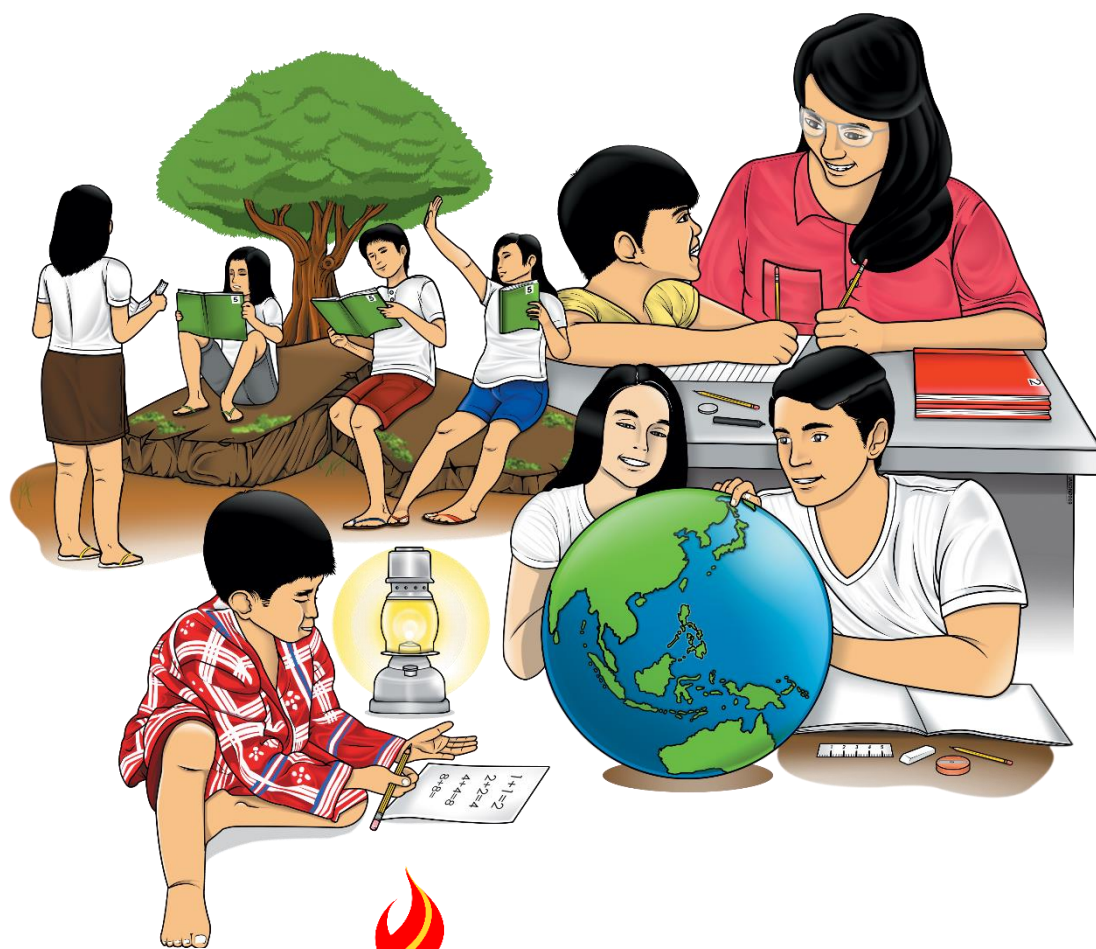


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Senior High School

Physical Science

Quarter 1 – Module 4: The Chemistry of Life (Biomolecules)



Physical Science – Grade 12
Alternative Delivery Mode
Quarter 1 – Module 4: The Chemistry of Life (Biomolecules)
First Edition, 2020

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Physical Science

Quarter 1 - Module 4: THE CHEMISTRY OF LIFE (BIOMOLECULES)

This instructional material was collaboratively developed and reviewed by educators from public and private schools, colleges, and or/universities. We encourage teachers and other education stakeholders to email their feedback, comments, and recommendations to the Department of Education at action@deped.gov.ph.

We value your feedback and recommendations.

Introductory Message

For the facilitator:

This module is intended for the Non-STEM Senior High School Students taking up Physical Science as their core subject. This may serve as remediation for learners as well as a form of Alternative Delivery Mode of Learning Resources, in times of need.

