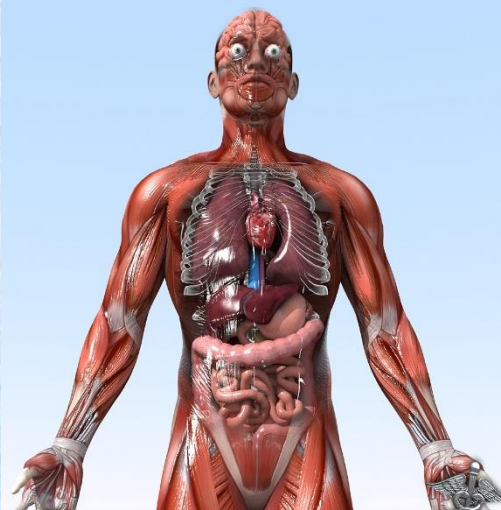
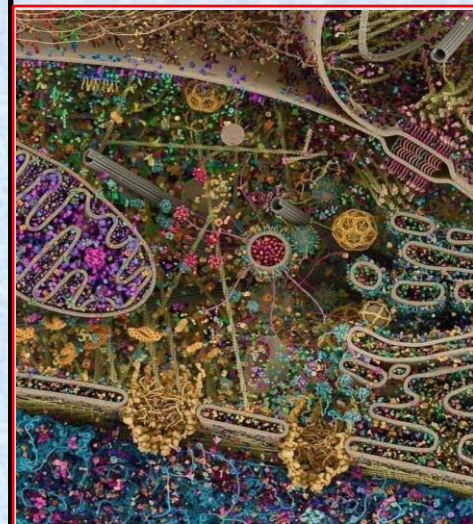


General Animal Biology

Zoo-109

علم الأحياء

109- حين



For Pre-Medical Students



Common First Year

السنة الأولى المشتركة - المسار الصحي

1444-H - 2023

Reference: Campbell, N. A. and Reece, J. B. (2014). *Biology (10th edition)*. Pearson Education. Inc. USA.

