

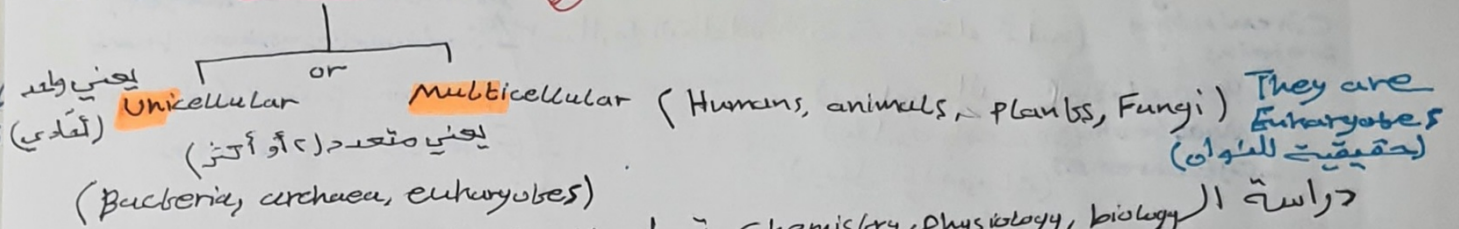
Biochemistry And medicine

By: Dr. Samir Saad. Mahjoub

DEFINITION OF Biochemistry: It is the application of chemistry to the study of **biological processes**.

which are
 - Structure (what they look like)
 - Composition (what are they composed of)
 - Chemical reactions in living systems.

at the ① Cellular and ② molecular level.



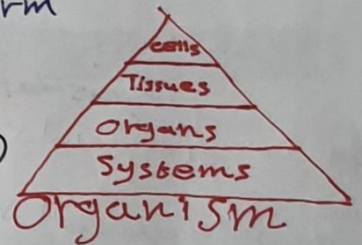
دراسة الكيمياء، الفسيولوجيا، البيولوجيا تساعدنا على فهم سلوك المركبات والطرق التي تتفاعل وتتكون بها. عن طريق شيتين؛

Micro عكس كبير! **Macromolecules; Polymers**

① Studying the structure and behavior of **complex molecules**.
 ① دراسة شكل وسلوك المركبات المعقدة.

② The ways these molecules interact to form

و الطرق التي تتفاعل بها هذه المركبات لتكون



* The reactions that take place in mitochondria are different from those that take place in cell membrane. In other words, each part of the cell has reactions different from other parts.

* التفاعلات التي تحدث في الميتوكوندريا تكون مختلفة عن التفاعلات التي تحدث في غشاء الخلية. بمعنى آخر، التفاعلات تختلف في كل جزء من الخلية.

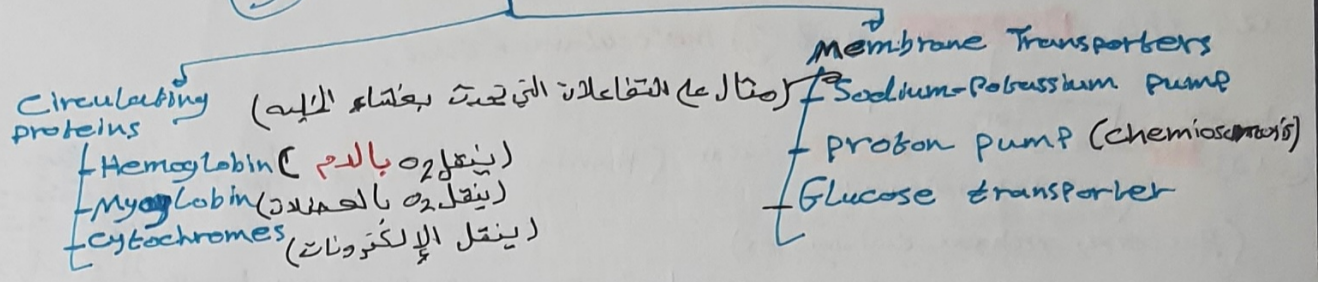
+ Chemical reactions taking place in nucleus (such as transcription) are different from those of in Endoplasmic Reticulum [ER] (translation replication)

• Molecular biology is also (incorporated, interrelated) because it is involving genes, which a specific part of the gene can produce a specific type of protein.

