

Physical Science Quarter 1 – Module 7: **Biological Macromolecules**



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Physical Science Quarter 1 – Module 7: Biological Macromolecules



Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-bystep as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Need to Know

This module was designed and written with you in mind. It is here to help you explain how the structures of biological macromolecules such as carbohydrates, lipids, nucleic acid, and proteins determine their properties and functions. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

After going through this module, you are expected to:

- 1. distinguish between carbohydrates, proteins, lipids, and nucleic acids;
- 2. summarize the general characteristics of each biomolecule; and
- 3. relate the structures of the biomolecules with their properties.



What I Know

Modified TRUE or FALSE. On the space before each number, write **TRUE** if the statement is correct; if the statement is **FALSE**, change the italicized word to make it true.

- _____1. *Carbohydrates* contain carbon.
- _____2. Meat is an example of *protein*.
- _____3. Lipids are *soluble* in water.
- _____4. *Proteins* are made up of nucleotides.
 - _____5. *DNA* is a nucleic acid.
- _____6. Sucrose is a *disaccharide*.
- _____7. *Starch* is composed of many glucose units.
- _____8. *Fructose* is also known as blood sugar.
- _____9. Keratin is *easily* dissolved in water.
- _____10. Proteins are made up of *nucleotides*.
- _____11. The iron group of *hemoglobin* is called a heme group.
- _____12. A nucleotide has *three* parts: nitrogenous base, sugar, and phosphate group.
- _____13. DNA has a *double-helix* structure.
- _____14. Triglyceride is a *protein*.
- _____15. Generally, *unsaturated* fatty acids remain solid at room temperature.

Lesson

Biological Macromolecules

Biological macromolecules are large, organic molecule such as carbohydrates, lipids, proteins, and nucleic acids. Most of them are organic compounds and the functional group determines their chemical properties. Biomolecules have a huge variety of functions, such as storing energy, protection, etc. Now be ready with your journey to the different biomolecules, their structures, and functions found in your food.



Analyze the Nutritional Facts of a food product given below and rank the nutrients needed by the following patients based on importance.

- A. a patient with hypertension
- B. a patient renal failure
- C. a patient with diabetes mellitus

Nutrition Facts

Serving Size 32 g

Serving Per Pack 1

Amount/Serving	%RENI
Total Calories 150	6%
Calories from Fat 45	
Total Fat 5g	
Saturated Fat 3g	
+ Trans Fat Og	
Cholesterol 3mg	
Sodium 170mg	35%
Total Carbohydrates 23g	
Dietary Fiber Og	0%
Sugars 4g	
Protein 3g	4%
Calcium 55mg	8%
Iron 1mg	8%



Food is a source of molecules that are needed for life. These are biological molecules. What you eat belongs to **biomolecules**. There are four biological molecules that make up all of life. Now, I have here a word hunt for your warm up.

Look for the words and write your answer: biomolecule, carbohydrate, lipid, protein, and nucleic acid.

F	А	Т	S	Η	Y	L	Ι	Р	Ι	D	Р
U	Р	Ι	А	Т	Е	Р	R	0	Т	Е	R
Ν	U	С	L	Е	Ι	С	А	С	Ι	D	0
Y	Т	Κ	Т	L	Р	D	G	0	G	0	Т
С	А	R	В	0	Η	Y	D	R	А	Т	Е
Α	R	0	А	А	Η	L	Е	W	V	W	Ι
В	Ι	0	Μ	0	L	E	С	U	L	E	Ν

You are really doing great! It seems that you are now ready for our first biomolecule.

Notes to the Teacher

Ask learners to list examples of carbohydrate, lipid, protein, and nucleic acid. Add on the list sources that are not mentioned by the learners.



Activity 1.1 Macromolecule Plates and Glass

1. Write inside the first plate an example of food rich in carbohydrates that you have eaten a while ago and tell us what you feel after eating it.



What did you feel after eating the food rich in carbohydrates?

2. Write inside the second plate an example of food rich in lipids that you have eaten a while ago.



What did you feel after eating the food rich in lipids?

3. Write inside the third plate an example of food rich in protein that you have eaten a while ago and tell us what you feel about what you have eaten.



