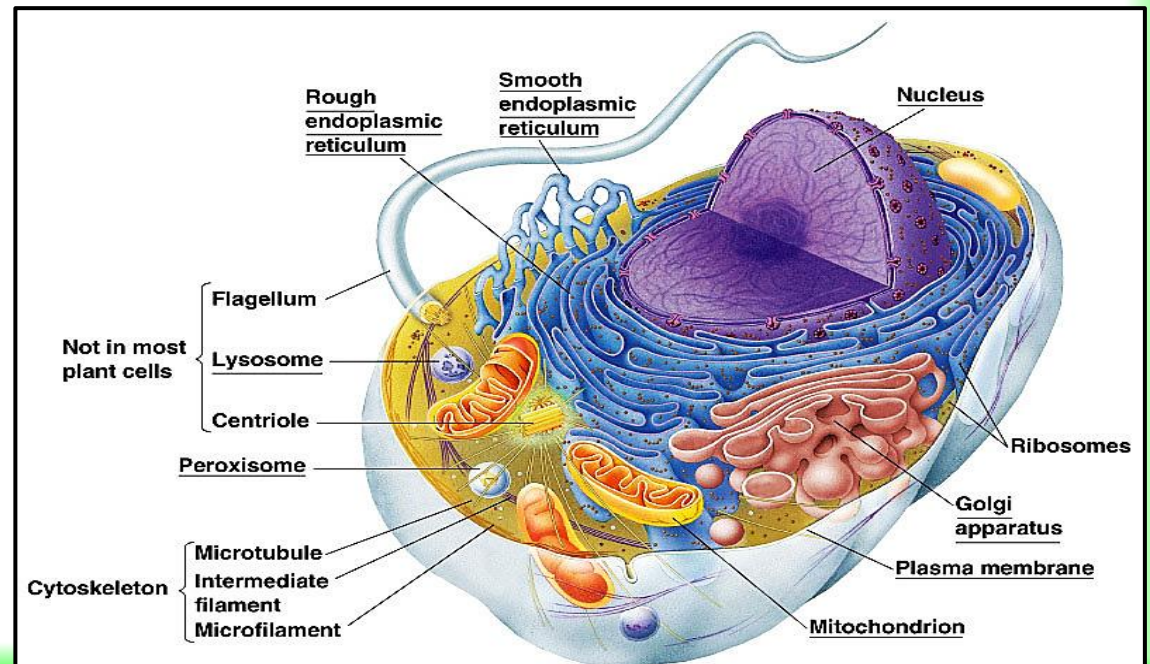
Write a short answer about the structure of the cell and explain the diagram of a cell as a figure?



**1. Prokaryotic cells** lack a well-defined nucleus and possess relatively simple structure. these include the various bacteria: They are single-celled organisms.



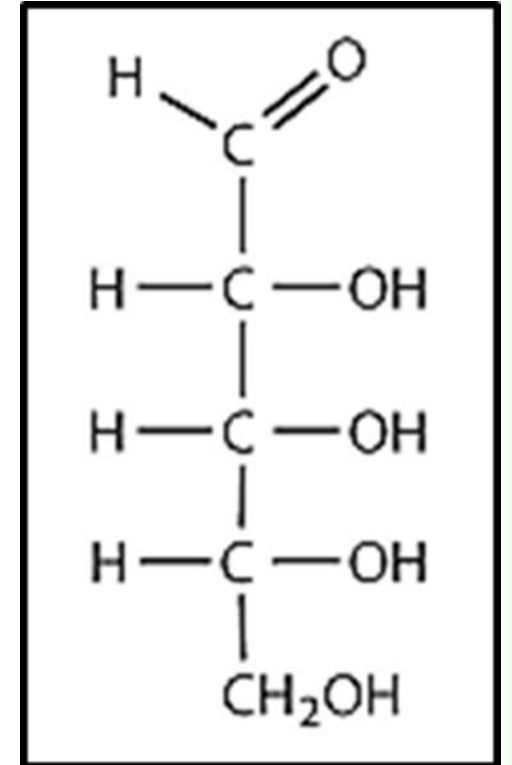
**2. Eukaryotic cells** which contain a nucleus and are more complex in their structure and function. The higher organisms (animals and plants) are composed of eukaryotic cells. They can be either single-celled or multicellular.



# Carbohydrates

**Carbohydrates:** are a biomolecule consisting of carbon (C), hydrogen (H) and oxygen (O) atoms, usually with a hydrogen–oxygen atom ratio of 2:1 (as in water). It is a synonym of saccharide, a group that includes sugars, starch, and cellulose. The saccharides are divided into four chemical groups:

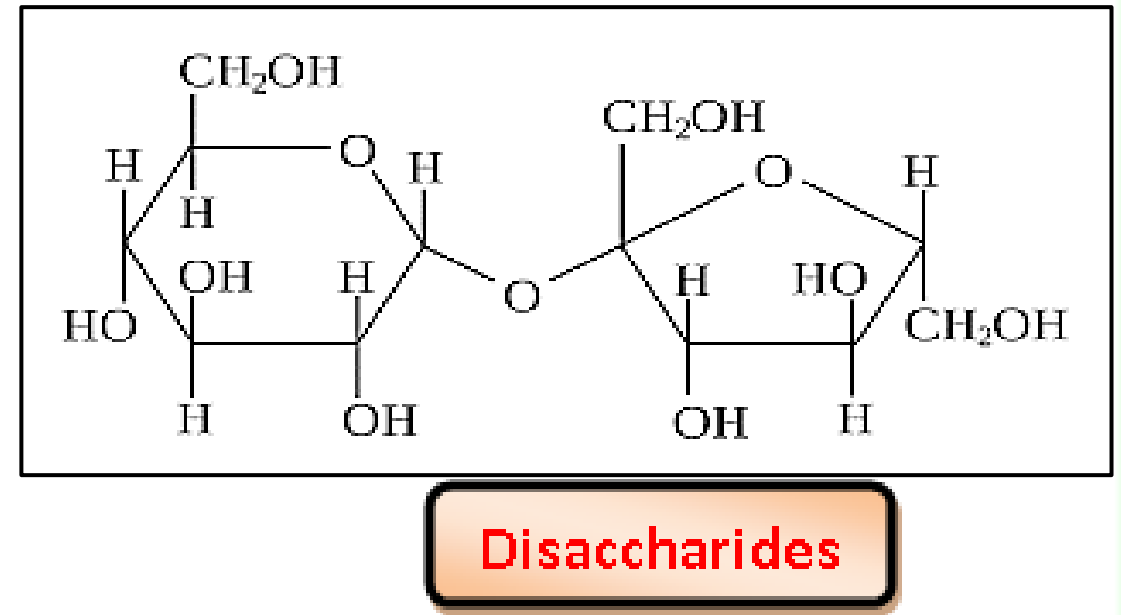
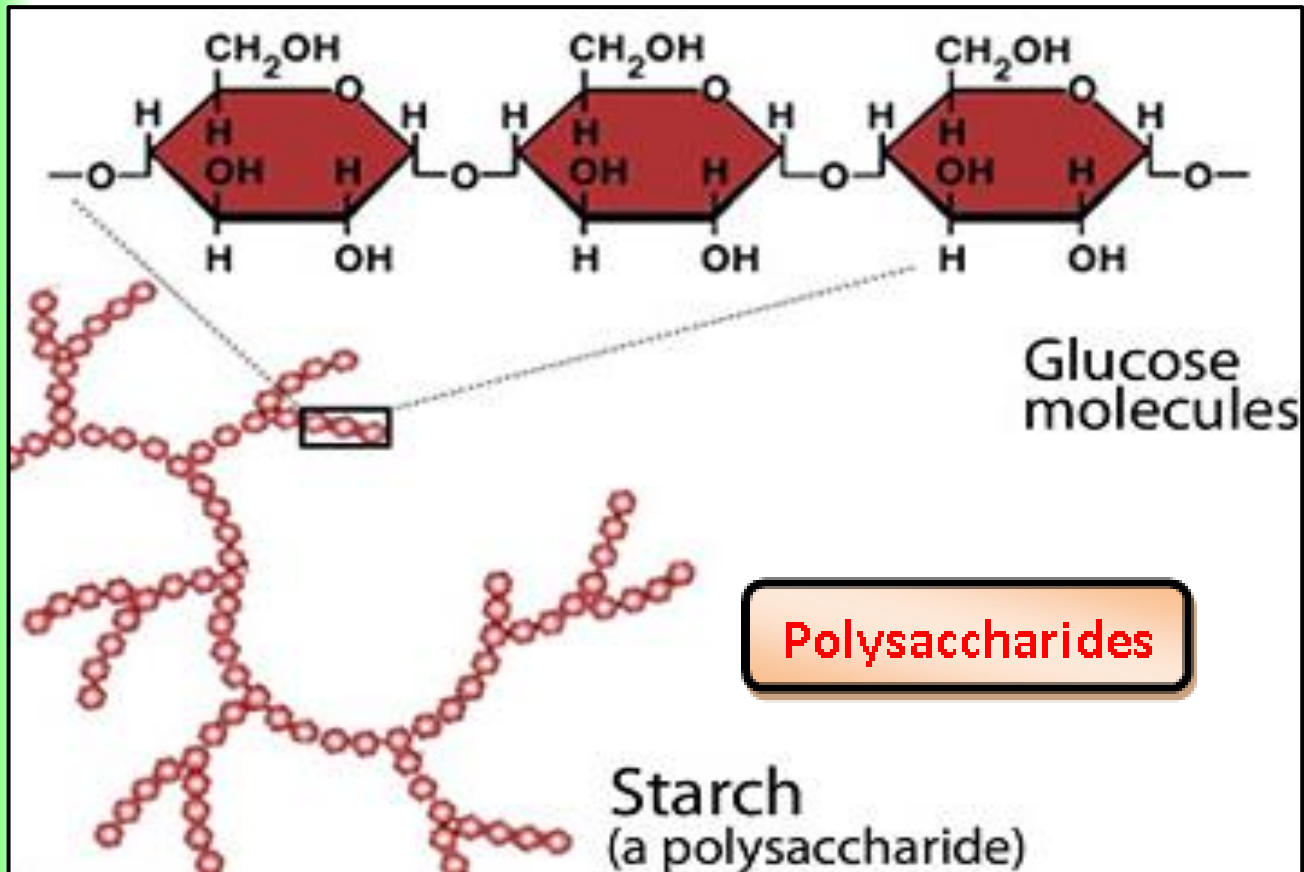
**monosaccharides, disaccharides, oligosaccharides, and polysaccharides.** Monosaccharides and disaccharides, the smallest (lower molecular weight) carbohydrates, are commonly referred to as sugars.



Monosaccharides



Carbohydrates perform numerous roles in living organisms. Polysaccharides serve for the storage of energy (e.g. starch and glycogen) and as structural components (e.g. cellulose in plants and chitin in arthropods).



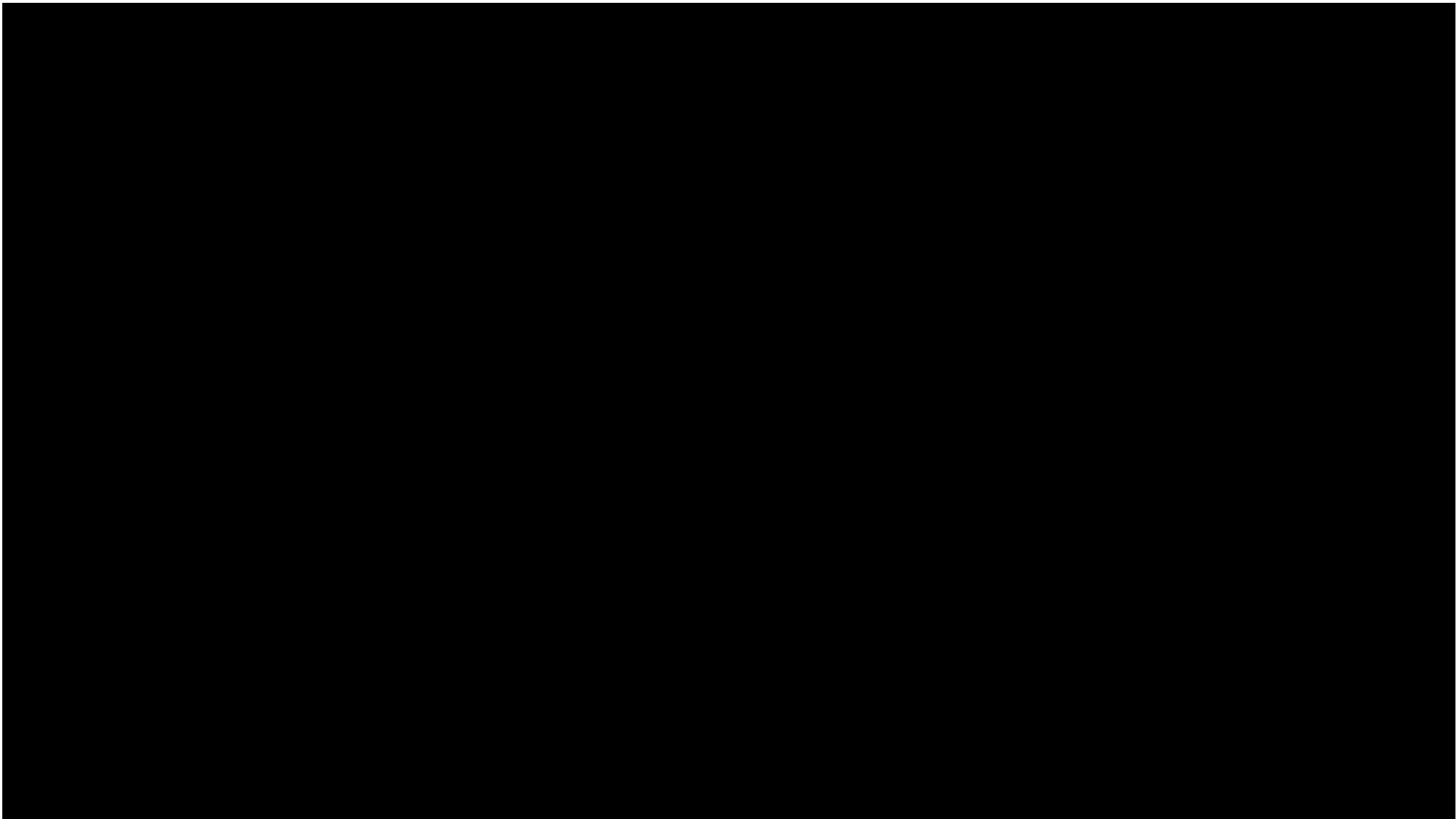


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<https://www.youtube.com/watch?v=K1mZuNQOwgM>

### **Homework:**

**Write a short answer about glycogen and explain the glycogen metabolism pathway?**



# Proteins

**Proteins:** are large biomolecules, or macromolecules, consisting of one or more long chains of amino acid residues.

Proteins perform a vast array of functions within organisms, including catalysing metabolic reactions, DNA replication, responding to stimuli, providing structure to cells, and organisms, and transporting molecules from one location to another.