عمادة التعليم الإلكتروني والتعلم عن بعد
E-learning Deanship



King Saud University

جامعة الملك سعود

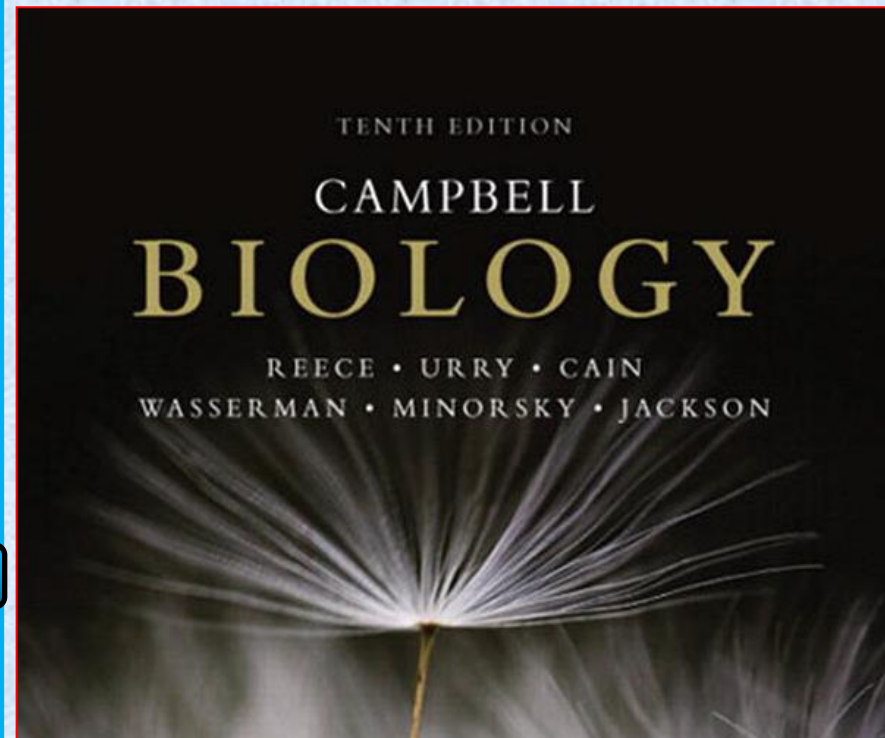
جامعة
الملك سعود
King Saud University

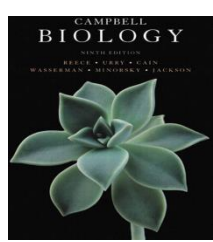


College of Science,
Zoology Department

TENTH EDITION
CAMPBELL
BIOLOGY

REECE • URRY • CAIN
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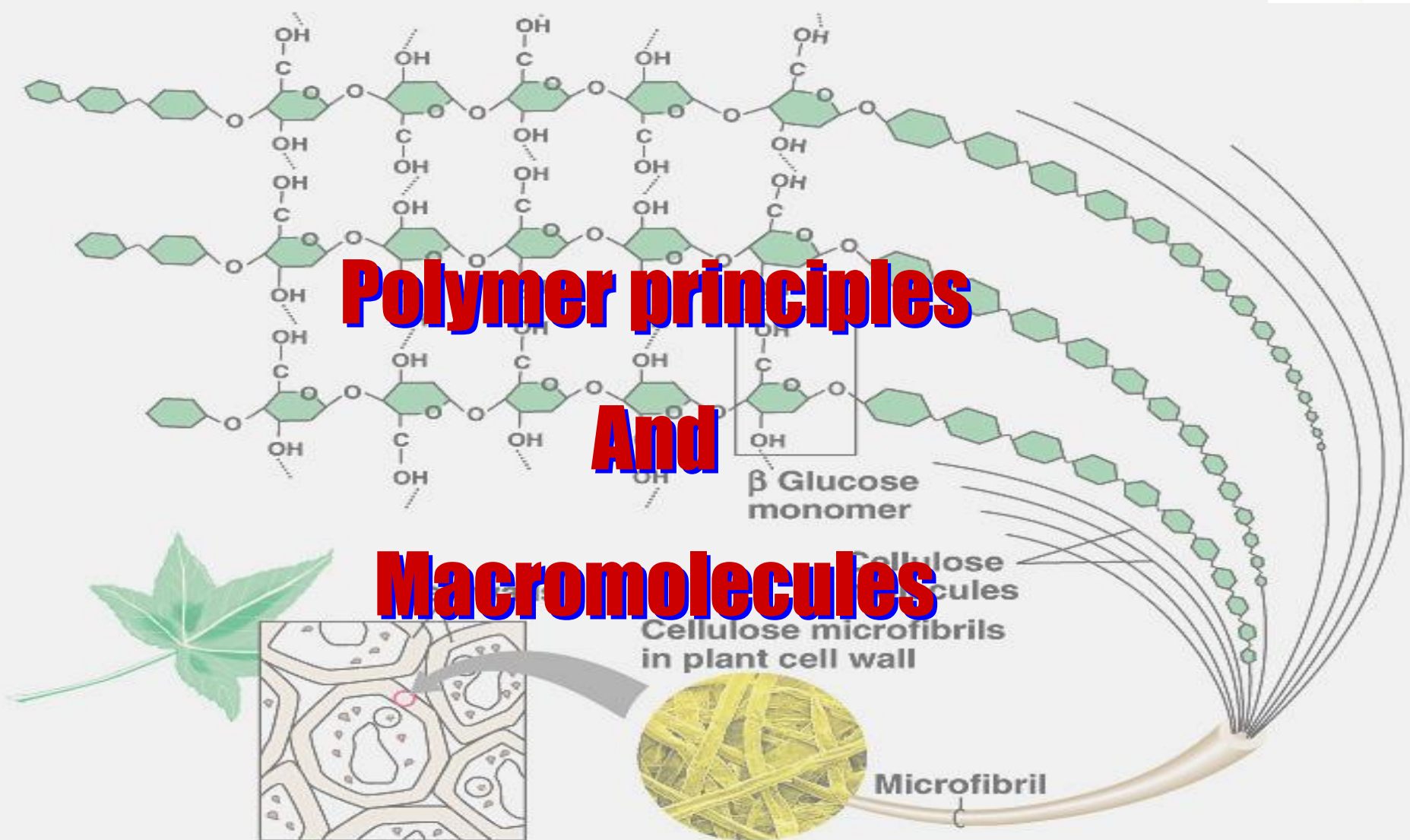
THE STRUCTURE AND FUNCTION OF MACROMOLECULES

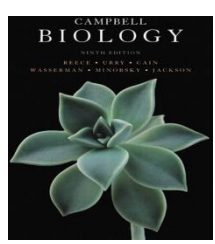


Polymer principles

And

Macromolecules

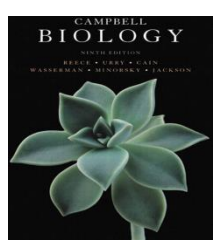




Polymers principles



1. Cells join **تربط** smaller organic molecules (**Monomers**) together to form larger molecules (**macromolecules**) (**Polymers**), which may be composed of thousands of molecules.
2. Macromolecules are organic molecules that weigh more than 100,000 Daltons (**ATOMIC MASS UNIT**).
3. The four major classes of macromolecules are:
 - a) - **Carbohydrates,**
 - b) - **Lipids,**
 - c) - **Proteins,**
 - d) - **Nucleic acids** (will be studied later: lectures 18, 19 & 20)



Objectives



- **Polymers principles:** The synthesis and breakdown of polymers.

