Senior High School

Physical Science

Quarter 1 – Module 4:
Biological Macromolecules

ALTERNATIVE DELIVERY MODE

ADM

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Alternative Delivery Mode
Quarter 1 – Module 4: Biological Macromolecules
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Quarter 1 – Module 4:
Biological Macromolecules

DepED
DEPARTMENT OF EDUCATION

Introductory Message

For the facilitator:

Welcome to the Physical Science – Grade 11 Alternative Delivery Mode (ADM) Module on Biological Macromolecules!

This module was collaboratively designed, developed and reviewed by educators both from public and private institutions to assist you, the teacher or facilitator in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

With this module, it will help you to understand the about the structures and functions of biological macromolecules. To further enhance your learning toward the concepts of biological macromolecules, different learning activities are provided. Learners may use extra sheet of paper upon answering the different activities included in this learning material.

This learning resource hopes to engage the learners into guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st century skills while taking into consideration their needs and circumstances.

In addition to the material in the main text, you will also see this box in the body of the module:

Notes to the Teacher

This learning module will help the learners to understand the structural properties of four groups of biological macromolecules, and its sub-kinds, functions and examples. Furthermore, several learning activities are provided to deepen the learners' understanding about the concepts of biological macromolecules.

For the learner:

Welcome to the Physical Science – Grade 11 Alternative Delivery Mode (ADM) Module on Biological Macromolecules!

This learning module deals with the four groups of biological macromolecules. It discusses the important role of each type of these biological macromolecules, structures and its functions.

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be enabled to process the contents of the learning resource while being an active learner.

This module has the following parts and corresponding icons:

 ***What I Need to Know***	This will give you an idea of the skills or competencies you are expected to learn in the module.
 ***What I Know***	This part includes an activity that aims to check what you already know about the lesson to take. If you get all the answers correct (100%), you may decide to skip this module.
 ***What's In***	This is a brief drill or review to help you link the current lesson with the previous one.
 ***What's New***	In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity or a situation.
 ***What is It***	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
 ***What's More***	This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.
 ***What I Have Learned***	This includes questions or blank sentence/paragraph to be filled in to process what you learned from the lesson.
 ***What I Can Do***	This section provides an activity which will help you transfer your new knowledge or skill into real life situations or concerns.

 ***Assessment***	This is a task which aims to evaluate your level of mastery in achieving the learning competency.
 ***Additional Activities***	In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends retention of learned concepts.
 ***Answer Key***	This contains answers to all activities in the module.

At the end of this module you will also find:

References	This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

What I Need to Know

This learning module was designed to help the students to learn the key concepts of biological macromolecules. In this learning module, it deals with the structures biological macromolecules (carbohydrates, lipids, nucleic acid and proteins). The lesson is presented in an easy way in order to address the learning difficulties of the students by using language level on their comprehension. Based on the recent study, students learn more if they are actively engage in the textbook they are using. Through this learning module, it can help to improve the student' s academic achievement in this subject. With this learning module, students can work in less supervision of the teacher.

The module is contained one lesson.

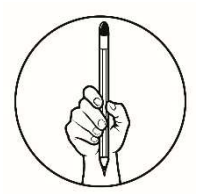
- Lesson 1 – Biological Macromolecules

The most essential learning competency for this module.

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 specifically expected to:

1. define carbohydrates, lipids, nucleic acids and proteins;
2. describe the structures of biological macromolecules (carbohydrates, lipids, nucleic acids and proteins); and
3. explain the structures of biological macromolecules in determining its properties and functions;



What I Know

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

1. It is a macromolecule that made up of carbon, hydrogen and oxygen atoms in 1:2:1 ratio.
    a. lipid
    b. protein
    c. nucleic acid
    d. carbohydrate

2. This serves as a catalyst for chemical reactions in cells.
    a. protein
    b. lipid
    c. carbohydrate
    d. nucleic acid

3. The process of digestion of fats by which separates molecules of fatty acid from the glycerol
    a. fattylysis
    b. homeostasis
    c. hydrolysis
    d. photosynthesis

4. This serves as a nucleotide energy carrier.
    a. nicotinamide adenine dinucleotide (NAD)
    b. adenosine triphosphate (ATP)
    c. flavin adenine dinucleotide (FAD)
    d. cyclic adenosine monophosphate (cAMP)