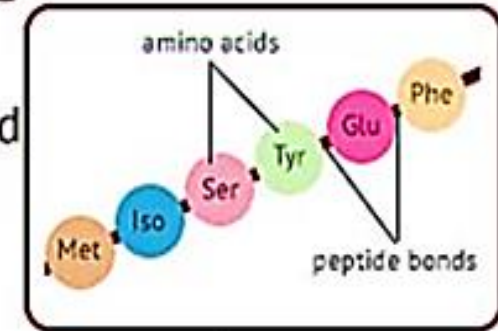
A linear chain of amino acid residues is called a polypeptide.

<https://www.youtube.com/watch?v=PPJ7C3hcnPw>

primary  
structure

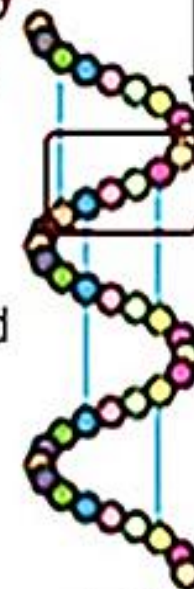
## Protein Structure

amino acid  
sequence



secondary  
structure

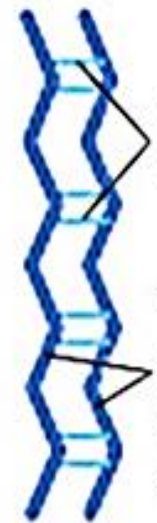
the helix  
shape is  
maintained  
with  
hydrogen  
bonds



$\alpha$  helix

hydrogen  
bonds

two  
poly-  
peptide  
chains



$\beta$  pleated  
sheet

tertiary

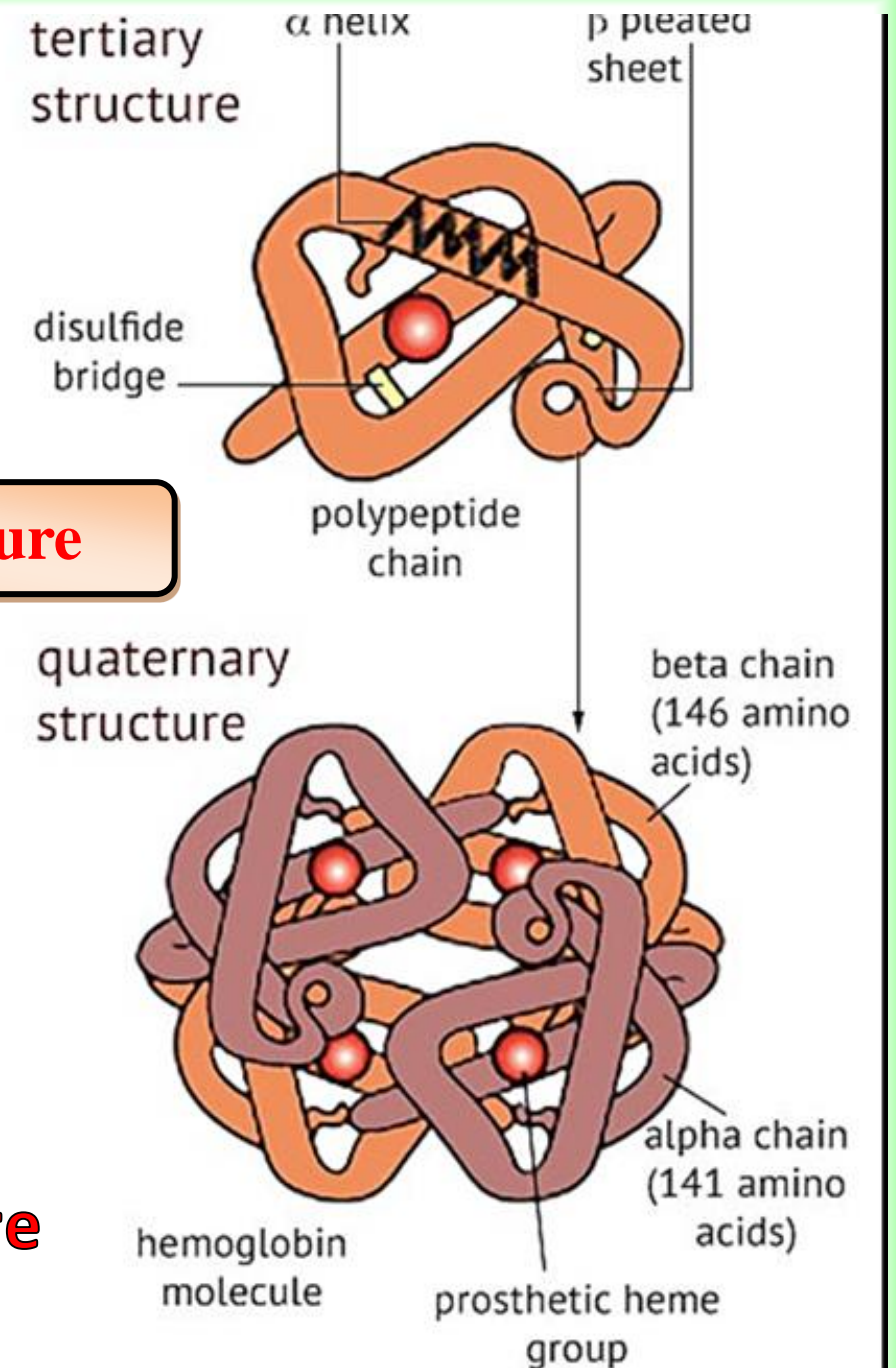
Proteins are composed of amino acids that are joined to form linear chains. In addition to carbon, hydrogen, and oxygen, proteins contain approximately 16% nitrogen by weight.

### Protein Structure

The digestive process breaks down proteins to their constituent amino acids, which enter the blood. The complete oxidation of proteins to CO<sub>2</sub>, H<sub>2</sub>O and NH<sub>4</sub>.

#### Homework:

Write a short answer about polypeptide structure and explain the formation of a polypeptide?