A)- Carbohydrates

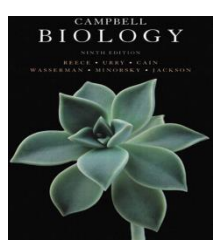
➤ Monosaccharides:

- Classifications of Monosaccharides: Types and examples.

➤ Disaccharides: Types and examples

➤ Polysaccharides:

- A)- Storage Polysaccharides: Types and examples
- B)- Structural Polysaccharides: Types and examples

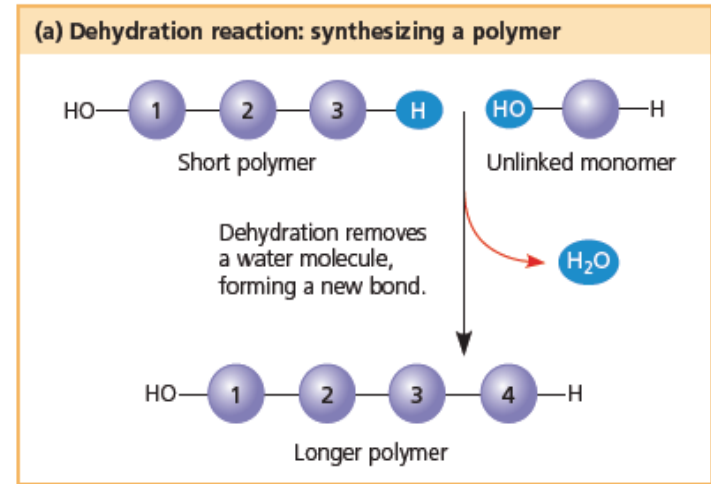


Polymers principles



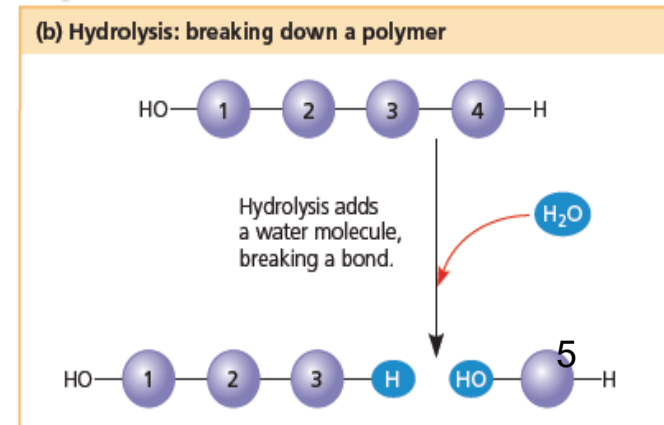
- Monomers are connected by **covalent bonds** through a **dehydration reaction** تفاعل نزع الماء

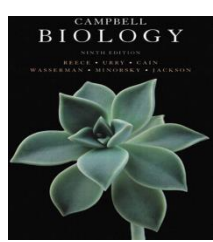
- One monomer provides a **hydroxyl group (OH)** and the other provides a **hydrogen (H) atom** to form water (H_2O).
- This process requires **energy** and is aided by **enzymes**.



- The covalent bonds connecting monomers in a polymer can be disassembled تفاعل إضافة الماء by **hydration (hydrolysis) reaction** تكسّر