5. The genetic information of a person is encoded in the sequence bases in_____.
    a. ribonucleic acid (RNA)
    b. deoxyribonucleic acid (DNA)
    c. amino acid
    d. polypeptide

Lesson 1 Biological Macromolecules

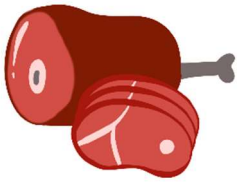
The biological macromolecules play a significant role in the structure and function of the cells. Biological macromolecules all contain ring or chain-shaped carbon, meaning that they are classified as organic. They usually contain hydrogen and oxygen, as well as nitrogen and additional minor elements. Each of these types of biological macromolecules performs a wide array of important functions within the cell; without many different types of these crucial molecules, a cell cannot perform its role within the organism.

What's In

Have you eaten these following foods? What biological macromolecules you might get from these foods?

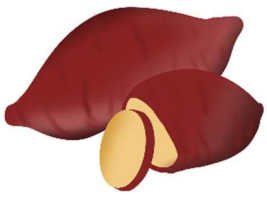
1._____

2._____



3. _____

4._____



5._____

Notes to the Teacher

This learning module will help the learners to understand the structural properties of four groups of biological macromolecules, and its sub-kinds, functions and examples. Furthermore, several learning activities are provided to deepen the learners' understanding about the concepts of biological macromolecules.

What's New

Biological macromolecules are made up made of monomers that are combined through covalent bonds to form large polymers. A **monome**r is a small building block molecule. It is literally means "single unit". On the other hand, when molecules formed by joining two or more monomers are called **polymer** which literally means "many units". *Dehydration or condensation reactions* occur when a monomer combined with another monomer releasing a water molecule leading to the formation of covalent bond. While *hydrolysis reactions* take place when polymers are broken down into single monomer in which the water molecules used to break the bond in this reaction. Both dehydration or condensation and hydrolysis reactions are the same for all biological macromolecules, but each monomer and polymer reaction is specific to its kind. Dehydration reaction requires taking in of energy for new bond formation, while hydrolysis reaction gives off energy to break the bonds.

Four Groups of Biological Macromolecules

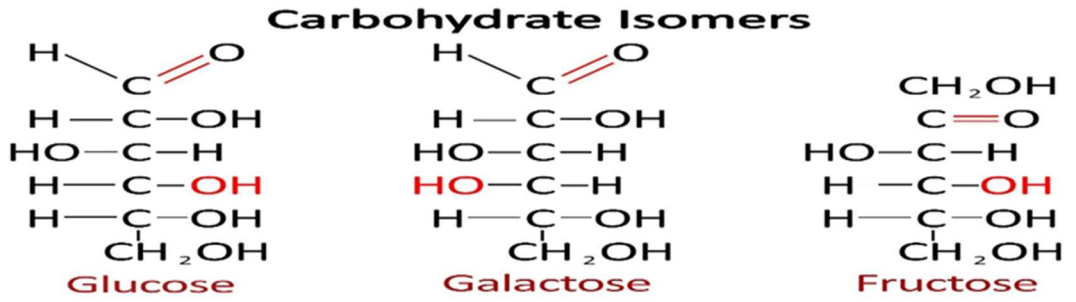
There are four groups of biological macromolecules, namely: Carbohydrates, Lipids, nucleic acids and proteins.

Carbohydrates

Carbohydrates are compounds made up of carbon (C), hydrogen (H) and oxygen (O) atoms with a ratio of 1:2:1. Some examples of carbohydrates are glucose, starch and cellulose. Majority of the organisms defend on carbohydrates as main source of energy. For instance, animals and plants need carbohydrates for structural purposes i.e chitin for insect and woody material for plant. In animals, carbohydrates are very essential in storing energy that can be released by cellular respiration to fuel

cell functions, while plant's carbohydrates play a significant role in energy transformation in plant cells and it is formed during the photosynthesis.

Glucose is the common type of simple carbohydrates with a molecular formula of ($C_6H_{12}O_6$). Starch and Cellulose are large complex molecules of carbohydrates.



Classifications of Carbohydrates.

