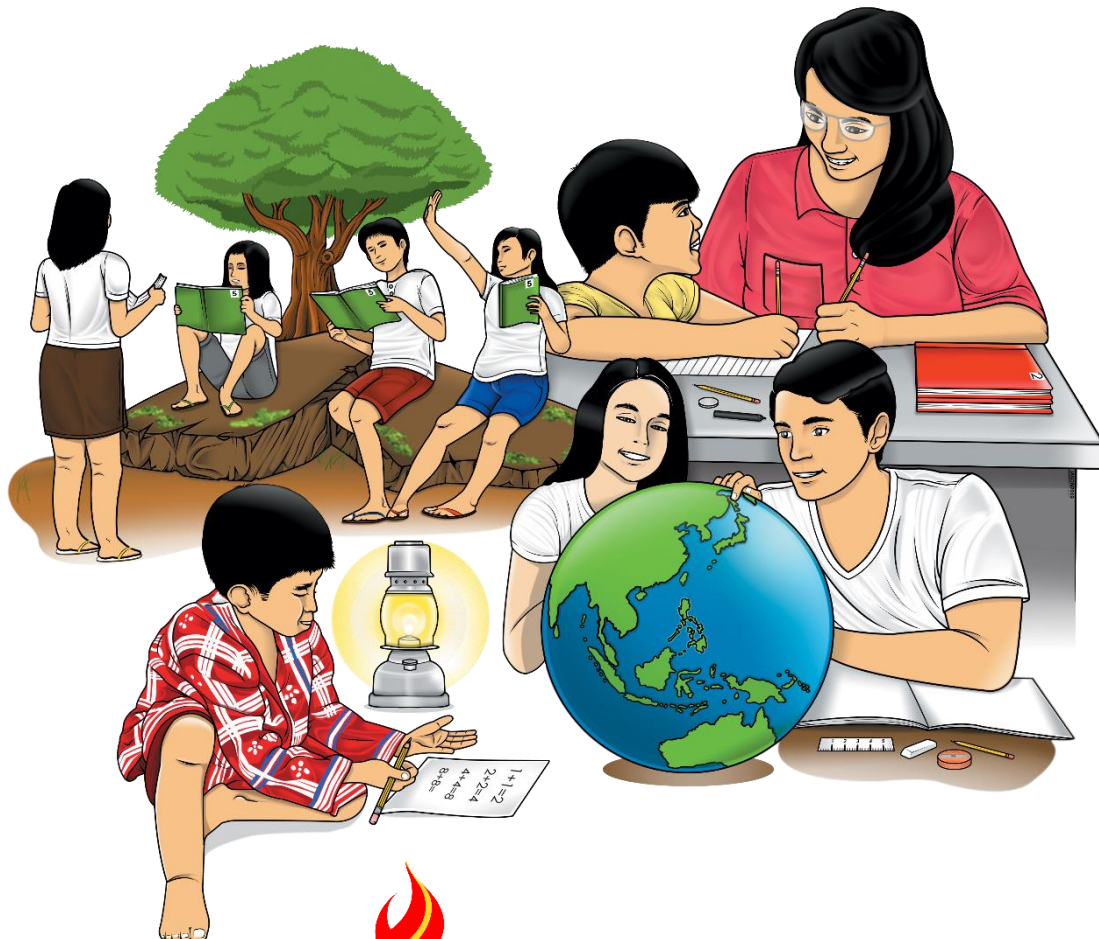


Senior High School

Earth Science for STEM

Quarter 1 – Module 2: Earth's Subsystems



**Earth Science for STEM
Alternative Delivery Mode
Quarter 1 – Module 2: Earth’s Subsystems
First Edition, 2021**

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Senior High School

Earth Science for STEM

Quarter 1 – Module 2:

Eath's Subsystems

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-by-step 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.



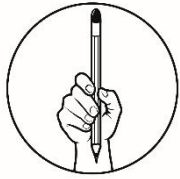
What I Need to Know

This Lesson pertains to the learning competency that would engage the students to explain that the Earth consists of four subsystems, across whose boundaries matter and energy flow. The activities would enable the students to determine the four subsystems of the Earth and help them differentiate the subsystems based on their characteristics. Also, the activities would enable the students to explain how matter and energy flow in the subsystems. They would also be able to trace the flow of matter and energy across the subsystems. This would also help them to internalize the role of humans in the unstoppable flow of matter and energy in the subsystems. This would also help the students intensify their roles as stewards of each subsystem.