# Quickly understand

## Structure of Proteins

Primary



$\alpha$  Helix



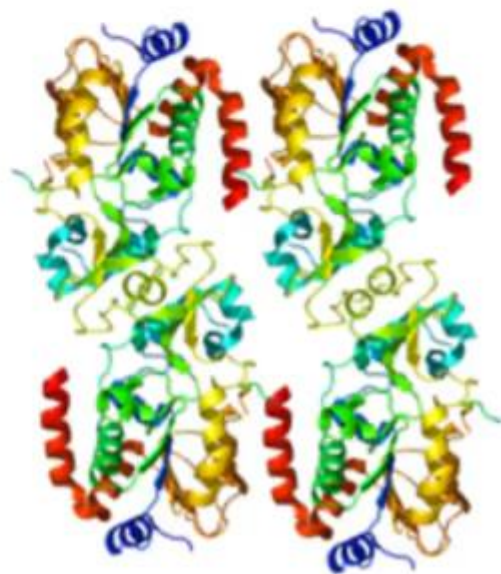
$\beta$  sheet



Tertiary



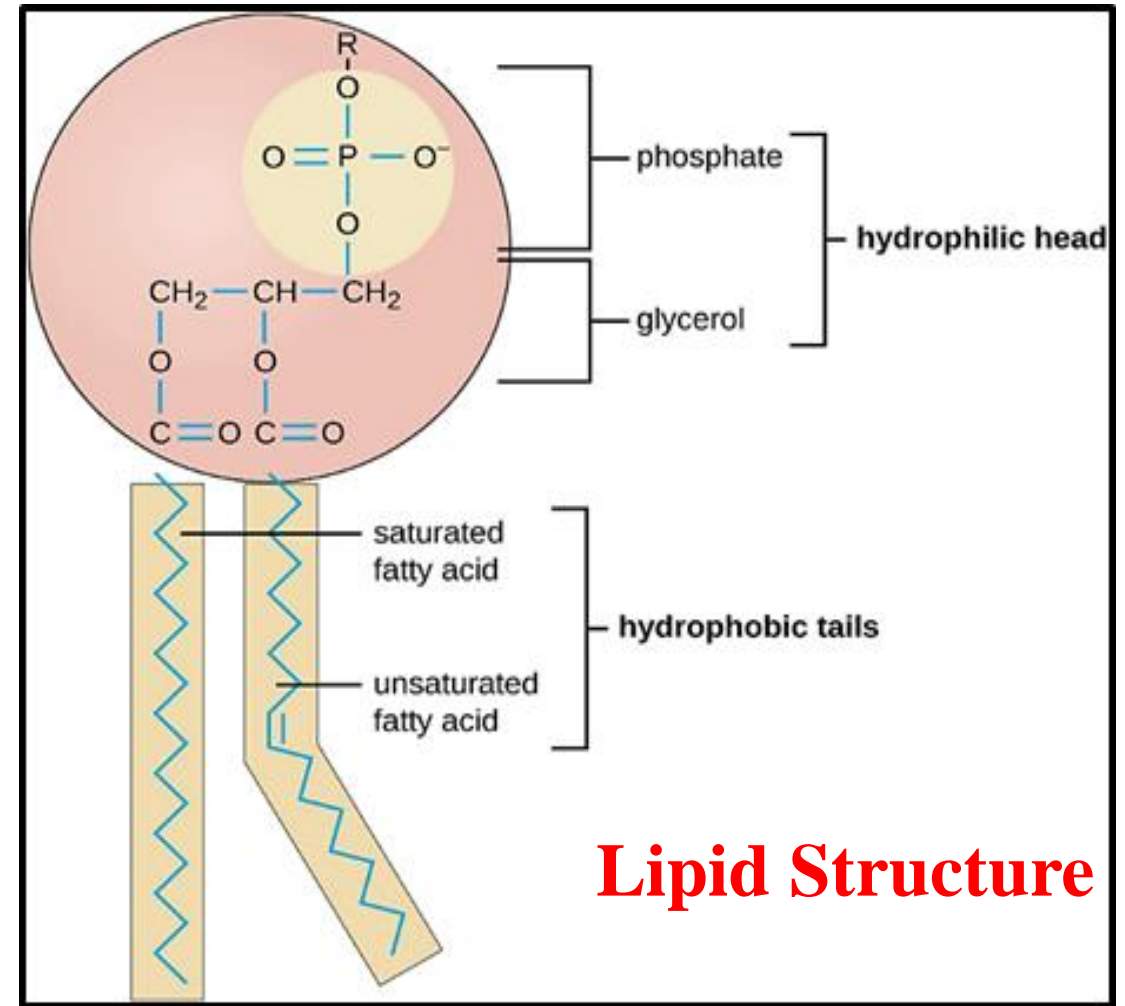
Quaternary



# Lipids

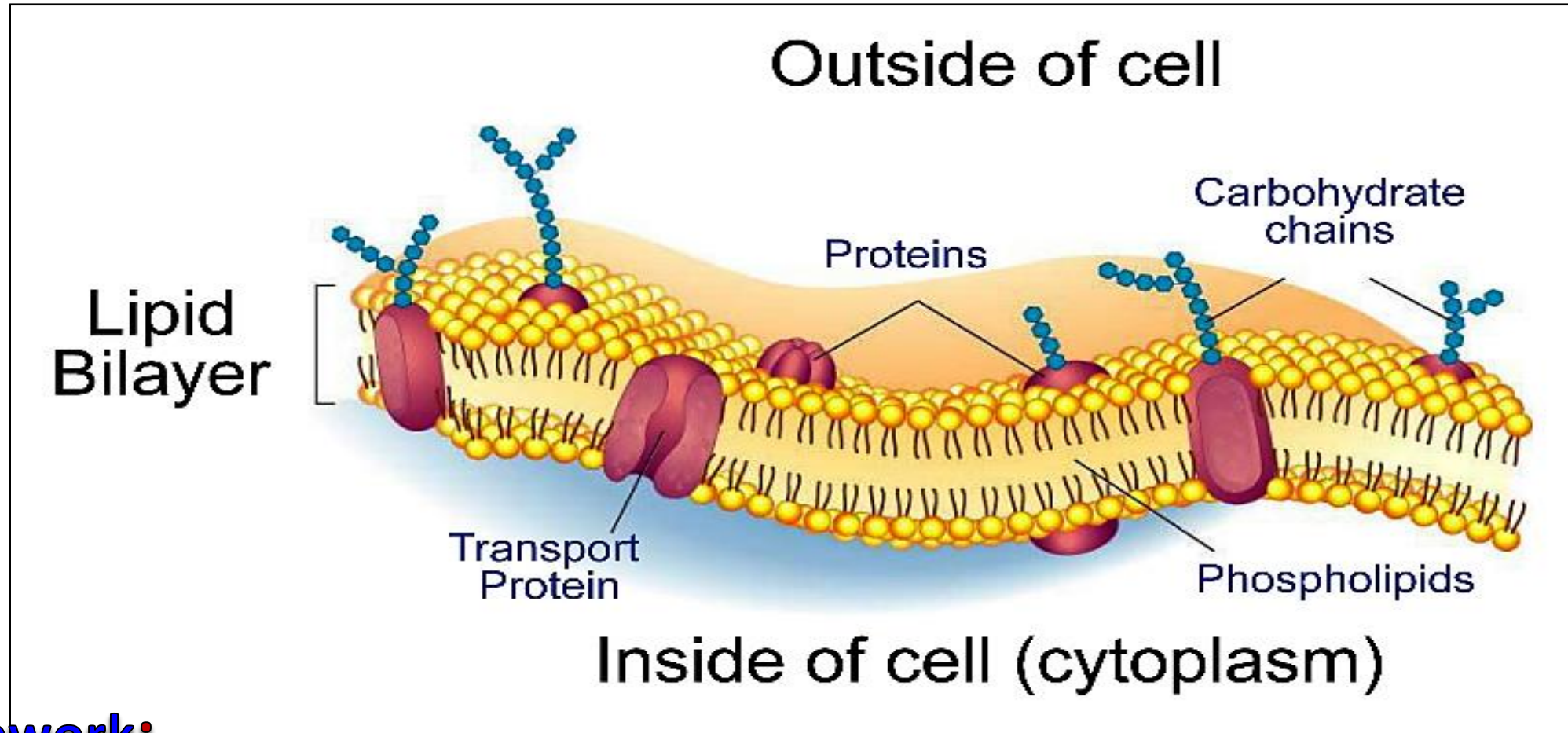
Lipids: are a macromolecules that is soluble in nonpolar solvents. do not dissolve in water, including fatty acids, waxes, sterols, fat-soluble vitamins

(such as vitamins A, D, E, and K), monoglycerides, diglycerides, triglycerides, and phospholipids. Fats contain much less oxygen than is contained in carbohydrates or proteins.