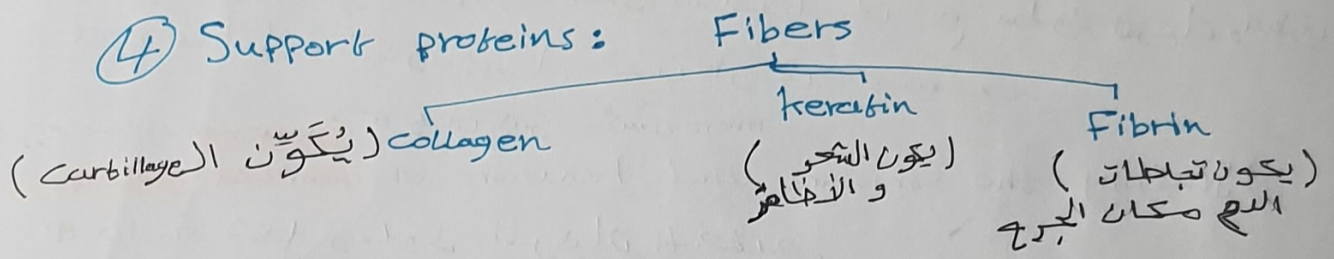
نفسه العن: متعلق

- * Types of proteins:
- ① Signaling proteins: Hormones
 - ② Defense proteins:
 - Immunoglobulins (Antibody) ^{Example}
 - Toxins (Snake venom) ^{Example}
 - cell-surface antigens (MHC proteins)

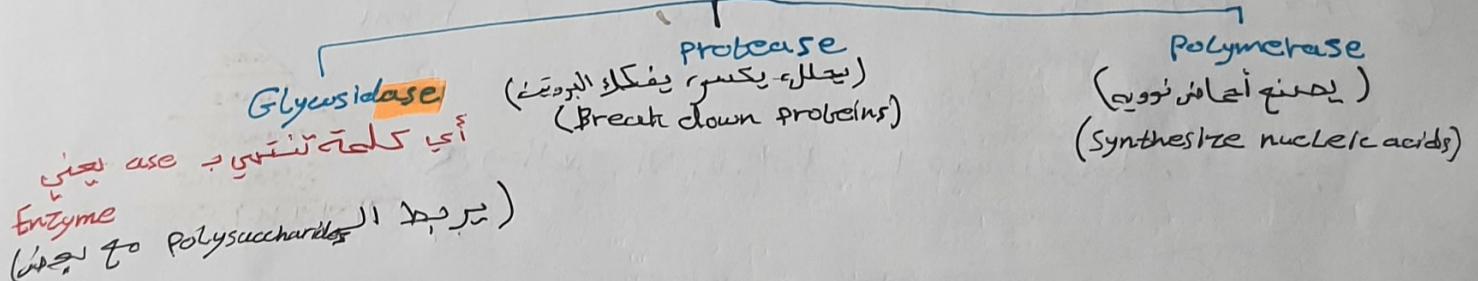
③ Transport proteins:



④ Support proteins:



⑤ Enzyme catalysis: Enzymes (أ.ب.ك. كمنع عبارة عن Proteins)



- Complex molecules (macromolecules)
- ① carbohydrates: are polysaccharides of monosaccharides such as
 - ① Glyceraldehyde
 - ② Ribose
 - ③ deoxyribose
 - ④ Glucose

أكثر ما حبة تكون
 Glycogen (في الحيوانات)
 Starch (في النباتات)
 Cellulose (جدار الخلية النباتية)

② proteins are polymers (polypeptides) made of monomers (peptides) called amino acids.

- اذ العلاقة ما بين البيولوجيا والأحياء الجزيئية (molecular biology) هو تحديد عدد الجينات والنتائج من كل جين.
- كل جين مسؤول عن تصنيع نوع بروتين واحد.

• The biochemical reactions taking place in different compartments, parts, (أجزاء) of the cell are under control of enzymes. Enzymes catalyze the reactions.

• proteins and hormones regulate the reactions

تكون التفاعلات الحيوية الكيميائية في الخلايا تحت سيطرة وتحكم الإنزيمات التي تقوم بحفزها (Catalyze) لتتفاعل.

- proteins can be:
 - ① Structural proteins (such as keratin, fibrin, collagen)
 - ② Globular proteins (such as toxins, immunoglobulins)
 - ③ Dynamic proteins
 - ④ Carrier proteins
 - ⑤ Hormones
 - ⑥ Enzymes

• The biological reactions can take place in a test tube or in a living organism (living system).