The module contains discussions on Earth's Subsystems and the flow of matter and energy in these subsystems.

After going through this module, you are expected to:

1. identify the four subsystems of the earth;
2. distinguish the characteristics of each subsystem;
3. explain how matter and energy flow in the subsystems; and
4. trace the flow of matter and energy in the subsystems.



What I Know

Read and analyze the following questions. Choose the letter that best answer the question. Write it on separate sheet of paper.

1. How is the hydrosphere distinct from the other subsystems?
 - a. It gives food for living organisms.
 - b. It offers shelter for land animals.
 - c. It provides natural resources such as minerals and rocks
 - d. It provides water for organisms which enable organisms to function properly.

2. The atmosphere serves as envelop which protects the earth. Which of the following is **TRUE** about atmosphere?
 - a. It includes all flying organisms.
 - b. It serves as the Earth's blanket.
 - c. It is affected by temperature and salinity.
 - d. It is composed of the different landforms of the Earth.

3. How is biosphere different from the other subsystems?
 - a. It is dependent only on hydrosphere and geosphere.
 - b. It is composed of all living organisms.
 - c. It is composed of soil, rocks, and minerals.
 - d. It provides air which supports respiratory processes of living organisms.

4. The Agusan Marsh is a large wetland with many plants, animals, and microscopic organisms. Which part of the Earth's subsystem includes the water in this wetland?
 - a. Atmosphere
 - b. Biosphere
 - c. Geosphere
 - d. Hydrosphere

5. Why are hydrosphere and geosphere involved in the given scenario below?

“Flooding moves soil and rock to new places.”

 - a. Flood, soil, and rock are components of hydrosphere.
 - b. Soil is part of geosphere while rock is a part of hydrosphere.
 - c. Flood is a component of hydrosphere while soil and rock are components of geosphere.
 - d. Flood is a part of geosphere while soil is a component of biosphere.

6. What is the reason why the atmosphere is essential to life?
 - a. It only provides blanket the covers the ears the earth's surface.
 - b. It solely gives oxygen and carbon dioxide.
 - c. It regulates the earth's temperature over a period of time.
 - d. It provides the gases essential to life and for organisms to perform bodily processes.

7. What subsystem interacts when a rice plant draws water and nutrients from the soil?
- Atmosphere, Biosphere and Geosphere
 - Biosphere, Hydrosphere and Geosphere
 - Geosphere, Atmosphere and Biosphere
 - Hydrosphere, Atmosphere and Geosphere
8. Why are the subsystems interconnected to each other?
- They have the same composition and characteristics.
 - They can alter the flow energy in a minimal amount.
 - They work together to influence the climate, trigger geological processes, and affect life all over the Earth.
 - They are all composed of living things that influence the flow of matter.
9. Oceans cover almost the entire Earth's surface. How does it contribute to Earth's habitable condition?
- It absorbs and redistributes solar radiation.
 - It absorbs and replenishes solar radiation.
 - It protects and absorbs solar radiation.
 - It protects and adsorbs solar radiation.
10. Analyze the ecological phenomena given below. Which of the given situations shows the interaction between hydrosphere and atmosphere?
- Evaporating water
 - Pouring rain
 - Flowing stream
 - Drinking water
11. What is the reason why geosphere is important?
- It provides the environment for all living things to live in and survive.
 - It is the physical sphere that is made up of only molten rock and other materials.
 - It sustains proper amount of water.
 - It regulates the internal and external heat of the earth.
12. Plants use sunlight, water and carbon dioxide during photosynthesis. Which of the following subsystems are interacting during this process?
- atmosphere, biosphere, and hydrosphere
 - atmosphere, biosphere, and geosphere
 - atmosphere, hydrosphere, and geosphere
 - hydrosphere, geosphere, and biosphere

13. Taal Volcano spews gases and ashes into air. How does this scenario affect the atmosphere?
- It decreases the air pressure in the area.
 - It increases the humidity in the area near the volcano.
 - It lessens the atmospheric temperature in the area.
 - It affects the amount of gases in the atmosphere through its emitted gases.
14. Water availability impacts the growth of animals like cows which depend on plants for food. Based on the given situation, which of the following subsystems are involved in this situation?
- Atmosphere and Biosphere
 - Hydrosphere and Biosphere
 - Hydrosphere and Geosphere
 - Atmosphere and Hydrosphere
15. Analyze the given situations below. Which of it shows an interaction between geosphere and atmosphere?
- Water evaporating from the soil
 - Bacteria converting nitrogen to ammonium
 - Plants undergoing the process of transpiration
 - Rocks undergoing the process of weathering due to flood

Lesson

2

Subsystems of the Earth

Earth is the third planet from the sun and considered as haven for many life forms. As a closed system, it serves as harbor of life for billions of years and still continue to comfort innumerable life forms. Thus, Earth itself has different systems that interact with other to provide all the necessities in order for life to continue to prosper.