For the learner:

The module is an interactive learning material. Answer pre-test prior to the reading of the information followed by answering the activities. Your learning assessment will be based on the post test.



What I Need to Know

This module was created to help and give you an idea of the concepts behind the four macromolecules: carbohydrates, lipids, nucleic acids, and proteins. Since these molecules primarily constitute a living organism, they are also called **biomolecules**.

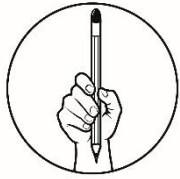
The module will focus on discussing the general structure and functions of biomolecules, as well as the common samples or material where they could be seen.

The learners are also expected to:

- (a) explain how the structures of biological macromolecules, such as carbohydrates, lipids, nucleic acid, and proteins, determine their properties and functions (S11/12PS-IIIe-22)

After going through this module, you are expected to:

1. Identify the four macromolecules according to their general structure;
2. Describe the properties of each macromolecule; and
3. Explain the functions of each macromolecule, as well as the common samples where it can be seen.



What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which biomolecule has a biological function as a first-line source of energy?
A. Carbohydrates
B. Lipids
C. Nucleic Acids
D. Proteins
2. Which represents a carbohydrate?
A. C_nH_{2n+2}
B. $(CH_2O)_n$
C. C_nH_{2n}
D. $(C_2HO)_n$
3. The following samples are simple carbohydrates except _____.
A. Cellulose
B. Fructose
C. Glucose
D. Sucrose
4. Which statement below best describes a lipid?
A. It is insoluble in water.
B. It is always in gaseous form.
C. Its general structure is only made up of carbon and hydrogen.
D. It can form ionic compounds due to its ability to become ionic.
5. Which structure below is rich in lipid as manifested by its function?
A. Human muscle fibers
B. Rigid cell wall of plant cells
C. Semi-permeable cell membrane
D. Enzymes catalyzing substances
6. Which one is NOT a lipid?
A. Cholesterol
B. Lactase
C. Triglyceride
D. Waxes
7. What is primarily the function of a nucleic acid?
A. As storage of energy of the body
B. As an energy source of the body
C. As structural molecules of most living organisms
D. For storage and expression of genetic information
8. What does DNA mean?
A. Dinucleotide adenine
B. Dinucleic adenine
C. Deoxyribonucleic acid
D. Diribonucleic acid
9. Which of the molecules below DOES NOT constitute a nucleic acid?
A. Amino acid
B. Nitrogenous base
C. Phosphate group
D. Sugar

For nos. 10-11, refer to the figure below:

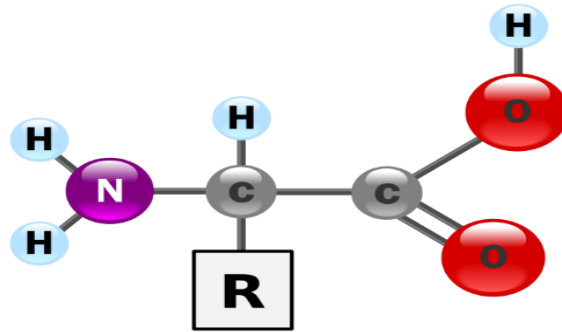


Figure 1 – Amino acid molecule

https://en.wikipedia.org/wiki/Amino_acid#/media/File:AminoAcidball.svg

10. What group is attached to the left side of the central Carbon?
 - A. Amino group
 - B. Hydrogen group
 - C. Acid group
 - D. Side Chains/Functional Groups
 11. What makes an amino acid unique from one other?
 - A. The form of attachment
 - B. The different side chains
 - C. The manner of peptide bonding
 - D. The presence of acids and bases
 12. Which is rich in protein?
 - A. Plant leaves
 - B. Human hair
 - C. Vegetable oil
 - D. Table salt
- For nos. 13-15, choices are:
- A. Carbohydrate
 - B. Lipid
 - C. Nucleic Acid
 - D. Protein
13. Which constitutes a plant fiber?
 14. Which is a component of grease?
 15. Which has amino acids as its building blocks?

Lesson

1

THE CHEMISTRY OF LIFE

Living organisms are primarily made up of organic compounds. The process of building organic molecules by living organisms is called biosynthesis.