[https://www.youtube.com/watch?v=\\_ExVXeovB6s](https://www.youtube.com/watch?v=_ExVXeovB6s)

The functions of lipids include storing energy, signaling, and acting as structural components of cell membranes.



**Homework:**

**Write a short answer about cell membrane and explain the components of the membrane**

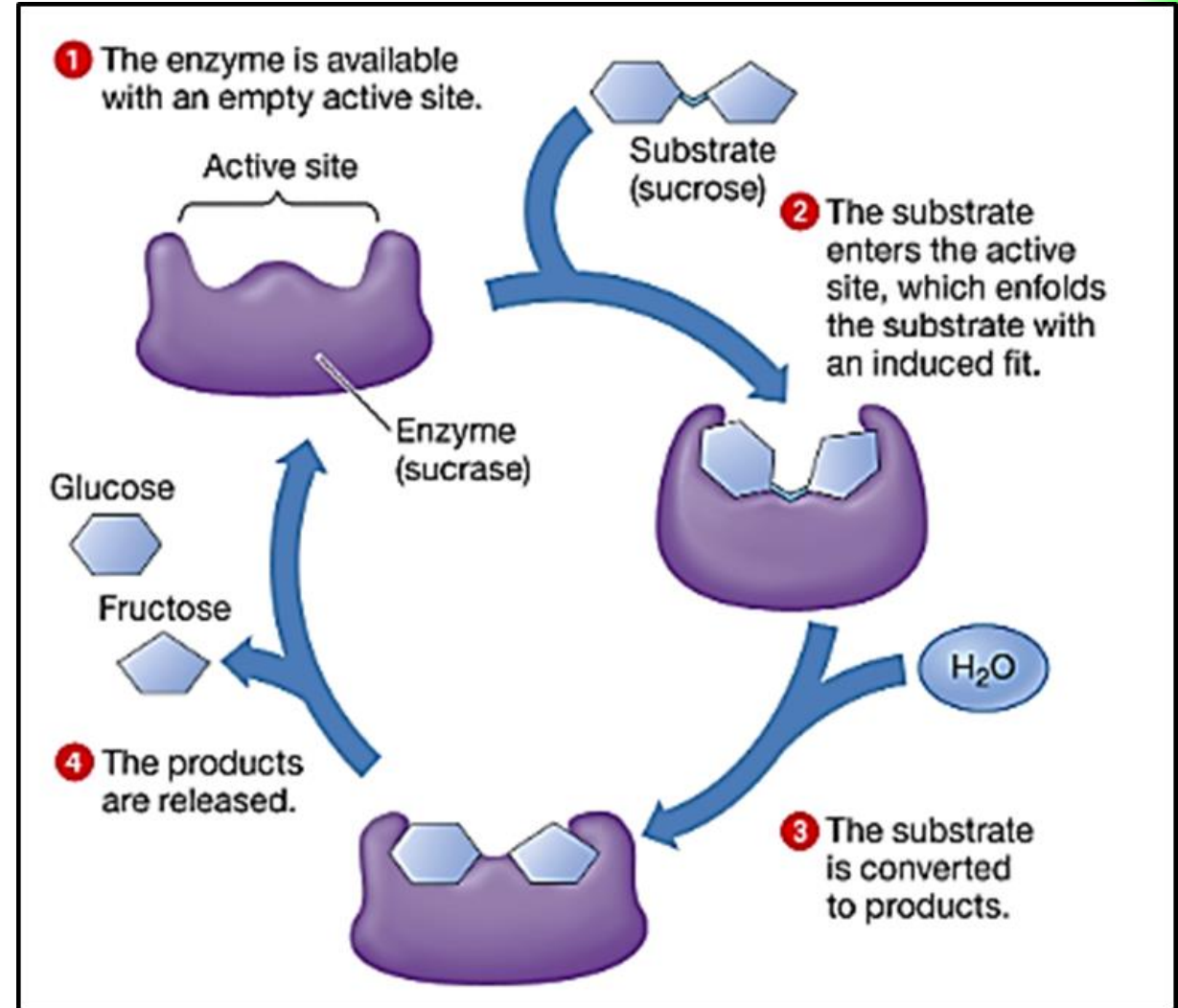




# Enzymes

**Enzymes:** are proteins that act as biological catalysts (biocatalysts). Catalysts accelerate chemical reactions.

The molecules upon which enzymes are called substrates, and the enzyme converts the substrates into different molecules known as products. Almost all metabolic processes in the cell need enzyme catalysis in order to occur at rates fast enough to sustain life.



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



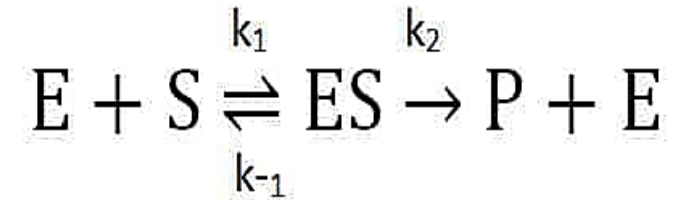
Metabolic pathways depend upon enzymes to catalyze individual steps. The study of enzymes is called enzymology.

Enzymes structure are made up of  $\alpha$  amino acids which are linked together via amide (peptide) bonds in a linear chain. The substrates bind to a region on the enzyme called the active site.

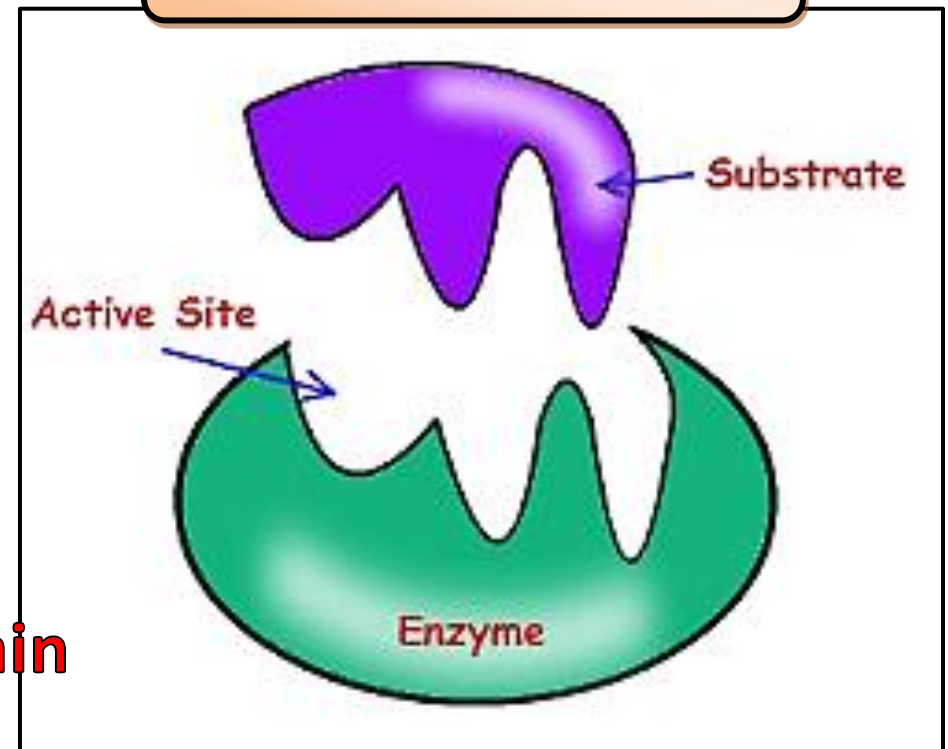
### Homework:

**Write a short answer about enzymes and explain the mechanism of enzyme?**

### Enzyme Equation



### Enzyme Structure

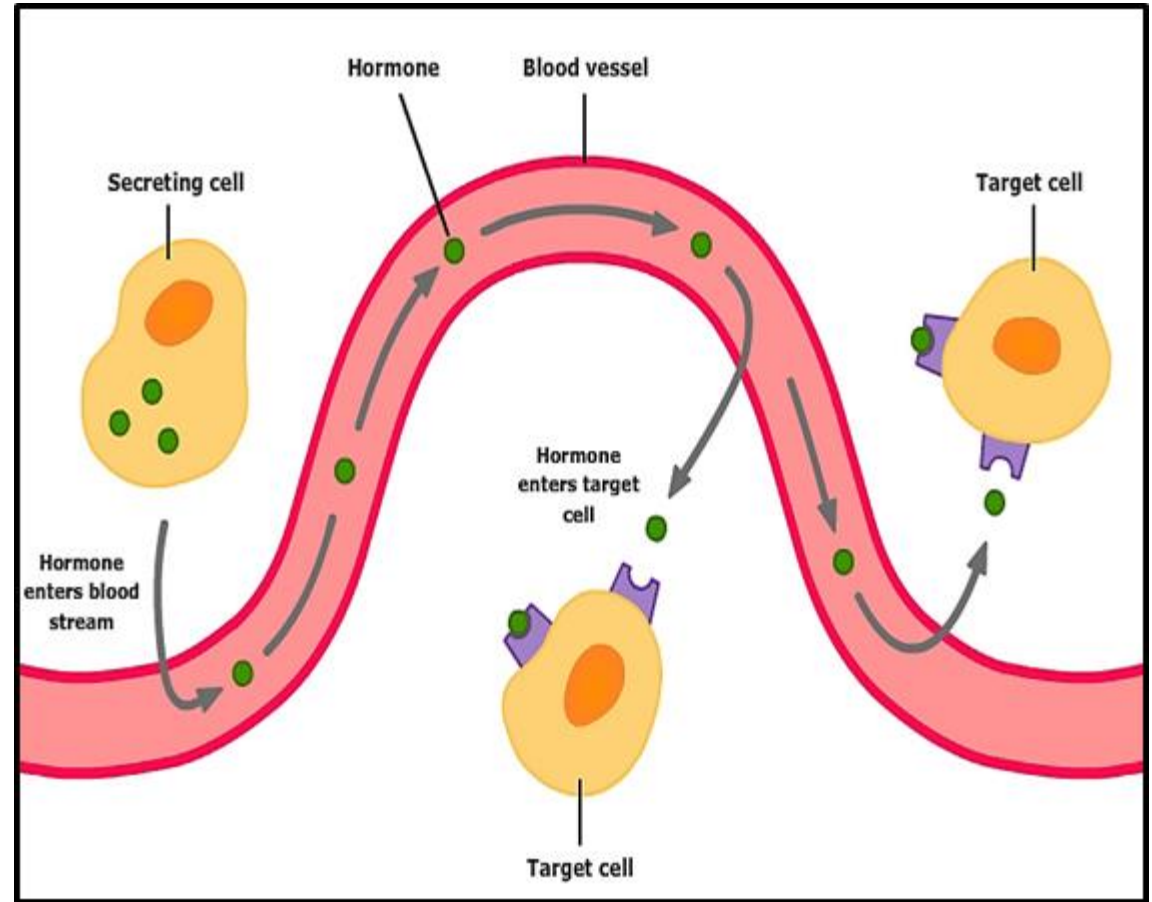


# Enzymes

# Hormones

**Hormones:** are any member of a class of signaling molecules, produced by glands in multicellular organisms, that are transported by the circulatory system to target distant organs to regulate physiology and behavior.

Hormones have diverse chemical structures, mainly of three classes: 1- Eicosanoids, 2- Steroids and 3- Amino acid/protein derivatives (amines, peptides, and proteins).



**Cell signaling for releasing hormones**

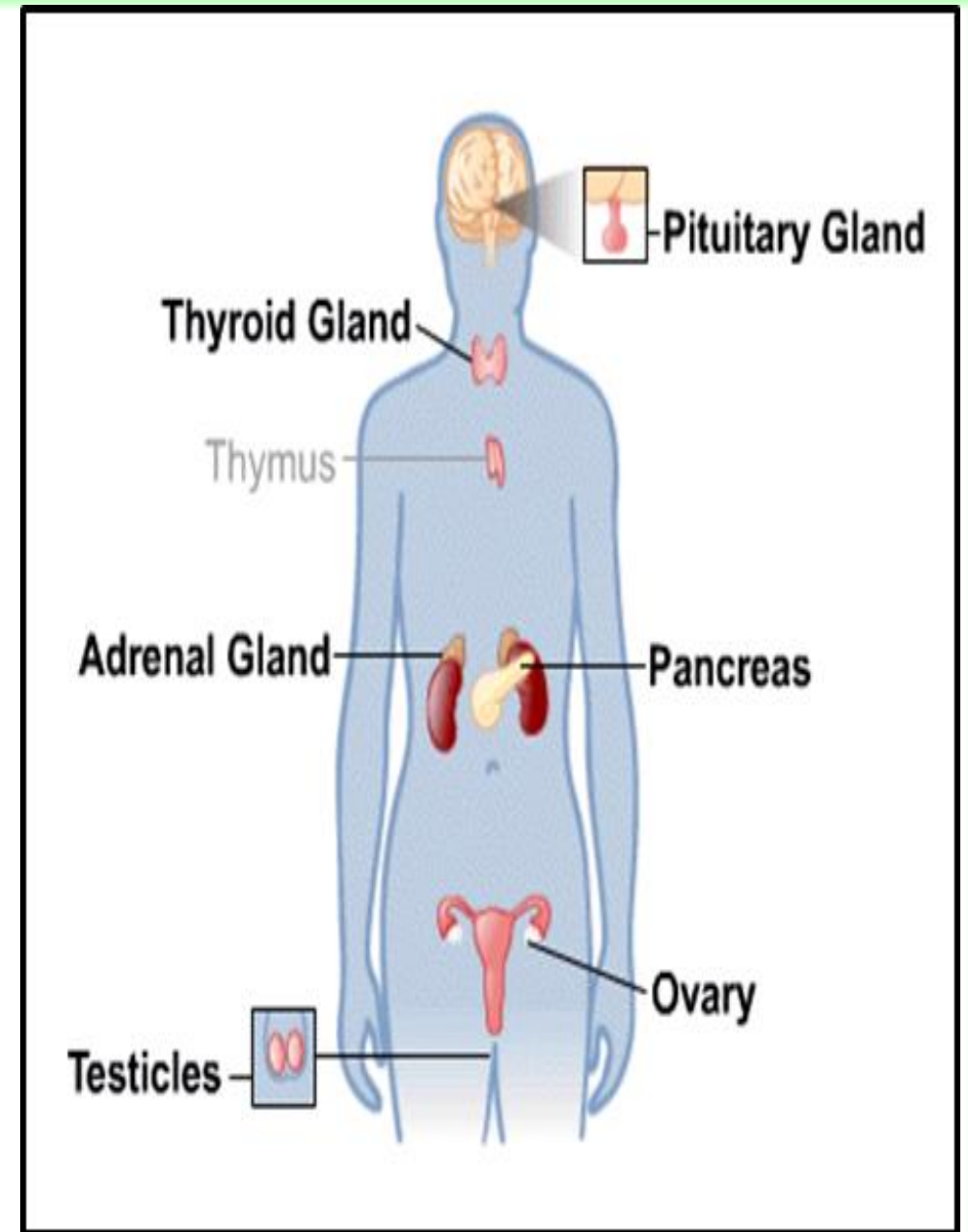
<https://www.youtube.com/watch?v=vLdNX5Te1Xo>