What's In

Analyze the given illustration below and answer the following questions. Write the answer on a separate sheet.



Figure 1. A Terrarium

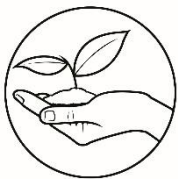
Guide questions:

1. What are the components of the terrarium?
2. Give the functions of each component in the terrarium that enable life to sustain on it.
3. How can you compare the terrarium to an Earth system?



Notes to the Teacher

This module is a self-assisted module however your help is necessary in monitoring and evaluating students work. Make sure that the students completely accomplish all the activities to ensure high quality transfer of learning in this module.



What's New

Listed below are the words associated to the different Earth's subsystem. Highlight them in the Word Hunt Box, then, answer the guide questions that follows. Write your answer on a separate sheet.

SUN	WATER	SOIL	ICE	DEW
HYDROSPHERE	ATMOSPHERE	LITHOSPHERE	VAPOR	LIFE
SAND	RAIN	MOUNTAIN	BIOSPHERE	TREE

W	V	S	S	B	P	F	V	K	D	P	E	P	N	B
L	Q	E	Q	Q	U	L	C	W	S	R	L	T	Y	M
C	Y	E	R	E	H	P	S	O	M	T	A	T	R	M
U	F	E	R	E	H	P	S	O	R	D	Y	H	S	J
X	R	J	P	H	H	I	K	O	D	D	E	V	U	S
B	O	C	F	G	I	P	U	W	J	L	L	X	N	G
A	P	H	P	A	D	B	S	T	Q	P	B	I	C	W
E	A	E	R	E	H	P	S	O	I	B	U	G	O	W
M	V	E	A	R	F	X	L	U	H	P	X	S	E	S
Y	Y	J	F	E	U	Y	D	X	B	T	N	F	B	J
K	T	V	F	T	D	N	A	S	V	S	I	T	J	M
Q	X	H	E	A	V	H	V	G	Y	L	I	L	Q	Q
W	B	Q	E	W	B	U	X	D	Z	O	A	H	G	G
S	N	M	Y	L	C	I	U	U	N	K	N	P	K	Q
E	A	W	Q	D	Y	G	U	S	T	U	W	F	J	W

Guide Questions:

1. How are the words associated to each other?

2. In which subsystem are the words connected?

3. How can you say that the highlighted words are related to subsystems?



What is It

Earth's Subsystems and the Flow of Matter and Energy

Earth is a complex system of interrelating physical, chemical, and biological processes. It is a system in which sets of interconnected components are interacting to form a unified whole. Earth is comprised of four major smaller systems known as subsystems. These are also called as spheres of the Earth. These are the atmosphere, geosphere, hydrosphere, and biosphere.

Atmosphere serves as the Earth's blanket. Its name rooted from the Greek word *atmos* which means gas and *sphaira* which means globe or ball. It is composed of gases in varying amount and its relative abundance is also crucial in different parts of the earth. The air in the atmosphere is generally composed of 78% nitrogen, 21% oxygen, 0.9% argon and the remaining 0.10% is made up of different trace gases and vapor. It serves as the Earth's protection form harmful UV rays and keeps the planet warm through greenhouse gasses. Atmosphere is affected by the Earth's gravity, so this is the reason why as the altitude increases the amount of gases in the atmosphere decreases. It is composed of layers namely: troposphere, stratosphere, mesosphere, thermosphere, and exosphere.

Geosphere comes from the Greek word *geos* meaning ground.

It pertains to the solid part of the earth. It is divided in to three layers such as the crust, mantle, and the core. It is composed of naturally occurring solid aggregate of minerals, organic material or natural glass called rocks. It is also composed of loose particles of rocks that enveloped the surface of Earth called regolith. It contains all the soil, rocks, and minerals present in the crust to the core of the Earth. It comprises the geologic landforms such as mountains and hills.