تتحدث التفاعلات الحيوية في أنبوب فكري أو جسم كائن حي.

• The difference between them is:

① In test tube, there is no regulation on the biological reactions, but in living organisms there is regulation (There must be regulation)

لا يكون هناك تنظيم في التفاعلات الحيوية في الأنبوب الفكري بينما يوجد أو يجب أن يوجد هناك تنظيم في الأجسام الحية.

• The cell is working on a method called [Economic State].

تعلم الخلية بطريقة تسمى [الحالة الاقتصادية] meaning the cell produces a product according to its requirements and it should be under regulation.

عنى أن الخلية تنتج حسب احتياجاتها و يجب أن يكون إنتاجها تحت التنظيم.

③ Fats (Lipids) : are macromolecules that contain hydrocarbons as their tail parts (it is nonpolar) and a hydrophilic polar head.

Lipid + phosphate

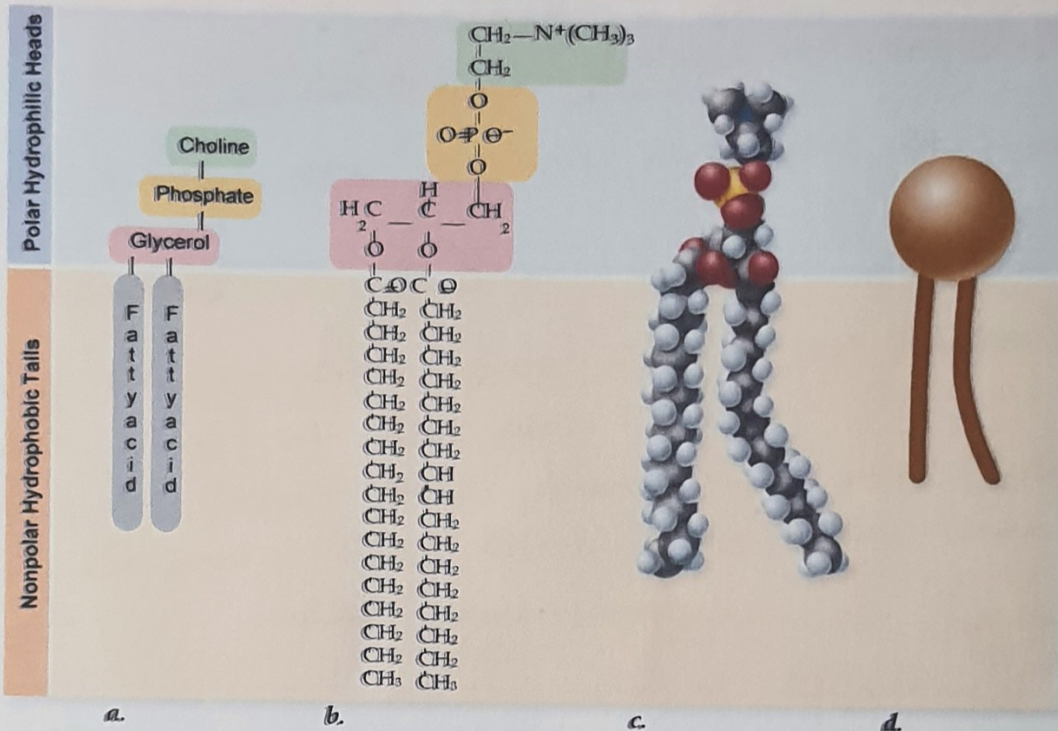


Figure 3.29 Phospholipids. The phospholipid phosphatidylcholine is shown as (a) a schematic, (b) a formula, (c) a space-filling model, and (d) an icon used in depictions of biological membranes.

تحتوي على (تحتوي على) في كروموسوم عكس الجاميتات
 عند الذكور (Spermatozoa) : Spermatozoa
 أو sperm - نصف الإناث
 عند الإناث : egg, oocyte, ovum
 نصف الإناث

In the beginning of Human Genome Project (HGP),
 باختصار فُكروا (العلماء) عند جمع الإنسان مليون جين
 ليس لقوا فيه خمسة الألف وهذا يعني
 أنه فيه جزء أكبر من الـ DNA عن مش على شكل بيتا
 *hydrocarbon: H-C bond.

③ Fats (Lipids): are macromolecules that contain hydrocarbon as their tail part (it is nonpolar) and a hydrophilic phosphate head.