Carbohydrates are divided into four groups includes, monosaccharide, disaccharide, oligosaccharide and polysaccharide.

1. *Monosaccharides* also known as simple sugars, consist of one sugar molecule. They are considered as the building block of carbohydrates. And they cannot be broken down to yield simple units of carbohydrates. Most of simple sugars have empirical formula, $(CH_2O)n$ or $C_nH_{2n}O_n$. Where n represents any number.

Examples of Monosaccharides

1. Glucose is chemically identical to Dextrose. The body's main source of energy and can be found in rice, bread and pasta.
2. Fructose or fruit sugar can be found in fruits and honey
3. Galactose or milk sugar can be acquired through consuming dairy products such as cheese, ice cream, butter and yoghurt.

2. *Disaccharides* are made up of two covalently bonded monosaccharides. Sucrose or table sugar is composed of glucose and fructose. It is commonly found in sugar cane. The extraction and crystallization of sucrose from sugar cane can produced table sugar. Lactose or milk sugar is a combination of two monosaccharides glucose and galactose. The source of lactose are dairy products and cereals. Maltose or malt sugar is chemically composed of two glucose molecules. Maltose are found in malt products, like cereals and beers.

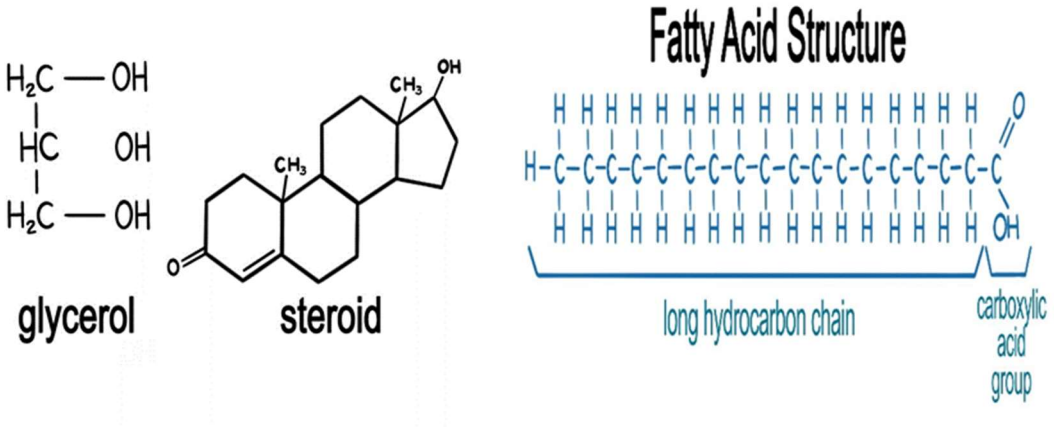
3. *Oligosaccharides* are formed of carbohydrates that consist of three to ten simple sugars. Most of oligosaccharides are naturally found in plants. Some examples of trisaccharides: Raffinose is found in plants composed of melibiose (glucose, galactose and fructose), Maltotriose is made up of three glucose also found in plants and in the blood of some arthropods. Lastly, stachyose is chemically consists of two galactose, one glucose and one fructose. It is naturally found in green beans, soy beans and also present in human milk.

4. *Polysaccharides* are complex formed of biological macromolecules which are composed of more than ten, hundreds or thousands of the same or different types of simple sugars. The straight or branched chain of polysaccharides is linked by glycosidic bond. The common examples of polysaccharides are starch, cellulose and glycogen. Starch is the energy storage of plants. Cellulose is the basic structure of