Hydro is a Greek word which means water. **Hydrosphere** is composed of all the water on Earth in any form. This includes ice, water vapor and liquid water. The permanently frozen part of this subsystem is called **cryosphere**. Earth is the only planet in the solar system that are known to contain water in all three phases.

Water on Earth is constantly and consistently moving because of temperature and salinity. It also plays an important role in absorption and redistribution of solar radiation.

Biosphere came from the Greek word *bios* meaning life. It is composed of all living things and the areas where they are found. It includes all animals, microbes, and plants. It extends to the upper areas of the atmosphere where insects and birds can be found. It also extends to the deep parts of the oceans where marine organisms can still survive. It is also in this zone that the interaction between the different subsystems is most dynamic. In biosphere, each organism plays an important role to the food web. If one is lost the others will be affected.

Matter and energy flows and cycle between the four subsystems to sustain and make life on Earth possible. Both of it can flow across the boundaries between each subsystem. The geosphere is where the rocky part of the earth is in contact with water, air, and life. It is also generally where the spheres intersect and affect each other. The processes that move matter and energy from one sphere to another is called as **sphere interactions**. Changes in any sphere greatly affect the other spheres as well since all the spheres are interconnected system.

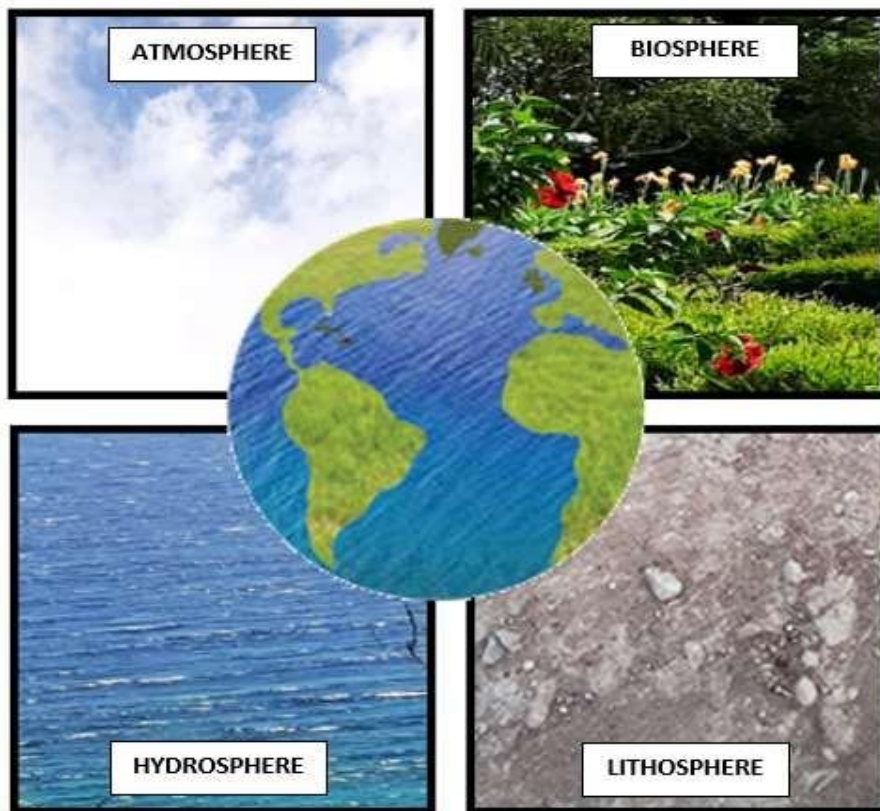
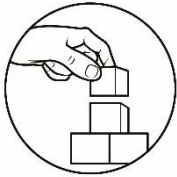


Figure 2. Earth's Subsystems

The four subsystems are closely linked through the **biogeochemical cycles** which involves biological, geochemical, and chemical factors. These cycles are alleyways by which substances move through biotic which is the biosphere and abiotic which is the geosphere, atmosphere and hydrosphere, components of Earth. It allows the circulation of important nutrients that form and support life like carbon, oxygen, nitrogen, phosphorus, calcium, and water. It also maintains the balance of

substances in the different subsystem of the Earth. Any interference and disturbances in the flow of matter and energy may cause damage to any of the subsystems and its components.