4. Write inside the glass the function of nucleic acids.





What is It

Terms and Definitions

Monosaccharide – simplest form of carbohydrates

Monomer – a molecule that can react with other molecule to form very large molecules or polymers

Peptide – short chain of amino acid monomer link by peptide bonds

Hormones – special chemical messengers that are created in the endocrine gland

Amino acids – organic compounds that combined to form proteins

Enzymes – proteins which make the biochemical reaction fast

Nucleotide – made up of three components: nitrogen-containing base, five-carbon sugar, and a phosphate group

Phospholipids - contain glycerol, two-fatty acids, and a phosphate group

Biological Macromolecules

1. Carbohydrates

The word **carbohydrate** may be broken down to carbon and hydrate. Another term for carbohydrate is **saccharide**. Carbohydrates are classified either as simple or complex. Simple sugars are **monosaccharide** and **disaccharides**. Complex sugars are **polysaccharides**.

Carbohydrates are the primary energy source of the human body. The different saccharides that humans eat are converted to glucose which can be readily used by the body. The excessive consumption of carbohydrates is converted to glycogen which is stored in the liver and in muscles. **Glycogen** is a slow-releasing carbohydrate.

Monosaccharide (one saccharide)

Glucose	used in dextrose, blood sugar; the form utilized by the human body
Galactose	found in milk and milk products
Fructose	found in fruits and honey

Disaccharides (two saccharides)

Maltose	glucose + glucose	found in malt
Sucrose	glucose + fructose	found in regular table sugar, sugarcane, and sugar beet
Lactose	glucose + galactose	found in milk and milk products

Polysaccharides (many saccharides)

Starch / Amylose	storage form of glucose in plants
Amylopectin	storage form of glucose in plants
Glycogen	storage form of glucose animal; stored in the liver and muscles
Cellulose	structural material in plantscell wall in wood, wood fiber cannot be digested by humans

Carbohydrates

They are made from carbon, hydrogen, and oxygen.

Monomer: saccharides

Examples: rice, cereal, potatoes, fruits, pastas

Function: main energy source of the body

Did you know that?

Marathon runners, triathletes, and other runners eat carbohydrates for weeks leading up to a big event. They call it "carbo-loading". What's the point?

As the athletes consume massive amounts of starch and pasta, the energy begins to store up in their body, saving itself for use during the event.

2. Lipids or Fats

Lipids or fats are important nutrients in your body but eating too many especially unhealthy fats such as **saturated fats** and **trans fats** can lead to heart disease, cancer, and obesity. Lipids also serve other functions such as material for cell membrane, insulation to maintain body temperature, aid in digestion, and as signal molecules.

There are different classifications of lipids: **triglyceride**, **phospholipid**, **wax**, and **steroid**. The lipid family is one of the most varied in terms of structure, but they share the common property of being insoluble in water.

Fat and **oil** are the most common examples of lipids. They are under triglycerides because they are composed of glycerol and three fatty acids.

Fat refers to solid triglyceride usually from animal sources such as meat, milk, butter, margarine, eggs, and cheese. **Oil** refers to liquid triglycerides from plant sources. Examples are olive oil, corn oil, sunflower oil, and soybean oil. Animal fats contain high percentages of saturated fatty acids while plant oils are mostly unsaturated fatty acids.

Lipids

They are made from carbon, hydrogen, and oxygen

They are soluble (dissolve) in oil but are insoluble (don't dissolve) in water.

Examples: fats and oils

Function: long-term storage of energy in the body

Monomer: fatty acid

3. Proteins

Proteins are composed of four elements, namely: **carbon**, **hydrogen**, **oxygen**, and **nitrogen**. Sulfur and other metals are sometimes also found in proteins. If carbohydrates are made up of saccharides, proteins are made up of **amino acids**.

Examples of proteins and their functions are:

- 1. Keratin is a structural protein found in hair, skin, and nails.
- 2. **Fibroin / Silk protein** Fibroin is found in silk. Silk has a smooth and soft texture. It is one of the strongest natural fibers that have high resistance to deformation. It is also a good insulating material.
- 3. **Collagen** is a major insoluble fibrous protein found in connective tissues such as tendons, ligaments, skin, cartilage and the cornea of the eye. It comprises as much as 30% of proteins in animals.
- 4. **Enzymes** function to catalyze chemical reactions. They either speed up a reaction, lower the needed energy for a reaction to take place, or bind substances to their specific partners.

Examples of enzymes

- a. Lipase help in digestion of fats
- b. **Pepsin** help in breaking down proteins into peptides (smaller units)
- c. Sucrase also called invertase; help in the digestion of sugars and starches
- 5. **Myoglobin** is a polypeptide that stores oxygen in muscles. It contains a heme group which has an iron where the oxygen is stored.