**Hormones** serve to communicate between organs and tissues for physiological regulation and behavioral activities such as:

digestion, metabolism, respiration, tissue function, sensory perception, sleep, excretion, lactation, stress induction, growth and development, movement, reproduction, and mood manipulation.

**Homework:**

**Write a short answer about hormones and explain the endocrine system?**



**Endocrine system for releasing hormones**

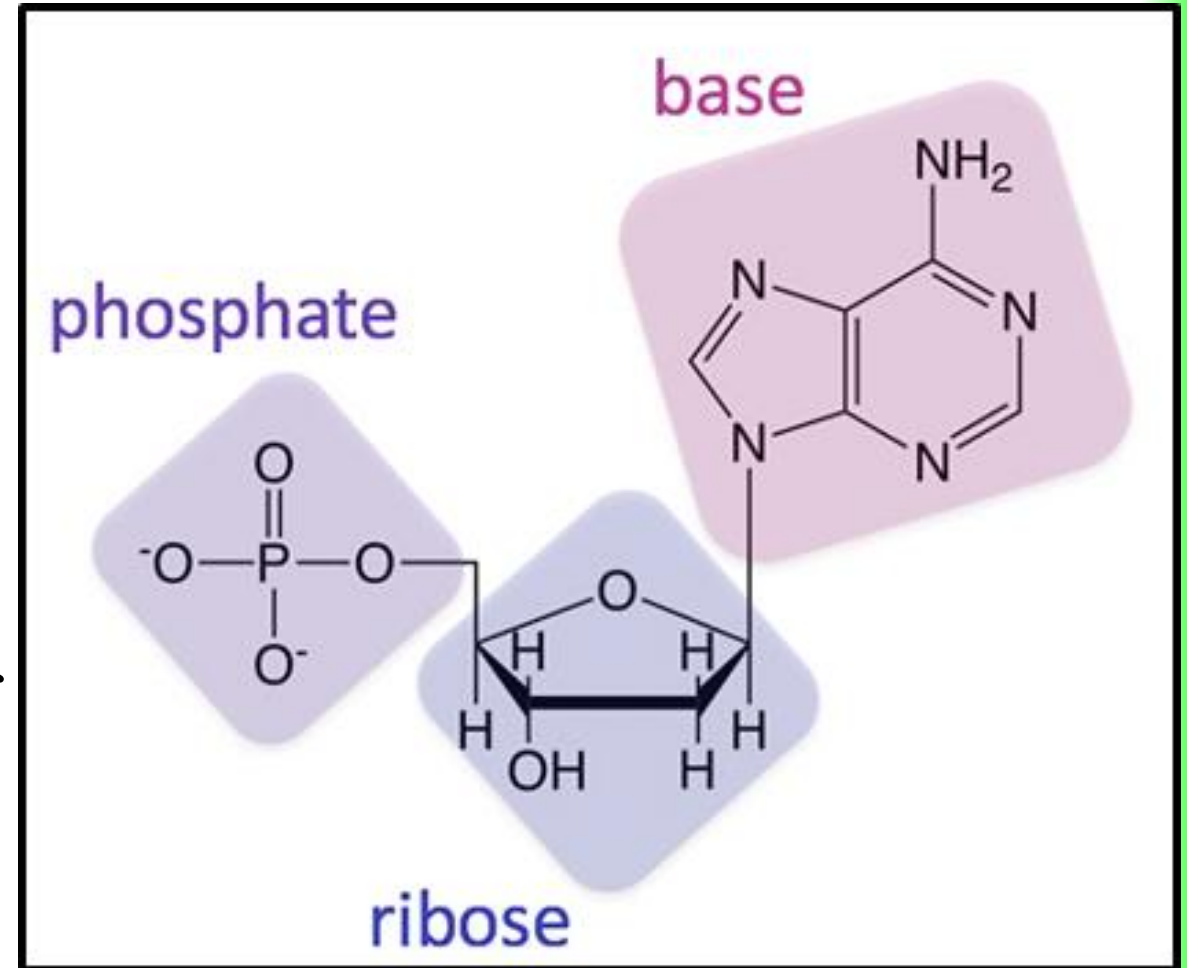


[www.AlilaMedicalMedia.com](http://www.AlilaMedicalMedia.com)

# Nucleic acids

**Nucleic acids:** are the biopolymers, or large biomolecules, essential to all known forms of life. The term nucleic acid is the overall name for DNA and RNA.

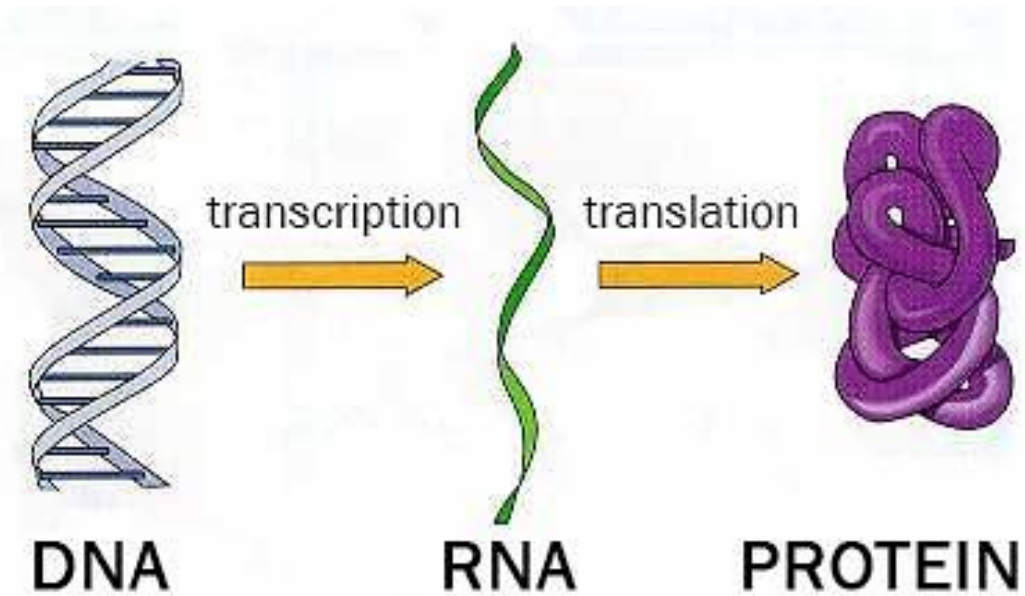
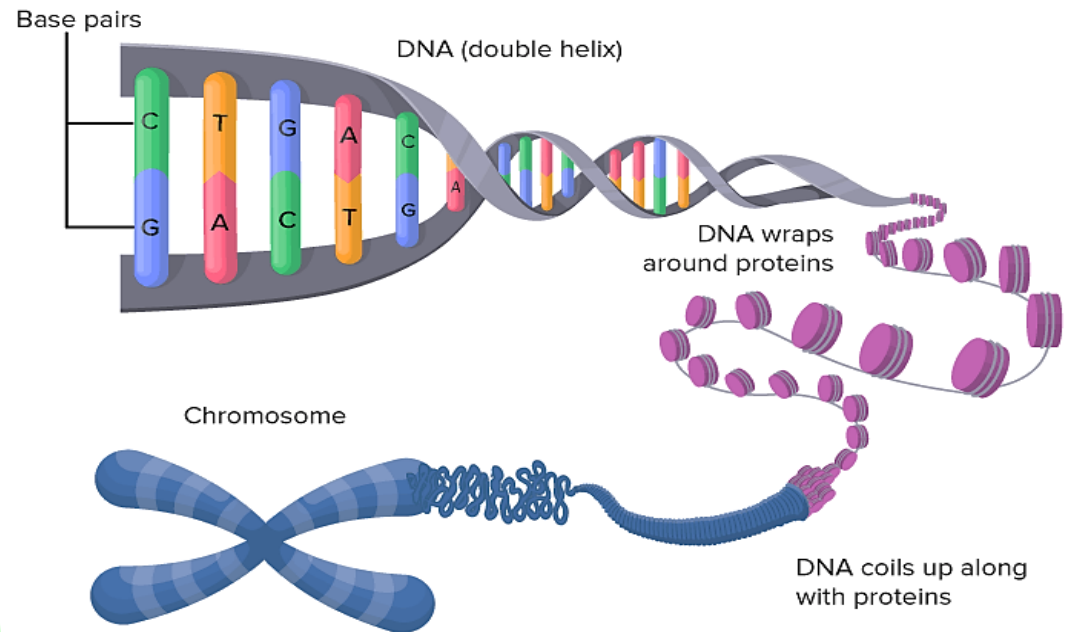
They are composed of nucleotides, which are the monomers made of three components: a 5-carbon sugar, a phosphate group and a nitrogenous base.