What's More

A. Direction. Identify the numbered figure below and give the subsystem it represents. Write your answers in a separate sheet of paper.

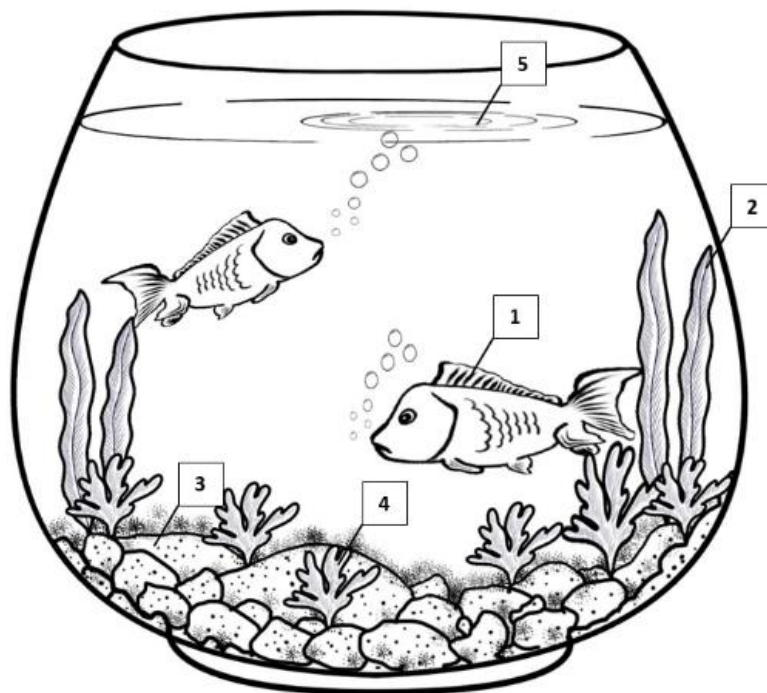


Figure	Subsystem
1	_____
2	_____
3	_____
4	_____
5	_____

A. Write **T** if the statement is **true** and **F** if the statement is **false**. If false, identify the word/words that make the statement incorrect.

- _____ 1. Earth is a multi-part system of interrelating physical, chemical, and biological processes.
- _____ 2. Atmosphere serves as the solid part of the Earth.
- _____ 3. Biosphere is considered as the life zone of the Earth.
- _____ 4. Earth is a dynamic entity with various separate but highly interrelating subsystems.
- _____ 5. Hydrosphere includes all water on the Earth's surface only.
- _____ 6. Earth can sustain and flourish life form due to its components.
- _____ 7. Matter and energy flows and cycle between the two subsystems to sustain and make life on Earth possible.
- _____ 8. Changes in any sphere greatly affects the other spheres.
- _____ 9. Any disturbance and interference in the flow of the matter and energy does not affect any of the subsystems.
- _____ 10. Both the biotic and abiotic components of the earth interact with each other in the biosphere.



What I Have Learned

A. Using the flow chart, identify the subsystems interacting in the carbon and oxygen cycle shown in the picture below. Write your answers in a separate sheet of paper.

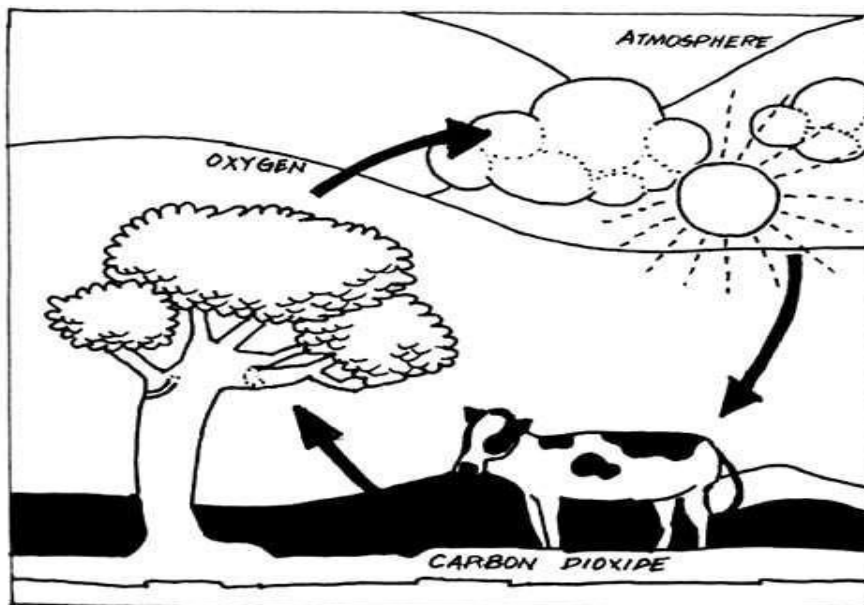


Figure 4. Carbon-Oxygen Cycle

B. Fill in the blanks with the correct word or phrase to complete the discussion of the carbon and oxygen cycle in which matter and energy flows from one subsystem to another. Choose your answer from the word pool below.