- Sideroblast: - Phospholipid: Lipid + phosphate
- Glycoprotein: protein + carbohydrate
- Lipoprotein: Lipid + protein

④ Vitamins: are organic molecules that are essential in diet.

⑤ Minerals: C_2, C_2O

[Not all reactions take place (or happen) on the same side of the cell. Reactions that take place in cytosol (cytoplasm- organelles) are different from those that take place in the nucleus. This is called compartmentation or compartmentalization.

التجزئة أو التكون

- There are 3.5×10^4 nucleobases (nucleobases make up nucleic acids)
- There are approximately 50,000 genes in our body.

Genome: is the entire sequence of genes in a single cell. (Somatic cell; Diploid cell (نفس الشري))

تحتوي على 67 كروموسوم عكس الجسيمات

Gametes; sex cells: عند الذكور (Spermatozoa) أو sperm - نفس الإناث

(تحتوي على 33 كروموسوم)

عند الإناث { egg, oocyte, ovum - نفس الإناث

• In the beginning of Human Genome Project (HGP), بالاختصار فكروا (الطيار) عند جمع الإنسان مليون جين

ليس لقوا فيه خمسة آلاف وهذا يعني

أنه فيه جزء كبير من ال DNA على شكل جسيمات

* hydrocarbon: H-C bond.

* Note: We have ^{to know} the exact location of genes on a particular chromosome? because to know if there's any effect or interactions (why?) between different genes the same chromosome,

ملاحظة: يجب علينا معرفة الموقع المحدد للجينات؟ (لماذا) لمعرفة التفاعلات والتأثيرات ما بين الجينات على نفس الكروموسوم.

• cell biology: Studying the cells, cell organelles and the function of each one of them. (Definition)

• بيولوجيا الخلية: هي دراسة الخلية، وعيانات الخلية والوظيفة لكل منهما. (تعريف)

• Molecular genetics: is the science of genetics.

الوراثة الجزيئية: هي علم الجينات.

Biochemistry describes (توصف): ① origin of molecules

• Deficiency: when the cell is unable to form a sufficient amount of a particular complex molecule.

الاعتلال: يحدث عندما لا تستطيع على إنتاج كميات مناسبة من مركب معيّن.

② Function

أصل المركبات الكيميائية

③ Formation

الوظيفة

④ Deficiency: → causes symptoms.

التكوين

⑤ Deficiency: → causes symptoms. (الأعراض)

⑤ Symptoms

الأعراض

• Molecular Genetics (علم الوراثة الجزيئية)

عكس الجينات الكلاسيكية (Classical genetics) فهي تختص بدراسة التركيب الكيميائي للجينات و الطفرات التي تحدث فيها نتيجة عوامل داخلية أو خارجية.

• We (Humans) have 46 chromosomes: 23 pairs (زوج)

23 paternal
(من الأب)

23 maternal
(من الأم)

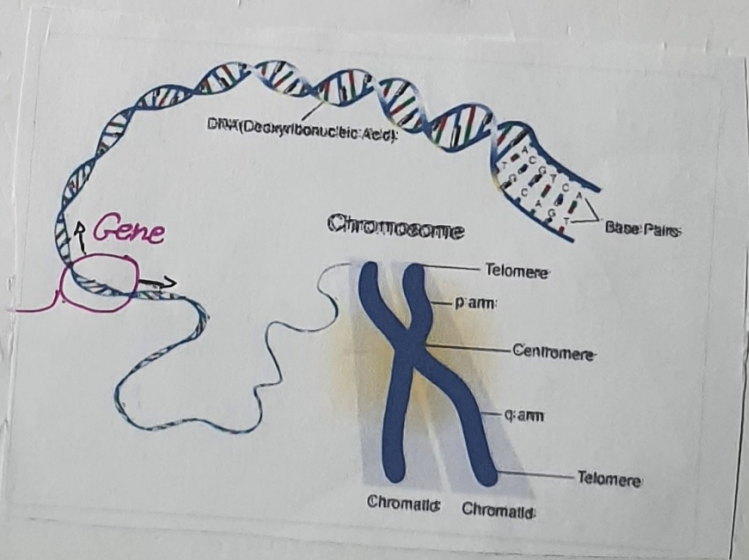
* Note: Each chromosome is carrying about 1000 genes; they are found in nucleus in a well-organized state.

