

CHEMISTRY OF LIFE

05 FEBRUARY 2014



Lesson Description

In this lesson we will:

- Discuss inorganic compounds and their importance
- Discuss organic compounds and their biological importance.



Summary

Inorganic Nutrients

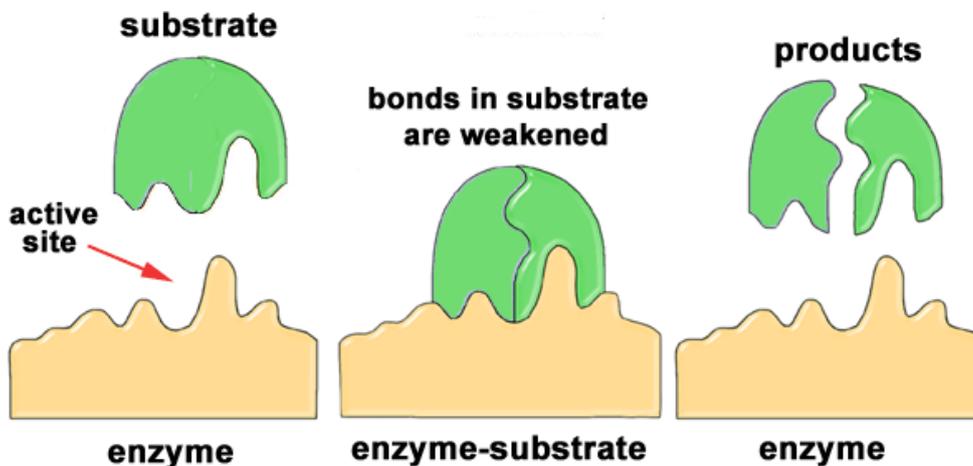
Water	Nutrients
<ul style="list-style-type: none"> • Solvent • Medium in which chemical reactions occur • Transport agent • Regulates body temperature • Lubricant • Reagent during hydrolysis • Gives shape and rigidity 	<p>Macro-nutrients – needed in large quantities. E.g. calcium, potassium, phosphorous, sodium</p> <p>Mirco-nutrients – needed in small quantities. E.g. iron and iodine</p>

Organic Nutrients

	Carbohydrates	Lipids	Proteins
Elements	<ul style="list-style-type: none"> • C, H, O 	<ul style="list-style-type: none"> • C, H, O 	<ul style="list-style-type: none"> • C, H, O, N and sometimes Fe and P
Monomers	<ul style="list-style-type: none"> • Monosaccharide (glucose, fructose, galactose) • Disaccharides (maltose, sucrose, lactose) • Polysaccharides (starch, cellulose, glycogen) 	<ul style="list-style-type: none"> • 3 fatty acids and 1 glycerol 	<ul style="list-style-type: none"> • Amino acids
Bonds	<ul style="list-style-type: none"> • Glycosidic bonds 	<ul style="list-style-type: none"> • Ester bond 	<ul style="list-style-type: none"> • Peptide bond
Biological Importance	<ul style="list-style-type: none"> • Most common source of energy e.g. glucose • Polysaccharides are stored as a reserve energy source • Cellulose is the major component of cell walls 	<ul style="list-style-type: none"> • Fats are a reserve source of energy • Insulation – under skin • It acts as a packing tissue between internal organs • It is an important part of cell membrane 	<ul style="list-style-type: none"> • Protoplasm is made up of many proteins • Form the outer layer of cell membranes • Reserve energy • Enzymes are proteins • Many proteins have a structural function – keratin, muscle, chromosomes, haemoglobin, collagen, bone • Some hormones are proteins
Properties	<ul style="list-style-type: none"> • Monosaccharides and disaccharides are sweet to the taste, polysaccharides are NOT • Monosaccharides and disaccharides dissolve in water, polysaccharides are NOT (osmotically inactive) 	<ul style="list-style-type: none"> • They do not dissolve in water • They do dissolve in or in alcohol • Fats are in a solid form at room temperature • Oils are in a liquid state at room temperature 	<ul style="list-style-type: none"> • They are sensitive to changes in temperature and pH

Enzymes

Enzymes are organic catalysts, as they speed up and control chemical reactions in living organisms without being changed by the reaction



(Taken from: <http://waynesword.palomar.edu/molecu1.htm>)

- They are proteins and therefore they:
 - a) Are inactive at low temperatures, denatured (changes shape) at high temperatures. Optimum temperature is 37°C
 - b) Enzymes are sensitive to changes in pH (acidity and alkalinity)
- Enzymes are specific in that they will only work on one kind of substrate. E.g. maltase will break down maltose, because of the shape

Vitamins

- Vitamins are essential for the normal growth, metabolism and development of the body
- Water -soluble vitamins – vitamins B and C. Absorbed by body together with water. Not stored in body and are excreted
- Fat-soluble vitamins – vitamins A, D, E and Absorbed when dissolved in fat. Stored in the body



Test Yourself

Select the most correct answer from the options given. Write down only the correct letter

Question 1

Organic compounds contain...

- A. sometimes carbon, but always oxygen
- B. always carbon, but sometimes nitrogen
- C. never hydrogen and oxygen
- D. usually hydrogen, but always carbon

Question 2

Iodine is required by humans to

- A. assist in the clotting of blood
- B. control the water balance of the body
- C. prevent muscular cramps
- D. produce the hormone thyroxin

Question 3

Iron is required by humans to

- A. build up bone and teeth
- B. function in muscular contraction
- C. form part of the oxygen carrying molecule in blood
- D. assist in the normal functioning of the thyroid gland

Question 4

Flowering plants need dissolved nitrogen and magnesium for the synthesis of

- A. lipids
- B. chlorophyll
- C. carbohydrates
- D. enzymes

Question 5

Evaporated milk contains vitamin B₁₂. 100 ml of evaporated milk contains 20 per cent of the body's daily requirement of this vitamin. What volume of evaporated milk (in ml) would a person have to drink to get their full daily requirements of vitamin B₁₂?