Plants Animals Digestion Metabolism Inhale
Photosynthesis Respiration Mining Element Exhale

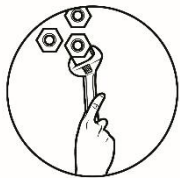
In the process of (1) _____, atmospheric carbon is absorbed by plants. This carbon is transferred from (2) _____ to the

(3) _____ feeding on them, and further moves up the food chain.

(4) _____, (5) _____, and (6) _____ of plants and animals result in some transfer of carbon back to the atmosphere. Some of these living beings buried millions of years ago have been converted to fossil fuels.

(7) _____ and burning fossil fuels can cause this carbon to move from the lithosphere to the atmosphere. Some of this atmospheric carbon gets dissolved in the oceans and thus, completes the cycle.

Oxygen is naturally occurring in the air. Oxygen is also considered as the most common (8) _____ of the human body. It plays a vital role in life forms. This also serves as an essential element in different biomolecules. All aerobic organisms use free oxygen for respiration. They (9) _____ oxygen from the environment and use it in the process of respiration while (10) _____ carbon dioxide. All green plants use carbon dioxide during the process of (11) _____ and release oxygen back into the atmosphere as a by-product. Animals exhale carbon dioxide back into the atmosphere which is again used by the plants during photosynthesis. Now oxygen is released back to the atmosphere.



What I Can Do

Make a concept map on how the four subsystems are connected. Use the word at the center as your reference point. Refer to the rubrics below as your reference in writing your ideas.

Category	4	3	2	1
Content	It shows an understanding of the topic's concepts and principles and uses appropriate terminology and notations. There is no misconceptions	It has some mistakes in terminology or shows a few misunderstandings of concepts. Few misconceptions are evident	It has many mistakes in terminology and shows a lack of understanding of many concepts. Some misconceptions are evident.	It does not show understanding of the topic's concepts and principles. It has many misconceptions.

	or errors evident			
Category	4	3	2	1
Organization of ideas	It is well organized in a logical format.	It is organized and easy to follow.	It is somewhat organized and incoherent.	It is confusing and misleading.
Number of pertinent words	At least 25 pertinent words were used	At least 20 pertinent words were used	At least 15 pertinent words were used	At least 10 pertinent words were used
Hierarchical structure	All concepts are connected in a hierarchical structure leading from complex to specific concepts.	Most concepts are connected in a hierarchical structure leading from complex to specific concepts.	Some concepts are connected in a hierarchical structure leading from complex to specific concepts.	Few concepts are connected in a hierarchical structure leading from complex to specific concepts.
Accuracy of relationship of words	All the concepts are significant and accurately related to each other.	Some concepts are significant and accurately related to each other.	Few concepts are significant and accurately related to each other.	The concepts are given are not related to each other.
Total Score				



Assessment

Multiple Choice. Read and analyze the following questions below. Write the letter that best answer each question. Write your answer in a separate sheet of paper.

1. Earth is made up of landforms like mountains and hills. Which subsystem do mountains and hills belong?
 - a. Atmosphere
 - b. Biosphere

- c. Geosphere
- d. Hydrosphere

2. Why is biosphere important to biodiversity?
 - a. It provides gases needed for respiration.
 - b. It prolongs life on earth through the circulation of proper amount of water.
 - c. It has vital role in climate change.
 - d. It is home to biodiversity within ecosystems and provides a reliable source of food.

3. Oceans cover almost the entire Earth's surface. How does it contribute to Earth's habitable condition?
 - a. It protects and absorbs solar radiation.
 - b. It protects and absorbs solar radiation.
 - c. It absorbs and redistributes solar radiation.
 - d. It adsorbs and replenishes solar radiation.