* ملاحظة: يحتوي كل كروموسوم على تقريباً ألف جين! توجد هذه الكروموسومات في النواة بجاه منظم.

• Genes are affected by the genes before them; and genes also affect the genes after them,

- تتأثر الجينات بالجينات التي قبلها والتي بعدها .

الجين هو جزء
معين من
الكروموسوم



هذا الجين
يؤثر بالجينات
التي قبله والتي
بعده .

* Note: We have to search for the causes of diseases to know more about diseases.

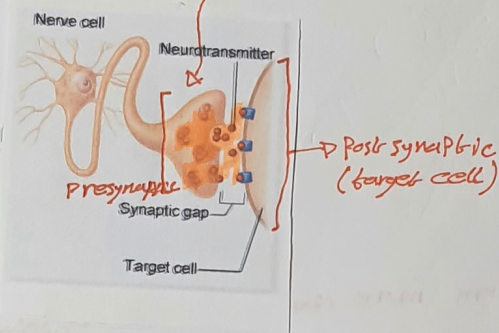
* ملحوظة: يجب علينا البحث عن أسباب الاعتلالات، لمعرفة أكثر عن الأمراض.

Types of complex molecules ((Biomolecules))

① Small molecules (simple):

→ A) **Neurotransmitters**: A chemical at the axon terminal of a neuron that travels across the cleft, binds a specific receptor on the far side, and depending on the nature of the receptor, depolarizes or hyperpolarizes a second neuron or a muscle or gland cell.

نواقل عصبية (عصبونات) → نواقل العصبونات



NEUROTRANSMITTERS

Neurotransmitters... are the chemicals that allow the transmission of signals from one neuron to the next across synapses (junction of 2+ neurons). They are found at the axon endings of motor neurons.

Dopamine
Produces feelings of pleasure when released by the brain reward system. Multiple functions but its is usual inhibitory

Glycine
Used mainly by neurons in the spinal cord. Almost always acts as an inhibitory neurotransmitter

Serotonin
Involved in many functions including mood, appetite, and sensory perception. In the spinal cord, Serotonin is inhibitory in pain pathways

Norepinephrine
A neurotransmitter AND a hormone. Part of fight or flight response. Also regulates normal brain process. Is usually excitatory but is inhibitory some times

Acetylcholine
Used by spinal cord neurons to control muscles. Also used in brain to regulate memory. It is usually excitatory.

GABA
(gamma-aminobutyric acid)
Main inhibitory neurotransmitter of the brain. It's the main papa and king of the other neurotransmitters

Glutamate
Most common excitatory neurotransmitter in the brain. Nearly all excitatory neurons are glutamatergic, and over half of all brain synapses release this agent

Adrenaline
Works w/ norepinephrine & dopamine, to be a catecholamine - a group of hormones released in response to stress. These three hormones react with various body tissues, preparing the body to react physically to the stress causing situation.

Endorphins
Interact with the opiate receptors in the brain to reduce the perception of pain. Leads to feelings of euphoria, modulation of appetite, release of hormones, and enhancement of the immune response.

REFERENCES

(is a type of protein)

protein

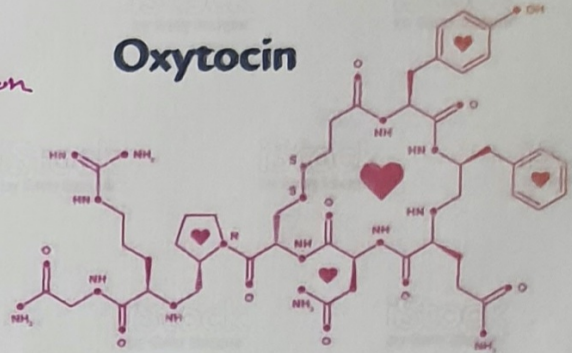
Cholesterol

β) Hormone: A molecule, usually a peptide or steroid, that is produced in one part of an organism and triggers a specific cellular reaction in target tissues and organs some distance away.

Example of a peptide hormone (protein)

Important in childbirth, reproduction and after childbirth.

Oxytocin



General Form of amino acids. (Empirical Structure)

R group: is a variable side chain.

هو الجزء الوحيد الذي يختلف بالانواع
الامينية.

بالانضمام، هو الجزء الذي يتفاعل ليكون
رابطة (bond)
بالبي، الذي لا يتفاعل.