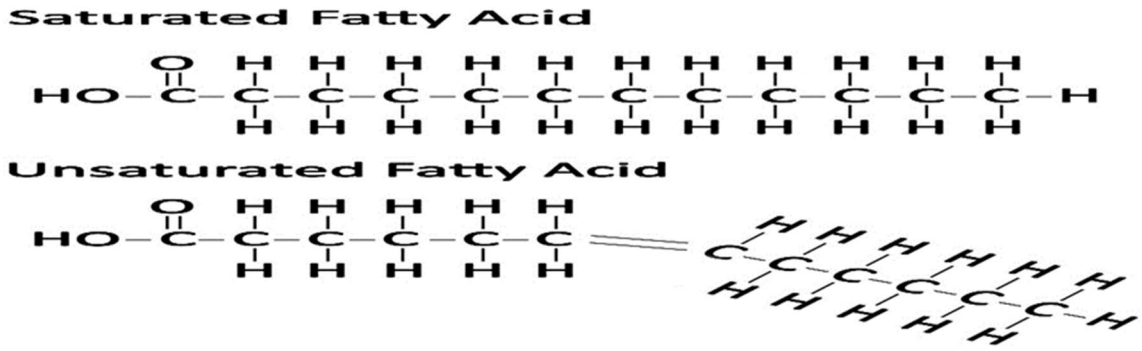
plant cell wall consisting of 3000 or more chain of glucose. Glycogen is a stored form of energy of animals.

Lipids

Lipids are composed primarily of carbon (C), hydrogen (H) and oxygen (O) but the oxygen is less than in carbohydrates. Lipids are formed when glycerol molecules joined with compound fatty acids. Single unit of fats is made up of four (4) building blocks, one molecule of glycerol and joined in by three molecules of fatty acids. This bond formed through dehydration synthesis by removing molecules of water. On the other hand, fats are digested through the process of hydrolysis, where in it separates the molecules of fatty acids from glycerol molecules by adding water molecules. Major role of lipids is to store energy. And other functions of lipids are, as concentrated food storage materials, as structural components of cells and as regulatory chemicals.



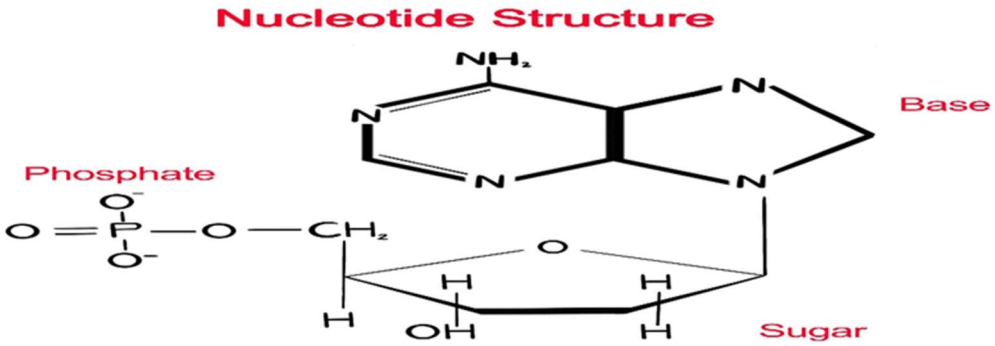
Some lipids are essential parts of biological membrane and water proof coverings. Saturated fats are solid at room temperature, where in the carbon atom in the carbon chain of fatty acids is bonded to four different atoms. While, unsaturated fats are liquid at room temperature because the two carbon atoms may share two electrons, forming a double bond between them. When, saturated fats are easily converted to the complex lipid called cholesterol. Atherosclerosis may occur when cholesterol accumulated in the wall of arteries, it reduces blood flow then will increase blood pressure. High cholesterol is a risk factor for coronary heart disease.



Examples of lipids include, fats, oils, waxes, steroid, phospholipids and cholesterol.