What's In

Biomolecules (also known as macromolecules) are organic compounds that make up all living organisms. They are all produced through the process of biosynthesis. As previously discussed, organic compounds are carbon-rich molecules usually in association with hydrogen and oxygen. Organic and nature-based materials that we use today are primarily rich in these four macromolecules. The four macromolecules are carbohydrates, lipids, nucleic acids, and proteins.



What's New

Activity 1

The objective of this activity is to determine how familiar you are with the different types of macromolecules and their examples.

Direction: Write the letter of the correct answer. Given the samples below, determine if they are made from:

- A. Carbohydrates
- B. Lipids

- C. Nucleic Acid
- D. Proteins

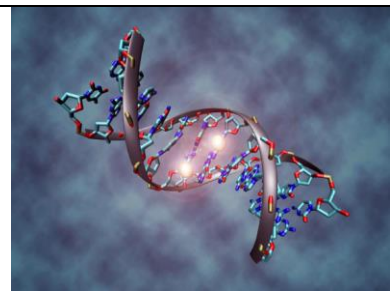
1.



2.



3.



4.



5.





What is It

Have you ever thought about what makes up a living organism? Biologically, they are made up of cells, tissues, organs, and body systems. But if we look closely, all forms of life are considered matter, hence, made up of compounds. Molecules that make up a living organism are called biomolecules. They are also known as macromolecules as they are large organic molecules.

Biomolecules are produced through a process known as biosynthesis. There are four types of biomolecules, namely: carbohydrates, lipids, nucleic acids, and proteins. Let us describe each of them, focusing on their function, importance, and practical examples.

CARBOHYDRATES

Carbohydrates are one of the most abundant macromolecules on Earth. Literally, the term means “hydrates of carbons” because of its 1:2:1 ratio of carbon, hydrogen, and oxygen of its simplest chemical formula, respectively (e. g., $C_6H_{12}O_6$ for glucose). A more generalized formula is $C_m(H_2O)_n$, where m is equal to 3 or more, and m and n are not necessarily equal (e. g. $C_{12}H_{22}O_{11}$ for sucrose or table sugar).

Carbohydrates are generally classified as simple or complex. Table 1 shows the difference between simple and complex carbohydrates.

Table 1 Simple and Complex Carbohydrates

	Simple Carbohydrates	Complex Carbohydrates
Structure	Small, usually made up of 1-2 sugar molecules	Made up of long chains of sugar molecules; made up of simple carbohydrates covalently bonded together
Rate of Digestion	Easy and quick to digest	Longer time to break down
Primary function in relation to its structure	Provides ‘instant’ energy, commonly in so-called ‘sugar rush’	As structural material, and as storage form -- provides more lasting energy
Examples	glucose, table sugar	Chitin (exoskeleton) Cellulose (plant cell wall) Starch and glycogen

LIPIDS

Lipids are a large group of substances also found in living systems. They are insoluble in water but are soluble in solvents that are nonpolar or have low polarity. Lipids have three major functions:

1. energy storage, especially in animal systems

2. structural, as part of cellular membranes
3. as chemical messengers that deliver signals from one part of the body to another

There are several types of lipids based on their structure but you would be more familiar with fats and oils, also known as triglycerides, or simply, “fats”. A fat molecule is composed of long-chain fatty acids bonded to glycerol. Glycerol is an organic compound with three carbons, five hydrogens, and three hydroxyl groups, while fatty acids have long chains of hydrocarbons with a carboxyl group. Can you identify these parts in Figure 1?

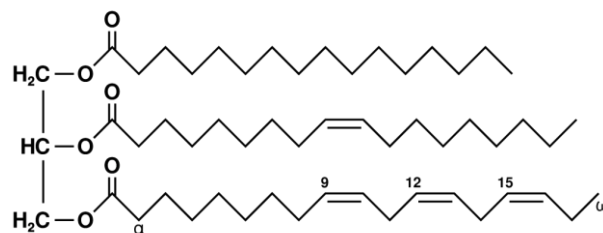


Figure 1 Lipid molecule

(https://en.wikipedia.org/wiki/Lipid#/media/File:Fat_triglyceride_shorthand_formula.PNG)

Fatty acids that make up fats are either saturated or unsaturated. Fats and oils may also be classified that way. “Saturation/Unsaturation” of fats indicates the presence or absence of double bonds in the fatty acid chain. Unsaturated fats have at least one pair of double-bonded carbons, are liquid at room temperature, and are commonly extracted from plants. On the other hand, saturated fats do not have double-bonded hydrocarbons, are solid even at room temperature, and present in animal fats. You may also have heard about trans fats. These are artificially hydrogenated oils commonly used in the food industry. Hydrogenation, the addition of hydrogen to the oil structure, results in the saturation of the oil, making it more stable hence prolonging the shelf life of food.