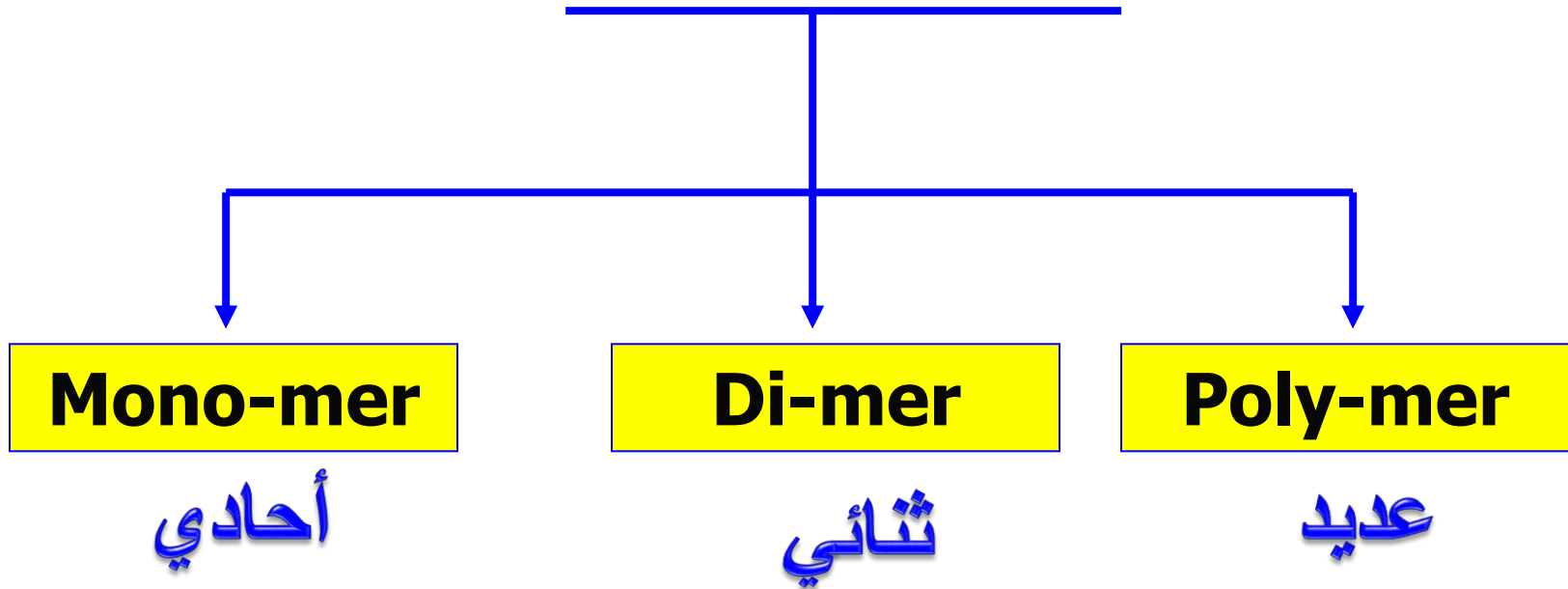
- In hydrolysis as the covalent bond is broken, a hydrogen atom and a hydroxyl group from a split water molecule attaches where the covalent bond used to be.
- Hydrolysis reactions dominate the **digestive process**, guided by **specific enzymes**.



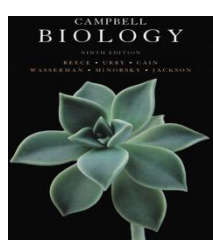


Polymers principles

(Carbohydrates, Lipids, Proteins and nucleic acids)



A Polymer: is a long molecule consists of a chain of **similar** building molecules (**monomers**) covalently bonded together.



A. Carbohydrates



Sugars, Carbo = carbon, hydrate = water; Used as an immediate energy source. The molecular formula is $C_nH_{2n}O_n$ means that, carbon, hydrogen and oxygen are found in the ratio = 1:2:1

1. Monosaccharides:

are the simplest form of carbohydrates (simple sugars).
contain a single sugar molecule.

2. Disaccharides:

contain two monosaccharides joined via dehydration reactions

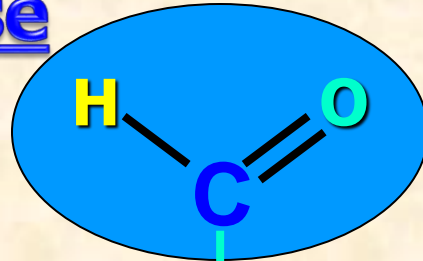
3. Polysaccharides:

are polymers of many monosaccharides.

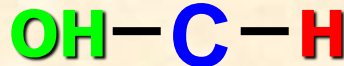
1- Monosaccharides السكر الأحادي

Aldehyde sugars

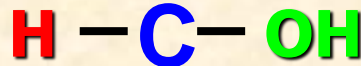
Aldose



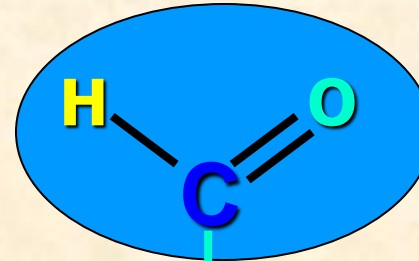
Glucose
 $C_6H_{12}O_6$



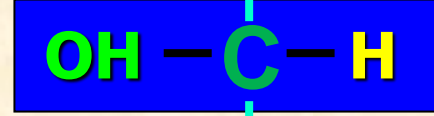
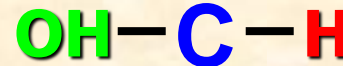
Asymmetric C