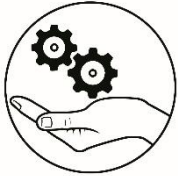
4. How is biosphere different from the other subsystems?
 - a. It is dependent only on hydrosphere and geosphere.
 - b. It is composed of all living organisms.
 - c. It is composed of soil, rocks, and minerals.
 - d. It provides air which supports respiratory processes of living organisms.

5. Analyze the given situations below. Which of it is an interaction between geosphere and atmosphere?
 - a. Bacteria converting nitrogen to ammonium
 - b. Plants undergoing the process of transpiration
 - c. Rocks undergoing the process of weathering due to flood
 - d. Water evaporating from the soil

6. Which of the following is **TRUE** about hydrosphere?
- It includes organisms.
 - It serves as the Earth's blanket.
 - It is affected by temperature and salinity.
 - It is composed of the different landforms of the Earth.
7. Why are hydrosphere and geosphere involved in the given scenario below?
- “Flooding moves soil and rock to new places.”
- Flood, soil, and rock are components of hydrosphere.
 - Soil is part of geosphere while rock is a part of hydrosphere.
 - Flood is a component of hydrosphere while soil and rock are components of geosphere.
 - Flood is a part of geosphere while soil is a component of biosphere.
8. Taal Volcano spews gases and ashes into air. How does this scenario affect the atmosphere?
- It decreases the air pressure in the area.
 - It increases the humidity in the area near the volcano.
 - It lessens the atmospheric temperature in the area.
 - It affects the amount of gases in the atmosphere through its emitted gases.
9. Why is the atmosphere essential to life?
- It only provides blanket the covers the earth's surface.
 - It solely gives oxygen and carbon dioxide.
 - It regulates the earth's temperature over a period of time.
 - It provides the gases essential to life and for organisms to perform bodily processes.

10. What subsystem interacts when a rice plant draws water and nutrients from the soil?
- Biosphere, Atmosphere and Geosphere
 - Geosphere, Atmosphere and Biosphere
 - Biosphere, Hydrosphere and Geosphere
 - Geosphere, Hydrosphere and Atmosphere
11. Which of the following situations show the interaction between hydrosphere and atmosphere?
- Drinking water
 - Flowing stream
 - Freezing water
 - Pouring rain
12. Why is geosphere important?
- It provides the environment for all living things to live in and survive.
 - It is the physical sphere that is made up of only molten rock and other materials.
 - It sustains proper amount of water.
 - It regulates the internal and external heat of the earth.
13. Plants use sunlight, water, and carbon dioxide during photosynthesis. Which of the following subsystems are interacting during this process?
- biosphere, atmosphere, and hydrosphere
 - biosphere, atmosphere, and geosphere
 - geosphere, atmosphere, and hydrosphere
 - geosphere, hydrosphere, and biosphere
14. Water availability impacts the growth of animals like cows who depend on plants for food. Which of the following subsystems are involved in this situation?
- Atmosphere and Biosphere
 - Hydrosphere and Biosphere
 - Hydrosphere and Geosphere
 - Atmosphere and Hydrosphere

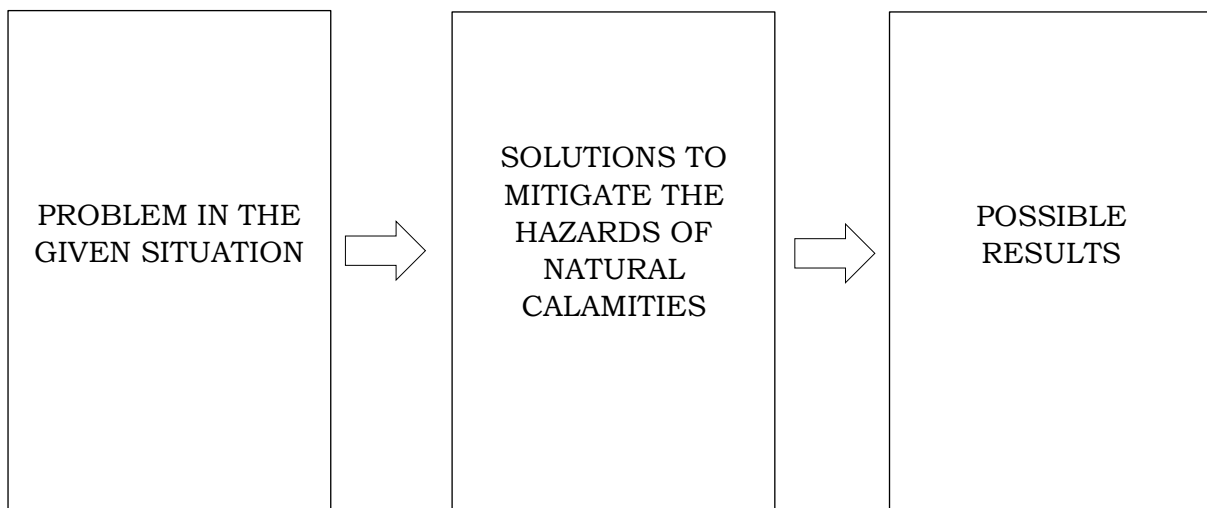
15. Which of the following events show an interaction between geosphere and hydrosphere?
- a. Bacteria converting nitrogen to ammonium
 - b. Plants undergoing the process of transpiration
 - c. Rocks undergoing the process of weathering due to flood
 - d. Water evaporating from the soil