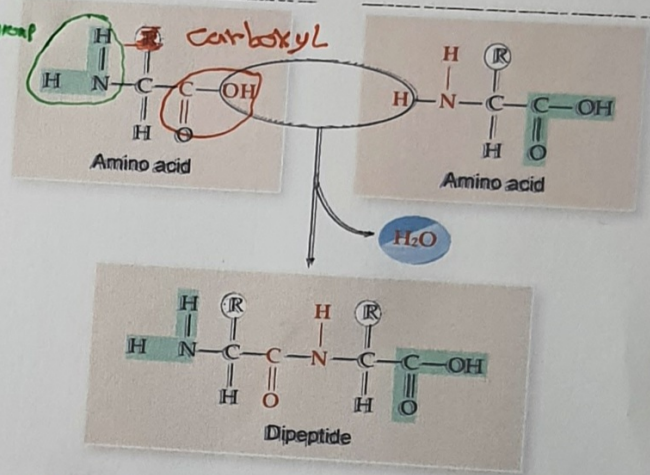


Figure 3.19 The peptide bond.

*Note: Not all monomers will form more complex molecules (polymers)
For example, phospholipid + phospholipid will produce a polymer, but
(monomer) (monomer)
Amino acid + Amino acid = protein (peptide)

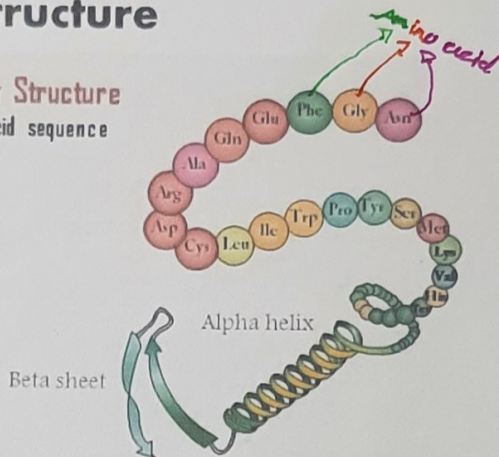
Polymers: are a group of monomers bonded together.

- Proteins =
- Dipeptides 2 amino acids,
 - Tripeptides 3 amino acids,
 - oligopeptides 10 amino acids,
 - Poly Peptides 10-44 amino acids

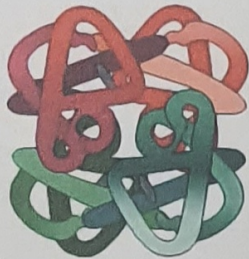
ليس معناها بالضرورة 10-44

Protein Structure

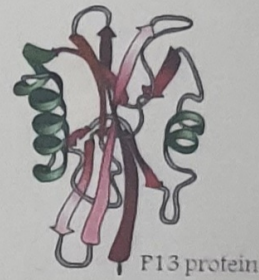
Primary Structure
amino acid sequence



Secondary structure regular sub-structure
hemoglobin



Quaternary Structure
complex of protein molecules

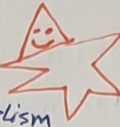


Tertiary Structure
three-dimensional structure

* Note:- All the reactions that occur in the body (All biochemical reactions) are metabolic. (Involve energy)

* ملحوظة: جميع التفاعلات الحيوية التي تحدث داخل الجسم الحي هي تفاعلات ميتابولية (تتطلب الطاقة)

- There are two types of metabolic reactions:
 - ① Catabolic (Catabolism) reactions It makes **energy** by breaking down molecules
 - ② ~~Metabolic~~ Anabolic (Anabolism) reactions

It requires  Energy to make large molecules.