Aldose



Galactose
 $C_6H_{12}O_6$

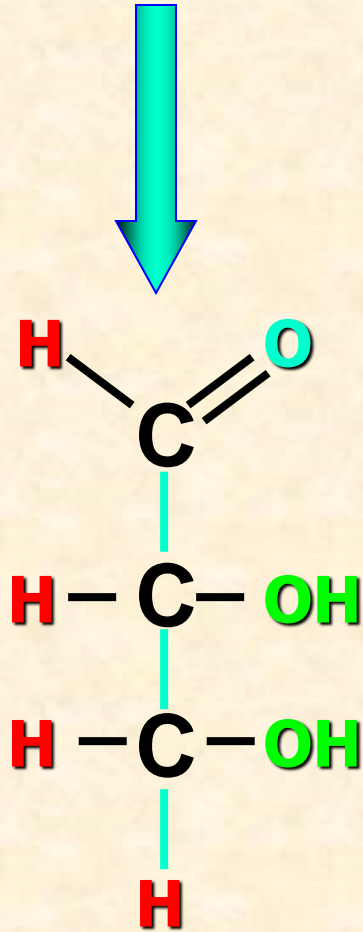


Asymmetric C



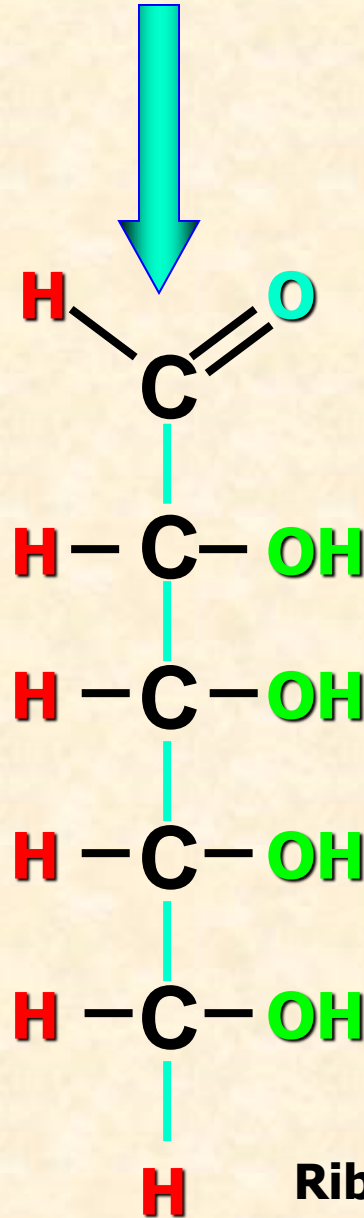
- An OH group is attached to each carbon except one, which is double bonded to an oxygen (carbonyl).