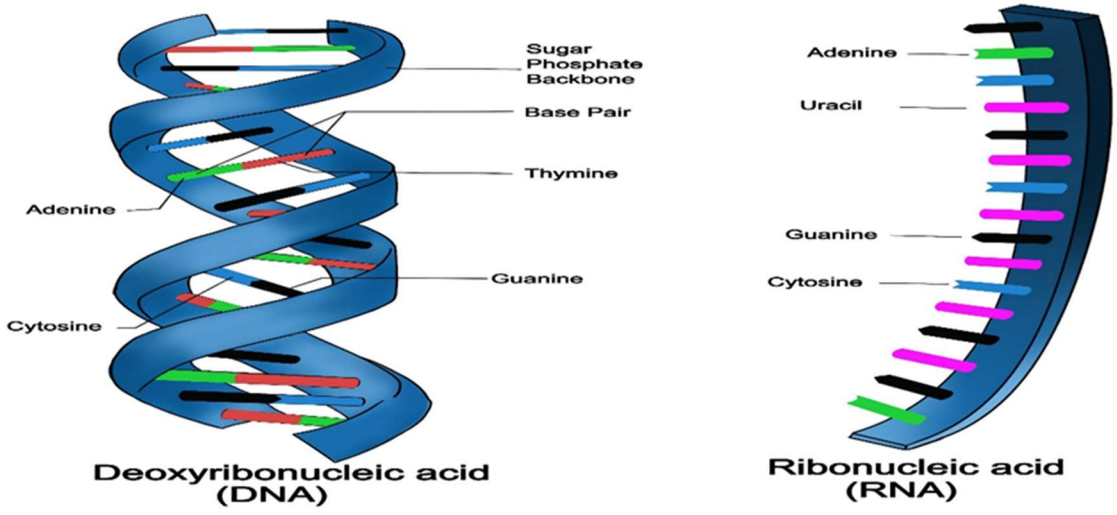
Nucleic acids

Nucleic acids are biological macromolecules containing mainly carbon (C), hydrogen (H), oxygen (O), nitrogen (N), and phosphorous (P). These large compounds are important to all forms of life since it contains genetic information of the cells and play an important role in translating hereditary materials into cellular function. Nucleic acids are made up of large single or double stranded chains of nucleotides. Nucleic acids can be found in lemons, orange juice, fish and corn as well as in all living things in their DNA and RNA.



Two Types of Nucleic Acids

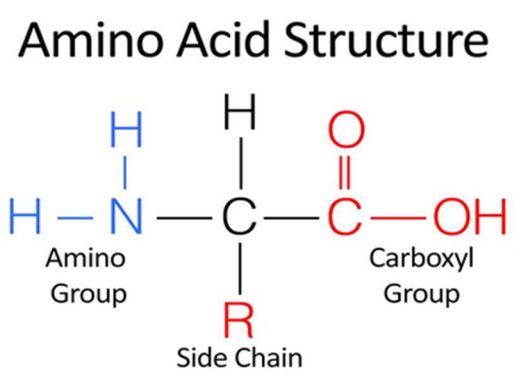
There are two types of nucleic acids, each has its own sugar structure. RNA or Ribonucleic acids and DNA or Deoxyribonucleic acids. Ribonucleic acids are nucleic acids containing ribose sugar and responsible in making proteins. While, Deoxyribonucleic acids contain deoxyribose sugar. Our genes are made of deoxyribonucleic acids.

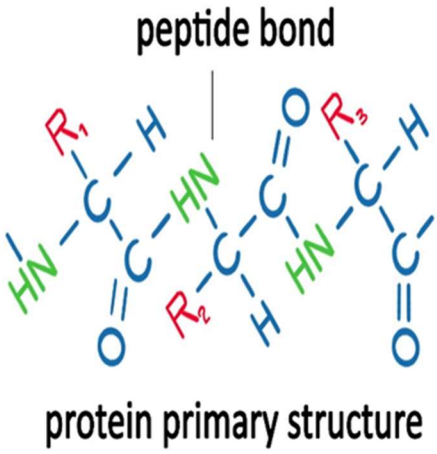


A nucleotide is the building block of nucleic acids, made up of a five-carbon sugar, phosphate group and nitrogen base. The nucleotide co-enzyme, nicotinamide adenine dinucleotide (NAD) and flavin adenine dinucleotide (FAD) transport the hydrogen atoms and electrons which are important in metabolism and also NAD and FAD are modified forms of vitamins niacin and riboflavin respectively. Adenosine triphosphate (ATP) serves as energy carrier while cyclic adenosine monophosphate (cAMP) is a chemical messenger.

Proteins

Proteins are biological macromolecules composed mainly carbon (C), hydrogen (H), oxygen (O), and nitrogen (N). Proteins are made up of long chain molecules called amino acids and joined together through peptide bond, which is a form of covalent bond. There are more than 20 amino acids in nature. Proteins serve as a catalyst for chemical reactions in cells, this called enzyme. And also, proteins are part of the structures of cells. Each protein has a specific role in organism. Some transport chemical substance in and out of the cells, help to fight diseases, control the rate of reactions and regulate cell processes and for bones and muscles formation.