Can you name some examples of the different kinds of lipids?

NUCLEIC ACIDS

Nucleic acids are the most important biomolecules in the continuity of life. They store genetic information in the cell, and are in the form of either DNA (deoxyribonucleic acid) or RNA (ribonucleic acid). Nucleic acids are made up of nucleotides. Nucleotides have three components: pentose sugar (5-carbon sugar), phosphate group, and nitrogenous base. Table 2 shows the features that differentiate DNA from RNA. Figure 2 shows the parts of a nucleotide.

Table 2 Features of DNA and RNA

Features	DNA	RNA
Strands	Double-stranded, helical	Single-stranded
Nitrogenous base/s present	adenine, guanine, cytosine, thymine	adenine, guanine, cytosine, uracil
Sugar molecule	Deoxyribose	Ribose
Functions	Carries genetic make up	For protein synthesis

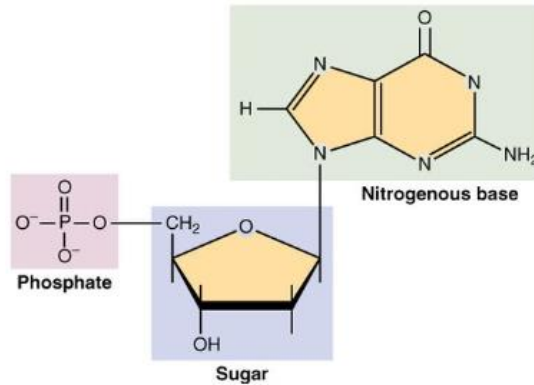


Figure 2 Parts of the nucleotide

(https://en.wikipedia.org/wiki/Nucleotide#/media/File:0322_DNA_Nucleotides.jpg)

PROTEINS

Proteins are some of the most complex macromolecules in terms of structure and function. Like carbohydrates, proteins are also very abundant in living organisms. The building blocks of proteins are the amino acids of which 20 are known. An amino acid has an amino group, a carboxylic group, and an R group or side chain. Each amino acid has a different R group or side chain, which makes each amino acid unique. Figure 3 below shows the parts of the amino acid molecule.

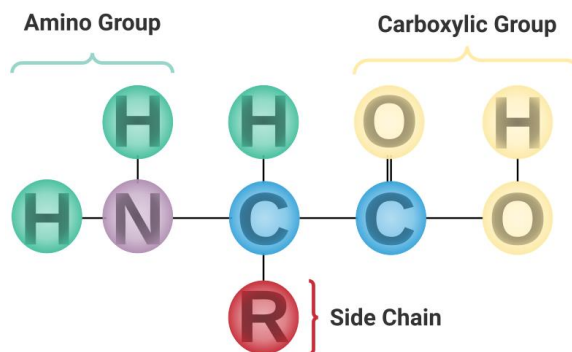
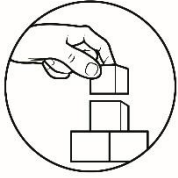


Figure 3 Amino Acid Structure

(https://commons.wikimedia.org/wiki/File:Unionized_Alpha_Amino_Acid_Structure.svg)

The different types of proteins are classified based on their function. Keratin in the hair is an example of a structural protein, while hormones like insulin are regulatory proteins. Actin and myosin proteins are for movement, and are called

contractile proteins. Antibodies that are produced by the white blood cells are called protective proteins, while hemoglobin which carries oxygen gas is an example of a transport protein. Egg albumin is a storage protein that serves as nourishment for the developing embryo.



What's More

Activity 1.1 Draw me

Draw the structure of the indicated example of biomolecules. Label the parts of the molecule.

Biomolecule Examples	Structure
1. Glucose	
2. Cholesterol	
3. Alanine	
4. DNA	

Activity 1.2 What makes it unique?

In two (2) sentences, describe the properties of the given biomolecule.

