UNIT Ⅰ The chemistry of life

單元一 生命化學

1. Introduction: themes in the study of life
2. The chemistry context of life
3. Water and life
4. Carbon and the molecular diversity of life
5. The structure and function of large biology molecules

Chapter 1 The structure and function of macromolecular

Chapter 2 Exploring Life

H2O

1. H_2O : polar covalent bond
2. the properties of water :
   (1)insects that walk on water
   (2)sugar dissolving in water
   (3)floating icebergs

Chapter 1

The structure and function of macromolecular

第一章 巨分子生物構造與功能

Carbohydrates.

1. lactose is formed by a β 1→4 linkage between a glactose and a glucose mdecul
2. the functions ofthe carbohydrates.
   (1)Chitin is a carbohydrate that is used in insects and other arthropods in the structures of their exoskeletons.
   (2)Glycogen is a carbohydrate that is used by animals as a way to store glucose.
   (3)Cellulose is a carbohydrate that serves a structural function in plants.
   (4)Starch is a carbohydrate that is used by some plants as a way to store glucose.
3. Carbonhydrate :Glucose , Starch , Cellulose ,Deoxyribose.
   Not carbonhydrate: Chitin
4. Cellulose
   (1)Cellulose, the most abundant organic compound on earth, is formed by liking glucose by β(1→4) bond.
   (2)cellulose :insoluble fiber
   (3)Humans are unable get metabolic energy from cellulose because cellulose digesting enzymes are absent
5. Chitin
   The major component of cell wall from fungi is chitin.
6. After ingestion, the first type of macromolecule to be worked on by enzymes in the human digestive system is carbohydrate.
7. In cells, the molecules are usually associated with providing energy:
   →(1)neutral fat (2)starch (3)egg albumin

【重點 1】 細胞的主要化合物

一、化合物（compound）：兩種或兩種以上元素（elements）按固定比率合併。

【TEST】

01. An element is to a (an) _____ as a tissue is to a (an) _____
   (A) atome; organism (B) compound; organ (C) molecule; cell (D) atom; organ
   (E) compound; organelle

02. 元素(elements)之於_____正如組織(tissue)之於_____。
   (A)原子(atom)；生物體(organism) (B)化合物(compound)；器官(organ)。
   (C)分子(molecule)；細胞(cell) (D)原子(atom)；器官(organ)
   (E)化合物(compound)；胞器(organelle)。

二、細胞內碳原子間以碳鏈或碳環的形式鍵結，形成各種化合物的骨架，此類化合物稱為有機分子。

細胞內四大群有機分子

	元素（原子）	單元體
Carbohydrate 糖類	C、H、O	單糖、(葡萄糖)
Fat 脂肪	C、H、O	脂肪酸、甘油
Protein 蛋白質	C、H、O、N (S)	胺基酸
Nucleic acid 核酸	C、H、O、N、P	核苷酸

【重點 2】 聚合物原理

一、condensation（縮合反應）

(一)單體以共價鍵連結成聚合物。

(二)dehydration reaction **脫水反應**。

過程中二分子間將損失 1 份 H_2O 。

二、hydrolysis（水解作用）

(一)聚合物拆解成單體

(二)經由與水反應，打斷分子內的共價鍵。

(三)The reaction of a fat to form glycerol and fatty acids with the utilization of water

利用水將脂肪形成甘油，脂肪酸反應。

(四)縮合反應或水解作用，均需 **酶** 的作用，方能進行

三、polymer 聚合物

(一)以共價鍵相連許多單體（monomers）所構成的長分子。

(二)carbohydrates (**糖類**), protein (**蛋白質**), nucleic acid (**核酸**)。

(三)細胞內四大類巨分子（mocromolecules）

sugar（糖醣）、protein（蛋白質）、fat（脂肪）、nucleic acid（核酸）。

(四)細胞內，碳原子間以碳鏈或碳環的型式鍵結，形成各種化合物的骨架，此類化合物稱有機分子。

【TEST】

01. Most of biological molecules are macromolecules (called polymers). These polymers consist of many similar or identical small units (called monomers). What type of reaction links monomers together to form polymers, and what type of reaction breaks down polymers to monomers?

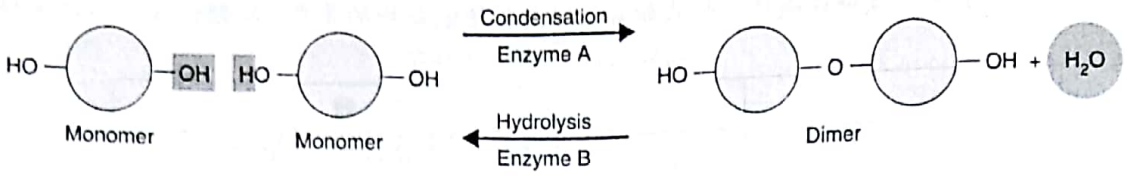

Figure 1-1 animated Condensation and hydrolysis reactions.
Joining two monomers yields a dimmer; incorporating additional monomers produces a polymer. Note that condensation and hydrolysis reactions are catalyzed by different enzymes.