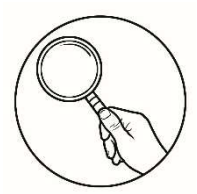




Condensation reaction is the process of forming proteins. The nitrogen of the amino group of one amino acid is linked to the carbon of the carboxylic group of another amino acid through a single covalent bond. This bond is called peptide bond. Peptide is a result of chain of two amino acids.

Some examples of Proteins

1. Albumin found in eggs and Casein in milk are used for energy and material storage.
2. Elastin provides skin elasticity
3. Keratin is main protein found in hair, horn and claws.

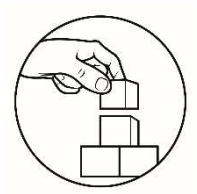


What is It

After reading the text in *What's new.* Let see how far you have learned the different concepts of biological macromolecules.

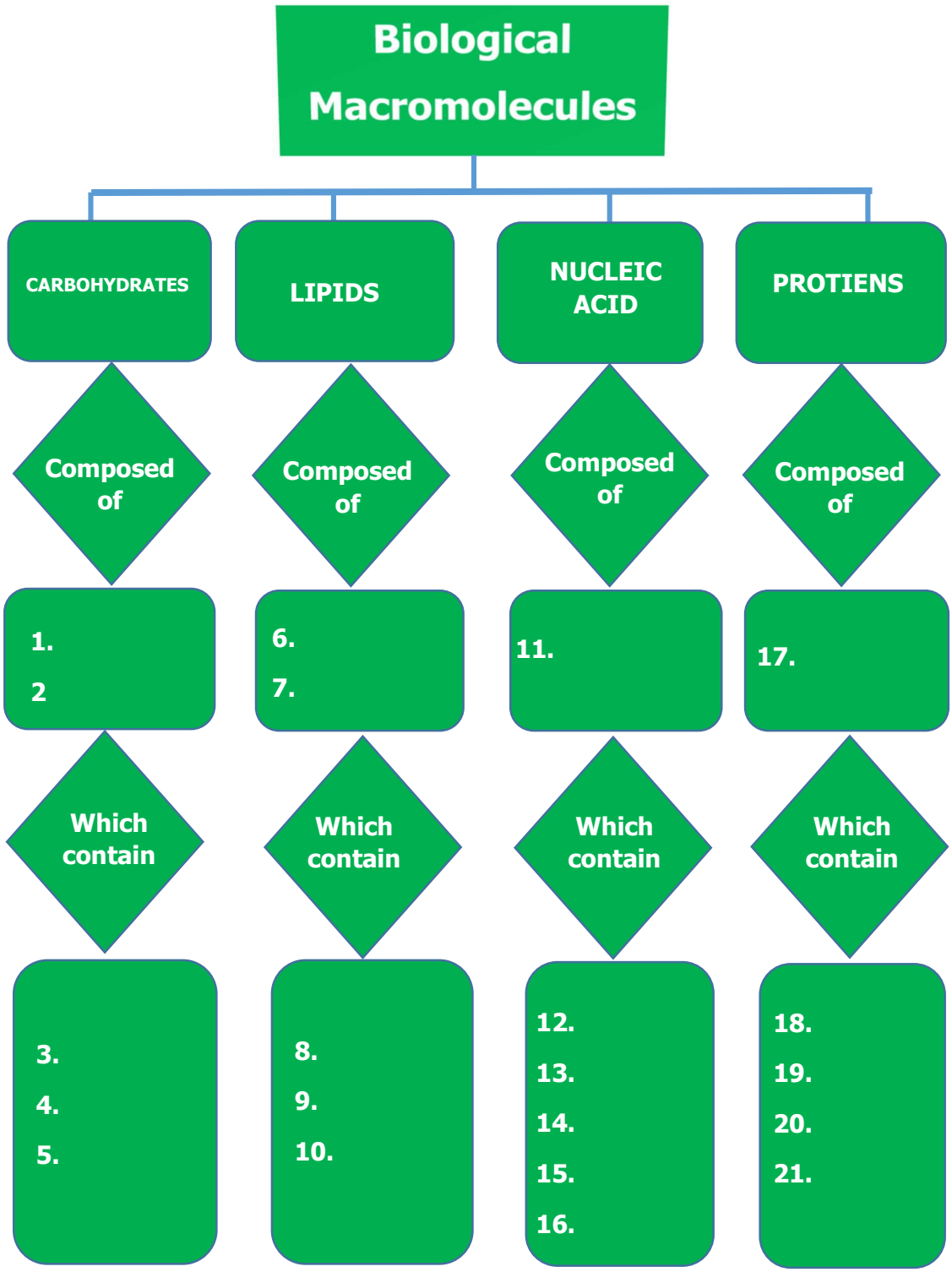
Matching type. Match the terms in column A to column B. Write your answer on the space provided before each number. Use another sheet of paper for your answer.