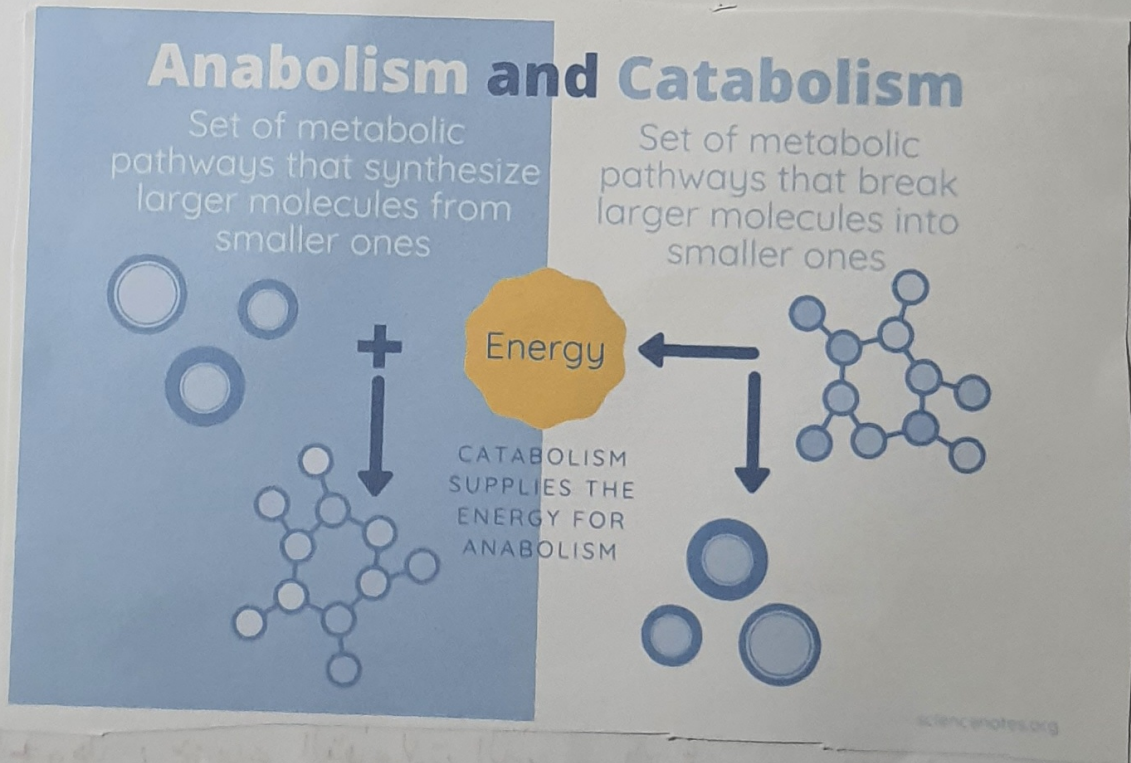
* Catabolism^{and anabolism} are Complementary reactions

- تفاعلات الهدم و البناء تعتبر متكاملة لبعضها البعض

* Note: Reactions could be-
1- Spontaneous (Not requiring an enzyme)
2- Slow reactions (require enzymes)

CAUTION

Catabolism مثل Hydrolysis ليس بالضروري ان يكون Hydrolysis ولكن ال Hydrolysis بالتهنئة! في الحقيقة هو احد انواع Catabolism و لكن ال Hydrolysis تسفل خروج ماء ك by-products مثال تفاعلات ال Carbohydrates تتمعت خروج H_2O من الروابط (bonds)



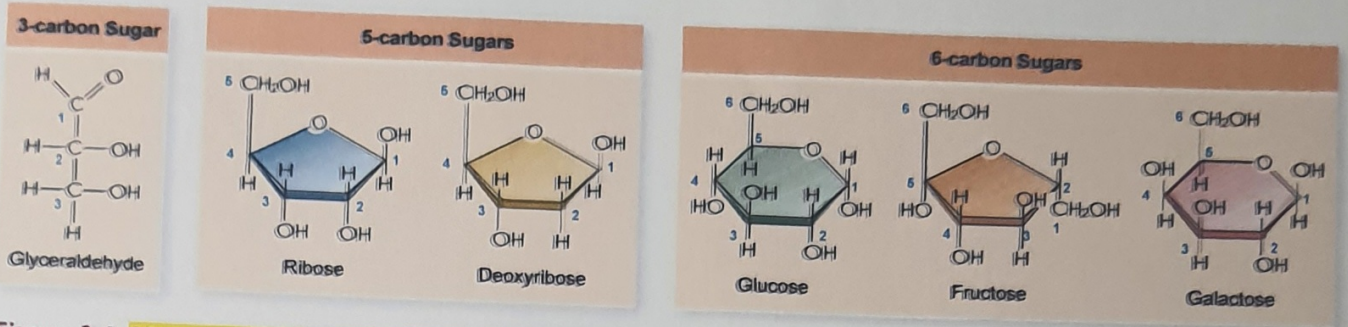


Figure 3.6 Monosaccharides-Carbohydrates. Monosaccharides, or simple sugars, can contain as few as three carbon atoms and are often used as building blocks to form larger molecules. The 5-carbon sugars ribose and deoxyribose are components of nucleic acids (see figure 3.15). The carbons are conventionally numbered (in blue) from the more oxidized end.