1. Carbohydrates

2. Lipids

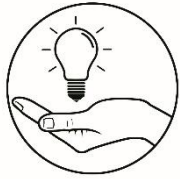
3. Nucleic Acids

4. Proteins

Activity 1.3 Biomolecule represent!

Complete the table below.

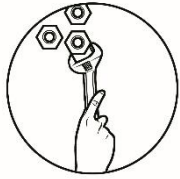
Sample	Type of Biomolecule	Function of the Sample
Hemoglobin		
RNA		
Plant fiber		
Margarine		



What I Have Learned

Fill in the blanks.

1. _____ are organic compounds that make up a living organism.
2. Ratio of C:H:O of in a glucose is _____.
3. Fat molecules are composed of glycerol and _____ _____.
4. Amino acids are the building blocks of _____.
5. _____ _____ is a type of nucleic acid that carries the genetic information of all living organisms.



What I Can Do

Now that you know the ideas and concepts of biomolecules. Give an example of products that you know for each biomolecule as per the indicated category.

Biomolecule	Health Sciences	Industry
CARBOHYDRATE		
LIPID		
NUCLEIC ACID		
PROTEINS		



Assessment

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

- Which biomolecule has a biological function as a first-line source of energy?
 - Carbohydrates
 - Lipids
 - Nucleic Acids
 - Proteins
- Which represents a carbohydrate?
 - C_nH_{2n+2}
 - $(CH_2O)_n$
 - C_nH_{2n}
 - $(C_2HO)_n$
- The following samples are simple carbohydrates except for _____
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- Which statement below best describes a lipid?
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- Which structure below is rich in lipid as manifested by its function?
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 - Enzymes catalyzing substances
- Which one is NOT a lipid?
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 - Lactase
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- What is primarily the function of a nucleic acid?
 - As storage of energy of the body
 - As a source of energy of the body
 - As structural molecules of most living organisms
 - For storage and expression of genetic information
- What does DNA mean?
 - Dinucleotide adenine
 - Dinucleic adenine
 - Deoxyribonucleic acid
 - Diribonucleic acid
- Which of the molecules below IS NOT a part of a nucleic acid?
 - Amino acid
 - Nitrogenous base
 - Phosphate group
 - Sugar

For nos. 10-11, refer to the figure below:

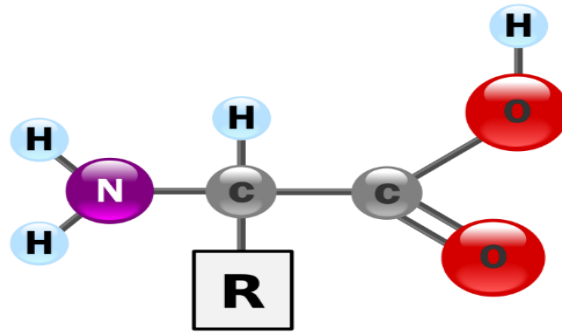
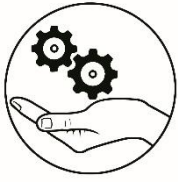


Figure 1 – Amino acid molecule

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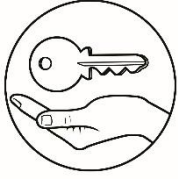
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- A. Carbohydrate
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 - D. Protein
13. Which constitutes a plant fiber?
 14. Which is a component of grease?
 15. Which has amino acids as its building blocks?



Additional Activities

Watch the video on <https://www.youtube.com/watch?v=WtCCobhLqng> entitled “Biological molecules - You are what you eat | Crash Course biology | Khan Academy”. Make a reflection of it using the four-square analysis.

Technical terms you learned from the video	Summary of the video in 10 sentences only
Title of the video	
Your insights about the topic being discussed on the video	Questions you want to address



Answer Key

<p>1. A 2. B 3. A 4. A 5. C 6. B 7. D 8. C 9. A 10. A 11. B 12. B 13. A 14. B 15. D</p> <p>Assessment</p> <p>1. BIOMOLECULES 2. 1:2:1 3. FATTY ACIDS 4. AMINO ACID 5. DEOXYRIBONUCLEI C ACID</p> <p>What I have learned</p>	
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<p>1. A 2. B 3. A 4. A 5. C 6. B 7. D 8. C 9. A 10. A 11. B 12. B 13. A 14. B 15. D</p> <p>What I Know</p>

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