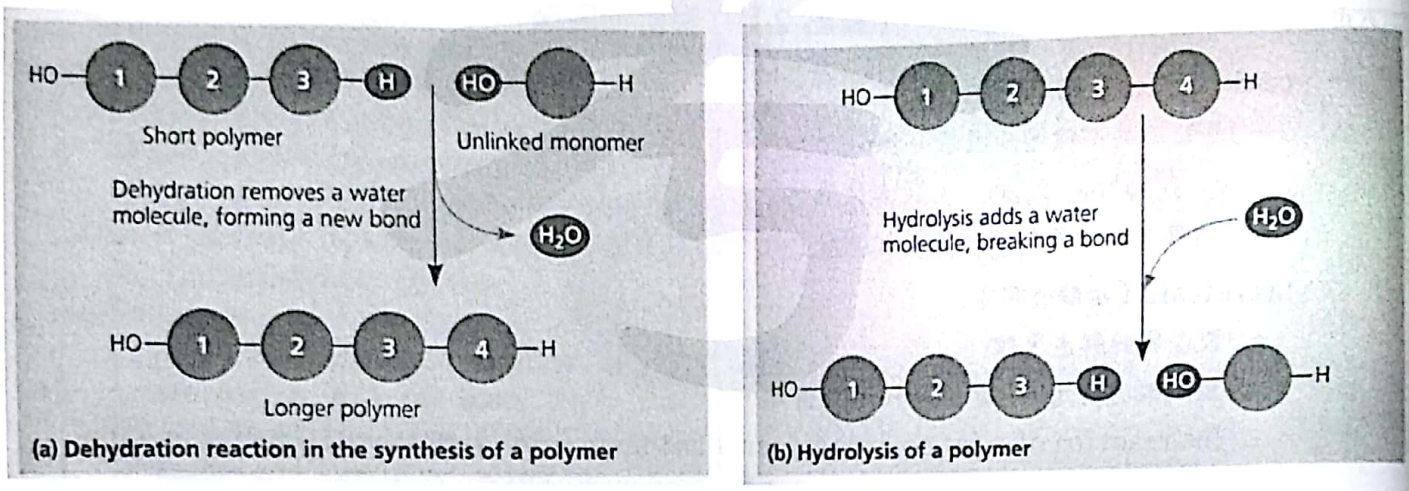

Figure 1-2 The synthesis and breakdown of polymers.

四、一組單體，經由線性排列序列的變異可組合出無限多聚合物，如同 26 個英文字母可造出數十萬個單字。

【TEST】

01. Which of the following illustrates hydrolysis?
(A)The reaction of two monosaccharides to form a disaccharide with the release of water
(B)The synthesis of two amino acids to form a dipeptide with the utilization of water
(C)The reaction of a fat to form glycerol and fatty acids with the release of water
(D)The reaction of a fat to form glycerol and fatty acids with the utilization of water
(E)The synthesis of a nucleotide form phosphate, a ribose sugar, and nitrogen base with the production of a molecule

02. 要將一個長 100 單體的聚合物完全水解，需耗費多少個水分子？
→99 個水分子。

03. 下列何者不屬於聚合物（polymer）？
(A)starch (B)protein (C)fatty acid (D)nucleic acid (E)none of above

04. The molecular formula for glucose is $C_6H_{12}O_6$. What would be the molecular formula for a polymer made by linking ten glucose molecules together by dehydration reactions? Explain you answer.

(A)$C_{60}H_{120}O_{60}$ (B)$C_6H_{12}O_6$ (C)$C_{60}H_{102}O_{51}$ (D)$C_{60}H_{100}O_{50}$ (E)$C_{60}H_{111}O_{51}$

05. 葡萄糖（glucose）的分子式是$C_6H_{12}O_6$。由十個葡萄糖分子以縮合反應（condensation reaction）串連而成的聚合物，其分子式應為何？

(A)$C_{60}H_{120}O_{60}$ (B)$C_6H_{12}O_6$ (C)$C_{60}H_{102}O_{51}$ (D)$C_{60}H_{100}O_{50}$ (E)$C_{60}H_{111}O_{51}$

解答：1. D 2. — 3. C 4. C 5. C

【重點 3】 Monosaccharide 單糖

一、三碳糖：glyceraldehyde（甘油醛），光合作用暗反應中間產物。

二、五碳糖：

(一)ribose（核醣）：組成 RNA ，ATP

(二)deoxyribose（去氧核醣）：存在 DNA （第 二 個碳上少一個氧）

三、六碳糖

(一)glucose 葡萄糖

(二)fructose 果糖

(三)galactose 半乳糖