<https://www.youtube.com/watch?v=MA-ouz1LtpM>

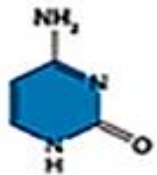
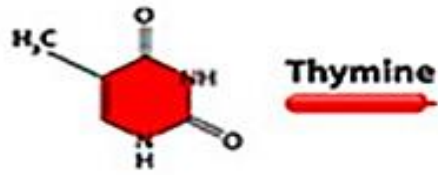
If the sugar is a compound ribose, the polymer is RNA (ribonucleic acid); if the sugar is derived from ribose as deoxyribose, the polymer is DNA (deoxyribonucleic acid).

Nucleic acids are the most important of all biomolecules. These are found in abundance in all living things, where they function to create and encode and then store information of every living cell of every life-form organism on Earth.

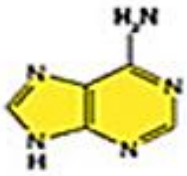




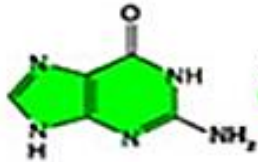
## Nucleic acids Structure (DNA and RNA)



**Cytosine**



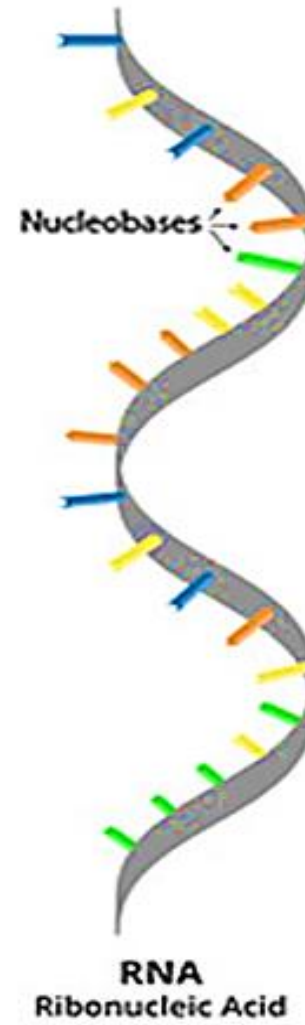
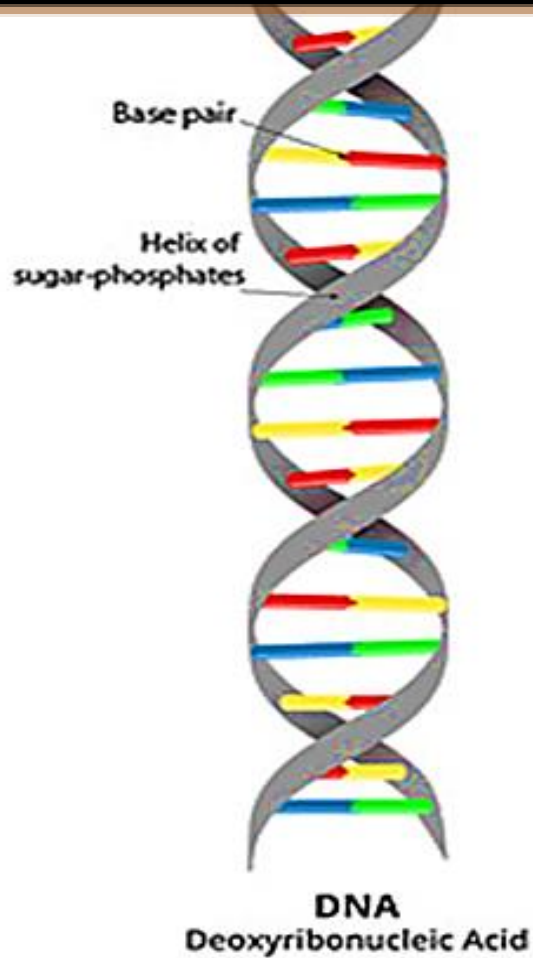
**Adenine**



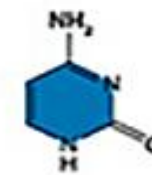
**Guanine**



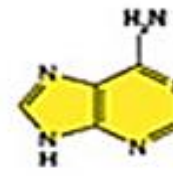
Nucleobases  
of DNA



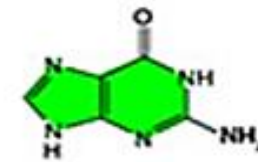
**Uracil**



**Cytosine**



**Adenine**



**Guanine**



Nucleobases  
of RNA

### Homework:

Write a short answer about Nucleic acids and explain the nucleotide structure

# **Nucleic Acids**

**Clinical value or reference values:** In medicine, a set of values that a doctor uses to interpret a patient's test results. The reference values for a given test are based on the results that are seen in 95% of the healthy population.

The reference values for a test may be different for different groups of people (Men and Women). Also called normal range, reference interval, and reference range

Analyte	Reference Range
Total cholesterol	140–200 mg/dL (3.6–5.2 mmol/L)
HDL-C	40–75 mg/dL (1.0–2.0 mmol/L)
LDL-C	50–130 mg/dL (1.3–3.4 mmol/L)
Triglycerides	60–150 mg/dL (0.7–1.7 mmol/L)





For your listening..



Medical Chemistry

Biochemistry