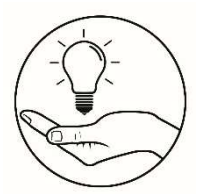
_____1. Glycosidic bond	a. with 1:2:1 ratio
_____2. Maltotriose	b. has $C(H_2O)n$ formula
_____3. Lactose	c. solid at room temperature
_____4. Disaccharide	d. chemical messenger
_____5. Carbohydrates	e. ribose sugar
_____6. Monosaccharide	f. protein in milk
_____7. Maltose	g. chain of polysaccharide
_____8. Lipid	h. nucleic acid
_____9. Unsaturated fat	i. amino acid
_____10. Saturated fat	j. beer
_____11. cAMP	k. composed of galactose and glucose
_____12. RNA	l. liquid at room temperature
_____13. Casein	m. made up of 3 glucose
_____14. Nucleotide	n. linked by 2 monosaccharides
_____15. Protein	o. fatty acid



What's More

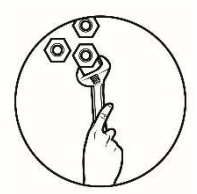
Activity 1.1 Concept Map of Biological Macromolecules





What I Have Learned

1. Biological macromolecules are made up made of monomers that are combined through covalent bonds to form large polymers.
2. The four types of biological macromolecules namely: Carbohydrates, Lipids, nucleic acids and proteins.
3. Carbohydrates are compounds made up of carbon (C), hydrogen (H) and oxygen (O) atoms.
4. Simple sugars have empirical formula, $C(H_2O)n$.
5. Monosaccharide, Disaccharide, Oligosaccharide and Polysaccharide are groups of carbohydrates
6. Chain of polysaccharides is joined by glycosidic bond.
7. The building block of lipids are glycerol and fatty acids.
8. Nucleic acids are made up of large single or double stranded chains of nucleotides.
9. Genes are made of deoxyribonucleic acids.
10. Proteins are made up of long chain molecules called amino acids.
11. Peptide is a result of chain of two amino acids.



What I Can Do

Fill in the necessary information needed in the table. Use another sheet of paper for your answer.

Biological Macromolecule	Simplest form/ basic subunit	Elements	Functions	Examples

Assessment

I. Multiple Choice. Read and analyze each question. Write the letter that corresponds to your answer on a separate sheet of paper.

1. Amino acids are to_____as_____are to nucleic acids?
   a. proteins; nucleotides
   b. carbohydrates; fatty acids
   c. lipids; proteins
   d. nucleotides; proteins

2. A process of synthesizing proteins.
   a. dehydration reaction
   b. glycosidic reaction
   c. hydrolysis reaction
   d. condensation reaction

3. A protein that gives skin elasticity.
   a. peptide
   b. keratin
   c. elastin
   d. albumin

4. A bond that links amino acid together.
   a. nucleotide bond
   b. peptide bond
   c. glycosidic bond
   d. hydrogen bond

5. Ribose is to RNA;_____ is to DNA
   a. galactose
   b. matose
   c. deoxyribose
   d. raffinose

6. Nucleotide co-enzyme that plays essential role in metabolism.
   a. cAMP and ATP
   b. NAD and FAD
   c. NAD and cAMP
   d. ATP and FAD

7. Chains of nucleotides will form?
   a. nucleic acid
   b. amino acid
   d. acetic acid
   c. muriatic acid

8. How do fats be digested?
   a. through hydrolysis by adding water to separates glycerol and fatty acids.
   b. through hydrolysis by removing waster to separates glycerol and fatty acids.
   c. through dehydration synthesis by adding water to separate glycerol and fatty acids.
   d. through dehydration synthesis by removing water to separate glycerol and fatty acids.