Triose Sugar



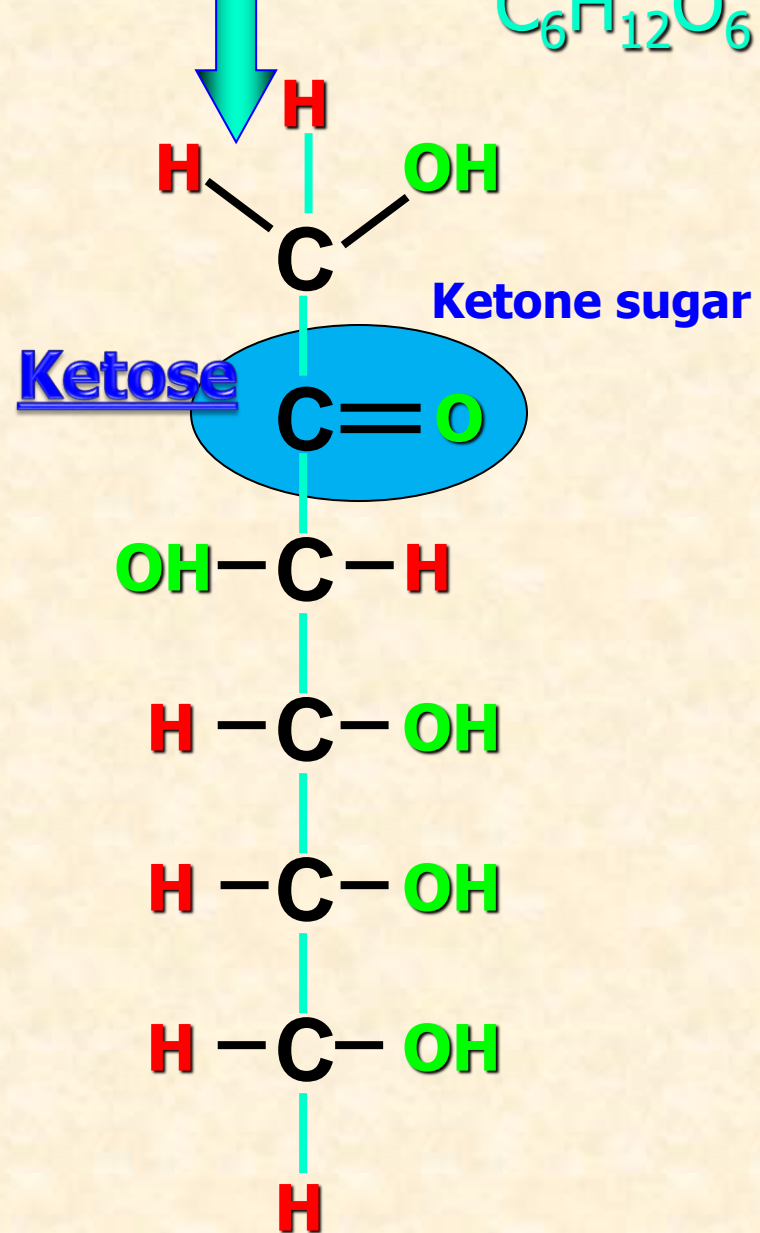
Glyceraldehyde

Pentose Sugar

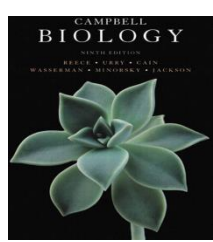


Ribose

Hexose Sugar



Fructose
 $C_6H_{12}O_6$



Classification of monosaccharides



A- Based on the location of the carbonyl group (C=O)

Aldoses: are the monosaccharides with the carbonyl group (C=O) at the end of Carbon chain (e.g. Glucose).

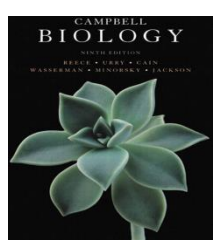
Ketoses: are the monosaccharides with the C=O carbonyl group within داخل the Carbon chain (e.g. Fructose).

B- Based on the number of C in the skeleton

Triose (3C): e.g. Glyceraldehyde.

Pentose (5C): e.g. Ribose.

Hexose (6C): e.g. Glucose, Fructose and Galactose.

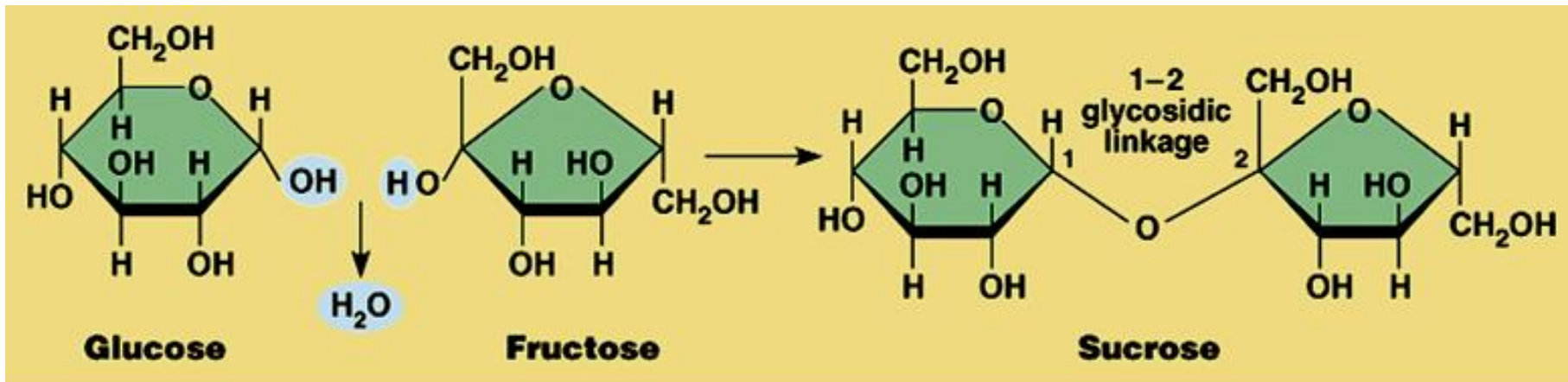


2- Disaccharides السكر الثنائي

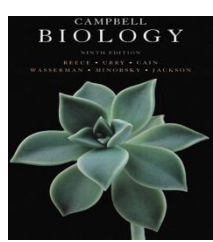


Consist of 2 monosaccharide molecules joined during a dehydration reaction. تفاعل نزع الماء.

Sucrose (table sugar): consists of **Glucose + Fructose**.



The covalent bond formed between Glucose & Fructose is called "glycosidic linkage".



3- Polysaccharides السكر العديد

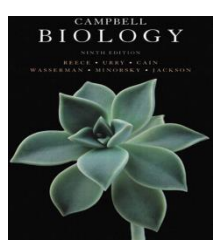


They consist of few hundreds to few thousands of monosaccharides joined by a **dehydration** reaction.

These are of two types:

1- Storage تخزينية. Provide sugar for cell by hydrolysis إضافة ماء.

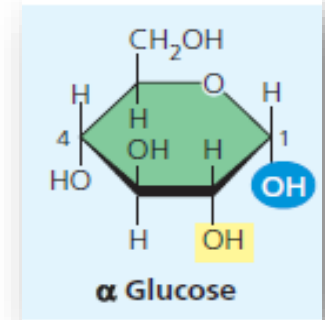
2- Structural تركيبية. Serve as building materials for the organism.