Proteins

They are made from carbon, hydrogen, oxygen, and nitrogen

Proteins are made up of amino acids combined through a dehydration link called a peptide bond.

Monomer: amino acid

Two classes:

1. **Saturated fats** have two carbons attached to each carbon (except the one at the end). Saturated fats are unhealthy fats like butter.

2. **Unsaturated fats** are missing at least one hydrogen and are curl in shape. The unsaturated fats are healthy, and it include oils.

4. Nucleic Acids

Nucleic acids play an essential role in the storage, transfer, and expression of genetic information. Nucleic acid was discovered by a 24-year-old Swiss physician named Friedrich Miescher in 1868. He was puzzled that an unknown substance in white blood cells did not resemble carbohydrates, proteins, or lipids. He was able to isolate the substance from the nucleus and initially called it **nuclein**. He eventually was able to break down nuclein into protein and nucleic acids. He found out that nucleic acids contain carbon, hydrogen, oxygen, nitrogen, and phosphorus.

The most common examples of nucleic acids are **DNA** (deoxyribonucleic acid) and **RNA** (ribonucleic acid). **DNA** is a nucleic acid that carries the genetic code of organisms. It is fondly termed as the blueprint of life. **RNA**, on another hand, carries the information from the DNA to the cellular factories for the synthesis of proteins. If carbohydrates are composed of saccharide units, proteins of amino acids, and lipids of fatty acids, nucleic acids are composed of **nucleotides**. Nucleic acids are also known as **polynucleotides**.

Three parts of nucleotide:

- 1. Nitrogenous base
- 2. Five-carbon carbohydrate or sugar
- 3. Phosphate group

Nucleic Acids

They are made from carbon, hydrogen, oxygen, nitrogen, and phosphorus.

Monomer: nucleotide

Examples: DNA and RNA

Function: involves the genetic materials, Deoxyribonucleic Acid (**DNA**) and Ribonucleic Acid (**RNA**). DNA is the blueprint of life because it contains instructions on how to make proteins in the body. How about RNA?

Structures of the Different Biomolecules

Remember this mnemonic device of biomolecules: CHO CHO CHON CHONP

- **C** stands for the element **Carbon**
- **N** stands for the element **Nitrogen**
- ${\bf H}$ stands for the element ${\bf Hydrogen}$
- ${\bf P}$ stands for the element ${\bf Phosphorus}$
- ${\bf 0}~$ stands for the element ${\bf 0xygen}$







What's More

Activity 1.2 Meal Plan

Think of a 3 – day healthy meal plan for a teenager like you following the table below. Make sure that you choose the right kind of food containing carbohydrates, proteins, and lipids.

	•		
	Day 1	Day 2	Day 3
Breakfast			
Morning Snack			
Lunch			
Afternoon Snack			
Dinner			
Dessert			

3 – Day Meal Plan



Activity 1.3 Maze Runner



I have a friend named Bimol. He needs our help in finding the right way to go back to his house. In order to help him, you need to answer some questions about biomolecules.



1

Hello! My name is Bimol. I have a problem. I cannot go back home. Please help me by answering the questions.

Carbohydrates	Lipids
What elements are they composed of?	What elements are they composed of?
What is the monomer?	What is the monomer?
What is its function for the body?	What is its function for the body?
Write two examples: 2	Write two examples:
Proteins	Nucleic Acids
What elements are they composed of?	What elements are they composed of?
What is the monomer?	What is the monomer?
What is its function for the body?	What is its function for the body?
Write two examples: 3	Write two examples: 4
Thanks for he	lping Bimol!
	номе



Complete the table filling out the required information. Identify the disorder/disease, related macromolecule and its function based on the given scenario.

- 1. Covida, a grade 12 student experienced excessive sweating, frequent urination, feeling very thirsty and hungry. She was not able to attend her class during that day. She was rushed in the hospital and upon examining her blood sugar it was found out that it is above its normal value.
- 2. One of the students of Mr. Corona shared her story when she was hospitalized at the age of three. She showed her picture with enlarged tummy, loss of muscle mass and inflamed patches on her skin. She even mentioned that she was also irritable and had failure to grow in height according to her mother.
- 3. While presenting the lesson on Circulation and Gas Exchange, the teacher of Pandemic Integrated National High School complains shortness of breath, tightness and aching sensation in his chest that radiates to his neck and jaw.