9. How do you describe complex carbohydrates?
   a. carbohydrates that have one chain of sugar
   b. carbohydrates that have long chain of sugar

c. carbohydrates that have no chain of sugar

d. carbohydrates that have no nitrogen based sugar

10. Carbohydrates provide the most energy an organism needs. What is the simplest form of carbohydrates?
    a. stachyose
    b. maltose
    c. galactose
    d. glycogen.

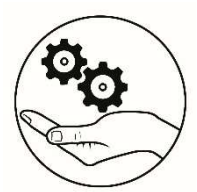
II. Explain the following questions comprehensively. Write your answer on the separate sheet of paper.

1. Why saturated fats are solid at room temperature?
2. Why all monosaccharides and disaccharides are soluble in water?
3. How is it possible that a polysaccharide molecule such as glycogen, may have one reducing ends and many non-reducing ends?

Score	Rubrics for Essay
5	Provides excellent information on the question and hit the necessary/specific terms.
3	Gives good ideas on the question but the necessary/required terms are limited.
1	Ideas on the question are seriously limited and unclear

III. Draw the structure of the following. Draw your answer on the separate sheet of paper.

1. Nucleotide
2. Fructose
3. Fatty acid
4. Protein
5. Steroid

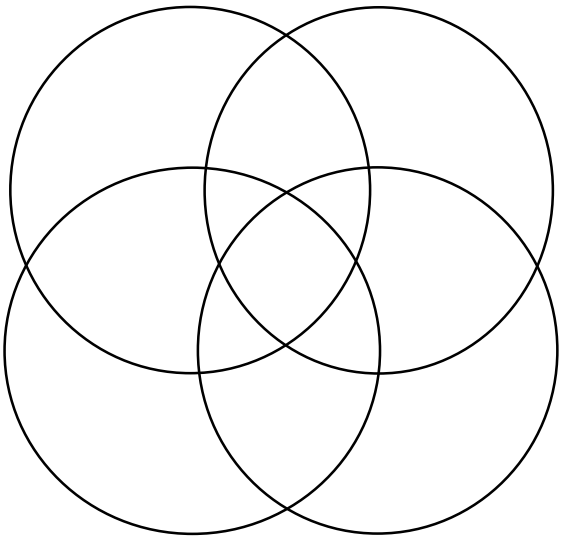


Additional Activities

Compare and contrast the 4 groups of biological macromolecules present it through a Venn diagram. Use another sheet of paper for this activity.

Write the name in each circle the four groups of biological macromolecules.

Fill in the Venn diagram with necessary information as much as possible.



Answer Key

What I know:

1. D
2. A
3. C
4. B
5. B

What's In:

1. Carbohydrates
2. Nucleic acids
3. Proteins
4. Fats
5. Carbohydrates

What is it:

1. G
2. M
3. K
4. N
5. A
6. B
7. J
8. O
9. L
10. C
11. D
12. E
13. F
14. H
15. I

What is more:

1. Sugar
2. Starch
3. Carbon
4. Hydrogen
5. Oxygen
6. Fatty acid
7. Glycerol
8. Carbon
9. Hydrogen
10. Oxygen
11. Nucleotide
12. Carbon
13. Hydrogen
14. Oxygen
15. Phosphorous
16. Nitrogen
17. Amino acid
18. Carbon
19. Hydrogen
20. Oxygen
21. Nitrogen

What can I do:

Biological Macromolecule	Simplest form/ basic subunit	Elements	Functions	Examples
1. Carbohydrates	monosaccharides	Carbon Hydrogen Oxygen	Main source of energy	Starch glucose
2. Lipids	Fatty acids Glycerol	Carbon Hydrogen Oxygen	Stores energy	Fats Cholesterol
3. Nucleic acids	Nucleotides	Carbon Hydrogen Oxygen Phosphorous Nitrogen	Translating genetic information	DNA RNA
4. Proteins	Amino acids	Carbon Hydrogen Oxygen Nitrogen	Transporting materials in and out the cells	Albumin Keratin

Assessment:

1. A
2. D
3. C
4. B
5. C
6. B
7. A
8. A
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