A)- Storage **تخزينية** Polysaccharides



I- Starch (in plants) النشا

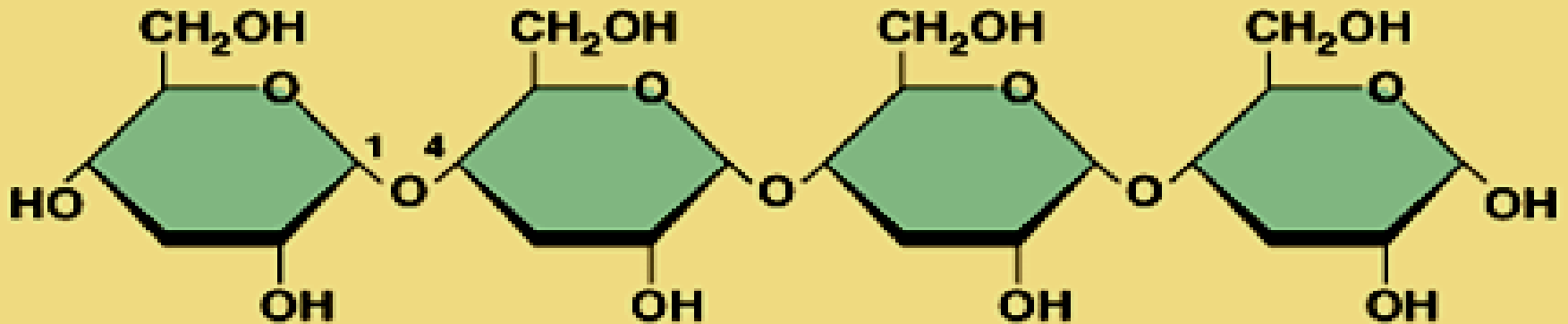


A storage polysaccharide of plants (within plastids).

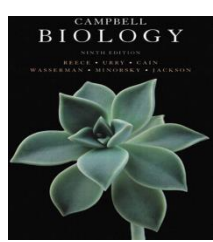
It consists of thousands of **α glucose** molecules.

Thus, it gives glucose when hydrolysed بإضافة الماء by special enzymes in humans.

Potatoes and grains are the major sources of starch.