Disorders/ Diseases	Related Macromolecules	Function of Macromolecules



Multiple Choice. Read and analyze the given statements below. Write the chosen letter on a separate sheet of paper.

- 1. Which biomolecular group carries and passes on the hereditary information of the organism?
 - a. carbohydrates
 - b. lipids
 - c. nucleic acids
 - d. proteins
- 2. Which biomolecules are significant features of the cell membrane?
 - a. carbohydrate and nucleic acid
 - b. lipid and nucleic acid
 - c. nucleic acid and protein
 - d. protein and lipid
- 3. Atom is the basic unit of a chemical element. What are the atoms that make up carbohydrates?
 - a. C and H
 - b. C, H and N
 - c. C, H and O
 - d. C, H, O and N
- 4. Which organic molecule gives fast source of energy?
 - a. carbohydrates
 - b. lipids
 - c. nucleic acids
 - d. proteins
- 5. Which nutrient group is used in the composition of waxes and responsible for insulation of some organisms?
 - a. carbohydrates
 - b. lipids
 - c. nucleic acids
 - d. proteins
- 6. Which of the following does NOT belong to the classification of lipids?
 - a. hemoglobin
 - b. phospholipids
 - c. steroid
 - d. triglyceride

- 7. Which of the following is considered as the building blocks of protein?
 - a. amino acids
 - b. nucleic acids
 - c. nucleotides
 - d. polypeptides
- 8. The excessive consumption of carbohydrates is converted into which polysaccharide that is stored in the liver and in muscles?
 - a. creatinine
 - b. glycogen
 - c. hemoglobin
 - d. uric acid
- 9. Which of the following is a monosaccharide which is used in dextrose?
 - a. fructose
 - b. galactose
 - c. glucose
 - d. lactose

10. Which is a good example of saturated fat?

- a. butter
- b. corn oil
- c. olive oil
- d. sunflower oil
- 11. Which is termed as the blueprint of life?
 - a. deoxyribonucleic acid
 - b. fatty acid
 - c. nucleic acid
 - d. ribonucleic acid
- 12. Proteins are composed of four elements, namely: carbon, hydrogen, oxygen and what other element?
 - a. magnesium
 - b. nitrogen
 - c. phosphorous
 - d. sulfur
- 13. This is a major insoluble fibrous protein found in connective tissues such as tendons, ligaments, skin, cartilage, and the cornea of the eye. What is it?
 - a. albumin
 - b. collagen
 - c. keratin
 - d. pepsin

- 14. Which polypeptide stores oxygen in muscles?
 - a. enzyme
 - b. heme
 - c. lipase
 - d. myoglobin
- 15. Which is not a part of a nucleotide?
 - a. nitrogenous base
 - b. phosphate group
 - c. ribonucleic acid
 - d. sugar



Activity 1.5 Biomolecule Poem

Summarize the topics and creatively translate them into a poem describing what you have learned about biomolecules. Write your answer on a separate answer sheet.



Answer Key

What I Know 1. True 2. True 3. insoluble 4. Nucleic acid 5. True 6. True 7. True 8. Glucose 9. not easily 10. amino acids	What's In A. In any order of chosen nutrients as long as cholesterol and fats are last in the list. B. In any order of chosen nutrients as long as sodium is last in the list. C. In any order of chosen nutrients as	What's New Answers may vary.
 True True True Iipid saturated 	long as carbohydrate is last in the list.	
What's More 1. carbon, hydrogen, and oxygen 2. carbon, hydrogen, and oxygen 3. carbon, hydrogen, oxygen, and nitrogen 4. carbon, hydrogen, oxygen, nitrogen, and phosphorus	What I Have Learned See table below.	What I Can Do See table below.
Additional Activities Answers may vary.	Assessment 1. C 2. D 3. C 4. A 5. B 6. A 7. A 8. B 9. C 10. A 11. A 12. B 13. B 14. D 15. C	

Function of Macromolecules	Related Macromolecules	Disorders/ Diseases
Carbohydrate becomes sugar when	Carbohydrate	sutilləM sətədsiC
break down which gives energy.		
Increased carbohydrate intake causes		
elevated blood sugar.		
Protein is essential in building muscle	Protein	zwashiorkor
mass. Decreased intake of protein can		
lead to Kwashiorkor.		
Lipids or Fats maintain body	biqiJ	Myocardial Infarction
temperature. Too much lipids or fats in		
the body narrow blood vessels which		
decreases blood flow.		

What I Can Do

Ућаћ I Наvе Learned

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