- A. 5
- B. 100
- C. 500
- D. 5000

Question 6

Which of the following organic compounds is not a carbohydrate?

- A. Cellulose
- B. Maltase
- C. Starch
- D. Lactose

Question 7

Which of the following chemical equations is incorrect?

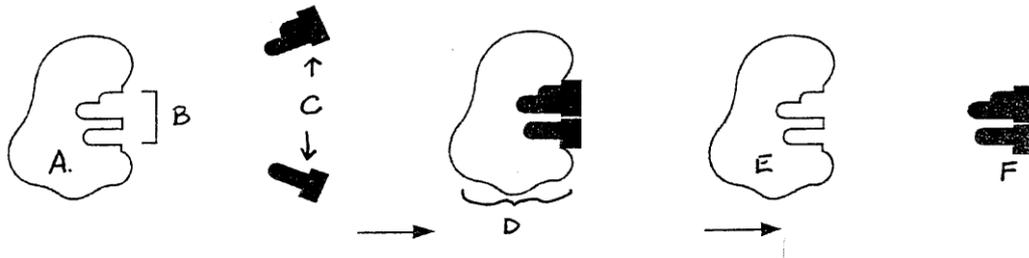
- A. 3 fatty acids + glycerol → lipid
- B. Amino acid + amino acid → protein
- C. Glucose + galactose → maltose
- D. Glucose + glucose → sucrose



Improve your Skills

Question 1

Study the diagram given and answer the questions on the answer sheet



- 1.1. Provide labels for the parts indicated A, B, C and F respectively. (4)
- 1.2. What characteristic of enzymes is visible in the diagram? (1)

Question 2

The following table shows an analysis of the nutrients found in 100g portion of breakfast. The breakfast was made up of eggs, bread and butter.

NUTRIENTS IN A 100 g PORTION	FOOD TYPES		
	Eggs	Bread	A specific brand of butter
Carbohydrates (g)	0,0	20,2	0,10
Fats (g)	12,5	0,2	85,20
Protein (g)	11,8	2,5	0,00
Calcium (mg)	56,0	3,3	13,80
Iron (mg)	2,8	0,6	0,15
Vitamin A (mg)	675,0	12,0	2 344,00
Vitamin C (mg)	0,0	,0	0,20

Use the information in the table to answer the following questions:

- 2.1 Name a vitamin deficiency disease that could result from a diet that consists mainly of bread.
- 2.2 Identify the food type that would be best for a person who suffers from night-blindness. Give a reason for your answer.
- 2.3 This breakfast provides very little vitamin C. What food would you recommend to correct this?

Question 3

Match the carbohydrate compounds from the following list with the statements listed below. Some statements require more than one answer. Write the letter or letters only of the appropriate carbohydrate next to the question number.

Letter to use	Carbohydrate	Letter to use	Carbohydrate
A.	glycogen	F.	fructose
B.	sucrose	G.	maltose
C.	glucose	H.	lactose
D.	starch	I.	cellulose
E.	galactose		

Statements:

1. storage carbohydrate found in liver and muscle tissue.
2. cane sugar, also found in sugar beet.
3. monosaccharide.
4. the main carbohydrate in milk.
5. disaccharide
6. structural carbohydrate found in plant cells.
7. combines with glucose to form lactose.
8. insoluble in water.

Question 4

An experiment was done using a specific substrate and enzyme. The table below shows the results.

Temperature (°C)	Speed of reaction (mg of product/unit (time))
5	0.3
10	0.5
15	0.9
20	1.4
25	1.9
30	2.7
35	3.3
40	3.6
45	3.0
50	2.3
55	0.9
60	0.1

- 4.1. Draw a line graph to illustrate the results of this experiment.
- 4.2. Which TWO factors are constant?
- 4.3. What do the results indicate?
- 4.4. What is the optimum temperature for this specific enzyme? Explain your answer.
- 4.5. Explain why the process slows down at higher temperatures.

Question 5

Read the following information on enzymes and answer the questions that follow

ENZYME USE IN THE TANNING INDUSTRY

Enzymes are used in the tanning industry because they are efficient in breaking down protein and fat. Enzymes are produced by microbial fermentation. Microbial enzymes are fast in action and used because they shorten the processing time, thereby reducing production costs.

The production of leather from animal skins involves a number of stages. These include the removal of natural oils and fats from the skin and the removal of hair. In tanneries, these processes are usually carried out with enzymes. Grease is an enzyme which hydrolyses triglycerides.

Through advanced biotechnology “designer” enzymes with improved performance have been developed. These genetically engineered enzymes would have their amino acid sequence altered to change the shape of the active site. This would result in enzymes with new and improved properties.

- 5.1. What are the products when triglycerides are treated with Greasex?
- 5.2. Greasex removes the oils and fats from the skin. Use your knowledge of enzyme structure to explain why a different enzyme must be used to remove hair.
- 5.3. What are the advantages of using micro-organisms such as bacteria to produce enzymes?



Links

- Summary Crash Course Biology www.youtube.com/watch?v=QnQe0xW_JY4