Additional Activities

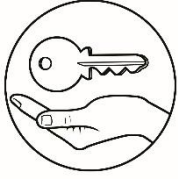
Read the statement below and answer the questions that follow. Write your answers in a separate sheet of paper.

These past few years, Philippines experienced devastating calamities that cause many casualties in different areas. Strong typhoons that cause flash floods, mud slides and storm surges in the areas of Rizal, Leyte, and Samar clearly manifested that the climate change is real. Using the knowledge that you have learned on the interactions of Earth's subsystems, what simple ways can you do to mitigate the hazards of natural calamities? Explain your answer. Refer to the rubrics below as your reference in writing your ideas.



Rubrics:

Category	5	4	3	2	1
Content	The problem was correctly identified and fixated on the main issue. All the solutions were clearly stated. All the results are precise and valid.	The problem was correctly identified and somehow fixated on the main issue. All the solutions were clearly stated. All the results are precise and valid	The problem was correctly identified and somehow fixated on the main issue. Some of the solutions and results given were clearly stated, precise and valid.	The problem was correctly identified and somehow fixated on the main issue. Few solutions and results were clearly stated, precise and valid.	The problem was incorrectly identified. The solutions about the problem and results given were not precise and invalid.
Organization of ideas	The ideas and concepts are precisely organized in a logical format and easy to follow.	Some ideas and concepts are vague but in a logical format but easy to follow.	Few ideas and concepts are vague and unorganized but not misleading.	Few ideas and concepts are incoherent and misleading.	All ideas and concepts are incoherent and misleading
Focus and details	There is one clear, well focused topic and content. Main ideas are clear and are well supported by detailed and accurate information.	There is one clear, well focused topic and content. Main ideas are clear but are not well supported by detailed information.	There is one topic and content. Main ideas are somewhat clear.	There is more than one focus of topic and content. Main ideas are vague and not detailed.	The topic and main ideas are not clear.
Total Score:					



Answer Key

What's More

A.1. Fish-Biosphere
 2. Seaweed-Biosphere
 1. 3. Rocks-Geosphere
 2. 4. Seaweed- Biosphere
 3. 5. Water-Hydrophere
 4.
 B. 1. T
 2. F – solid
 3. T
 4. T
 5. F-only / surface only
 6. T
 7. F- two
 8. T
 9. F-does not
 10. T

What's In

1. 1. Water
 2. 2. Ice
 3. 3. Sand
 4. 4. Mountain
 5. 5. Rain
 6. 6. Dew
 7. 7. Tree
 8. 8. Air
 9. 9. Wind
 10. Clouds

What I Know

1. 1. D
 2. 2. B
 3. 3. B
 4. 4. C
 5. 5. C
 6. 6. D
 7. 7. B
 8. 8. B
 9. 9. A
 10. 10. A
 11. 11. A
 12. 12. A
 13. 13. D
 14. 14. B
 15. 15. A

What I Have Learned

1.1. Photosynthesis
 2.2. Plants
 3.3. Animals
 4.4. Respiration
 5.5. Digestion
 6. Metabolism
 7. Mining
 8. Element
 9. Inhale
 10. Exhale
 11. Photosynthesis
 1.

Assessment

1. C
 2. D
 3. C
 4. B
 5. D
 6. C
 7. C
 8. D
 9. D
 10. D
 11. C
 12. A
 13. B
 14. A
 15. B
 16. C

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