Its empirical formula is $C_n(H_2O)_n$

Carbohydrates are molecules that contain carbon, hydrogen, and oxygen. **CHO**

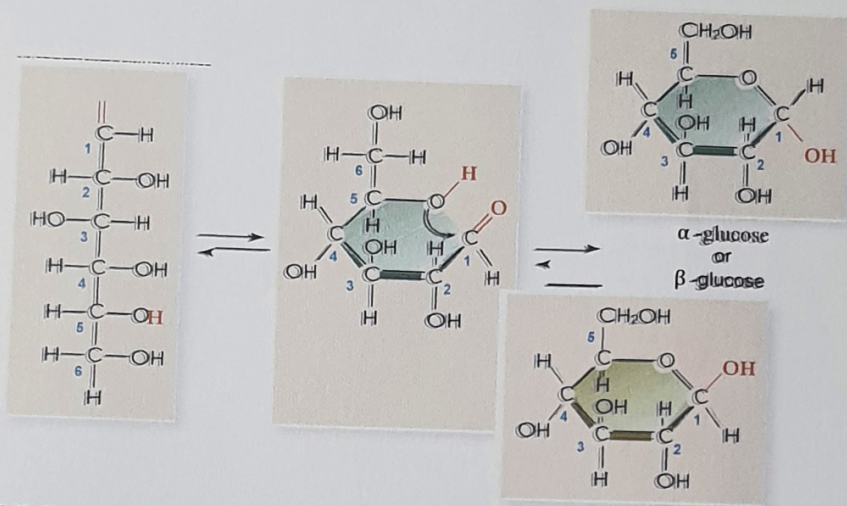


Figure 3.7 Structure of the glucose molecule. Glucose is a linear, 6-carbon molecule that forms a six-membered ring in solution. Ring closure occurs such that two forms can result: α -glucose and β -glucose. These structures differ only in the position of the $-OH$ bound to carbon 1. The structure of the ring can be represented in many ways; shown here are the most common, with the carbons conventionally numbered so that the forms can be compared easily. The heavy lines in the ring structures represent portions of the molecule that are projecting out of the page toward you.

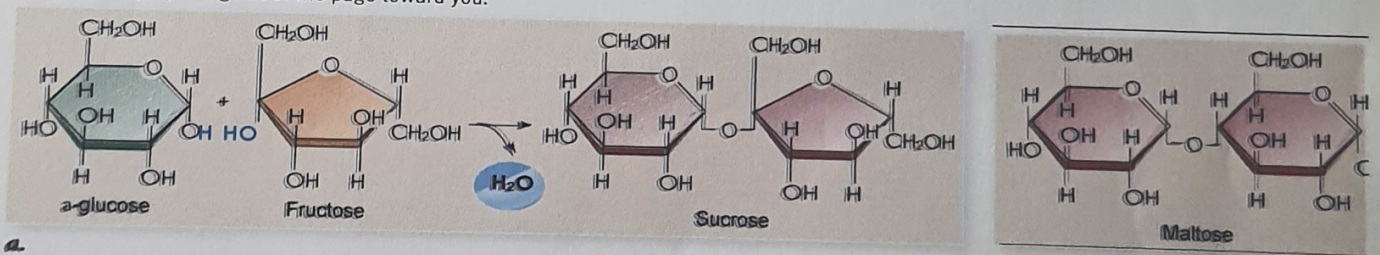


Figure 3.9 How disaccharides form. Some disaccharides are used to transport glucose from one part of an organism's body to another; one example is sucrose (a), which is found in sugarcane. Other disaccharides, such as maltose (b), are used in grain for storage.

* The primary functions of metabolism: ① Utilization of energy
: For the vital activities

② Synthetic Pathways for cell structure and Functioning.

Like muscle contractions + transmission of impulses along the neurons.

③ Removal of waste products.

- الوظائف الرئيسية لتفاعلات الهدم والبناء (الأيض):
- ① استخدام الطاقة والاستفادة منها في النشاطات الحيوية في الجسم
مثل تعدد وتفاعل العضلات + نقل السوائل العصبية عبر الغالبية العصبية (العصبون).
 - ② صيانة إمداداته لشكل الخلية ووظيفتها.
 - ③ التخلص من الفضلات. (فضلات الخلية)

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