(b) Starch: 1–4 linkage of α glucose monomers



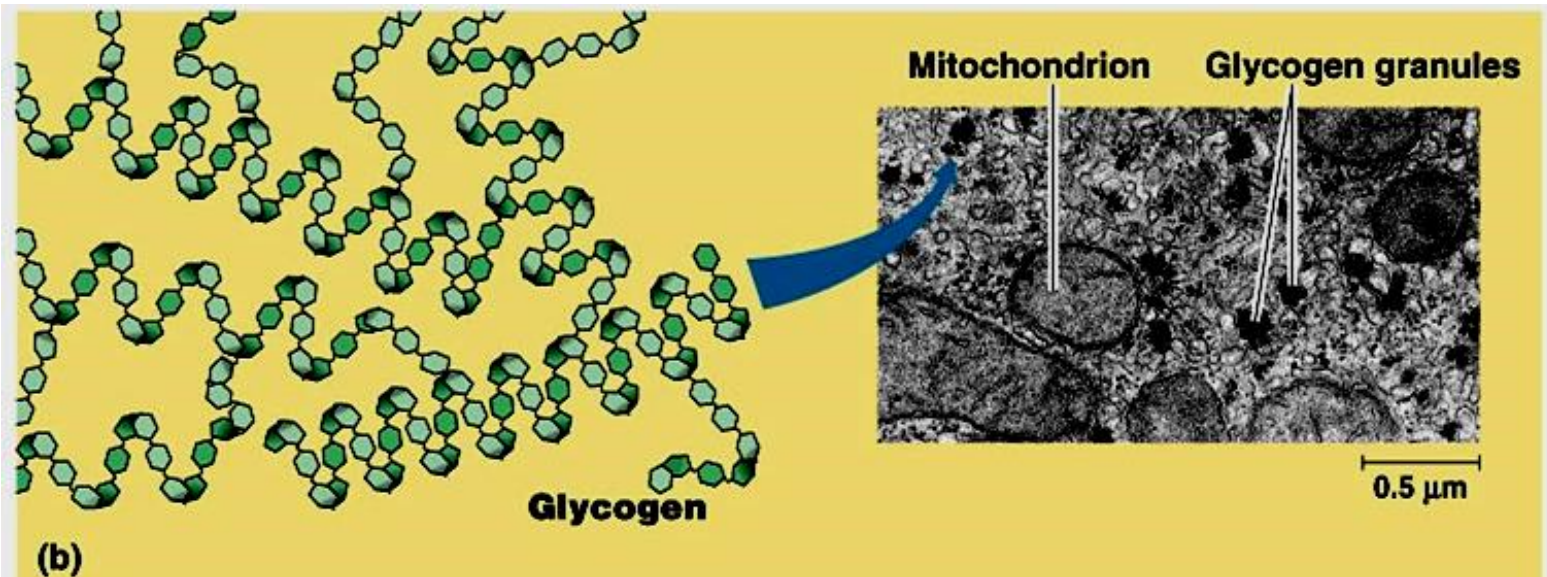
Storage Polysaccharides



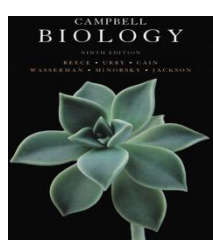
II- Glycogen (in animals) الجليكوچين

Stored in animal cells (e.g. liver and muscle cells in Human).

It is consisted of thousands of **glucose** molecules.



Thus, it gives glucose when hydrolysed.



B)- Structural **تركيبية** Polysaccharides

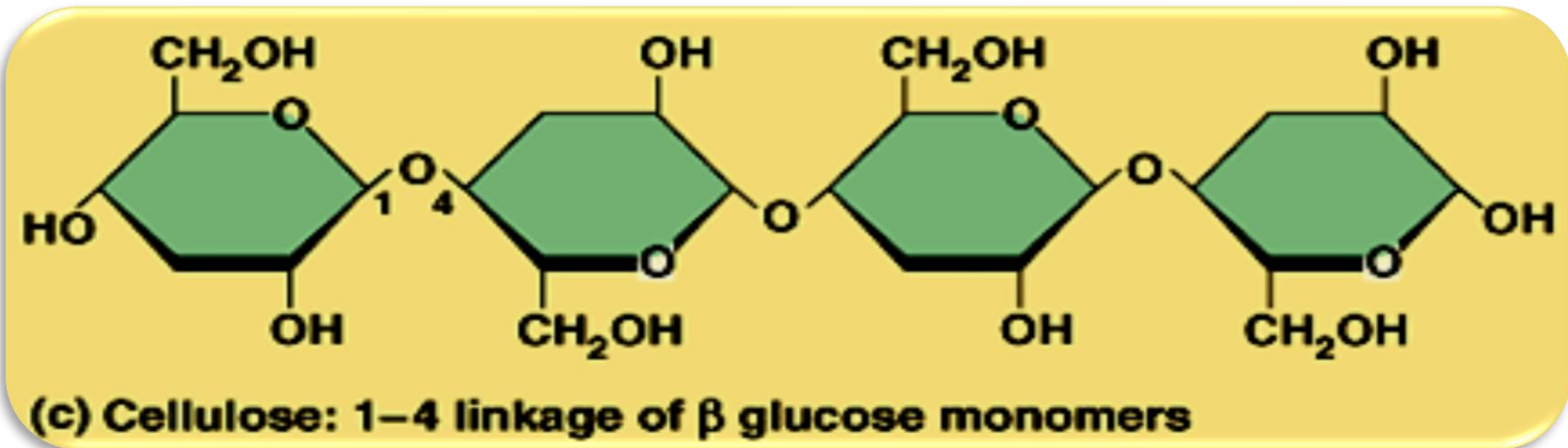
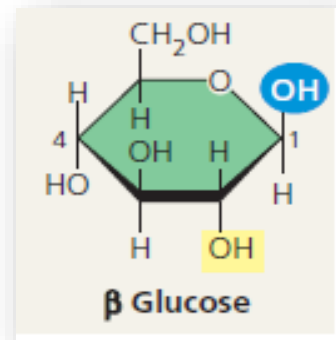


I- Cellulose

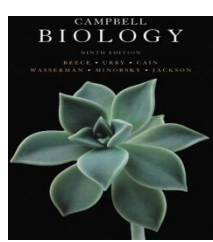
It is the building material of plant cell wall.

Forms the micro-fibrils and cell wall in plants.

It is consisted of thousands of **β glucose** molecules.



Humans cannot digest it, but some bacteria and protozoa can (e.g. in Termites and Cows stomach).



Structural Polysaccharides



II- Chitin الكيتين

It is the building material of the cuticle الجليد in insects.

It is consisted of thousands of **glucose** molecules with a **N** atom at one end.

It is used to manufacture the surgical threads.



Carbohydrates

No. of sugar molecules

Monosaccharides

(Glucose)

Disaccharides

(Sucrose)

Polysaccharides

Storage

Starch (in plants)
&
Glycogen (in animals)

Structural

Cellulose (in plants)
&
Chitin (in insects)

No. of C atoms

Location of
Carbonyl Group

Triose (3C)
Glyceraldehyde

Pentose (5C)
Ribose

Hexose (6C)
Glucose

Aldose
C=O on top

Ketose
C=O within chain

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Thank you very much

شكرا جزيلاً

Zoology Department