Senior High School

Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

Earth & Life Science

First Quarter-Module 2

Earth's Subsystems

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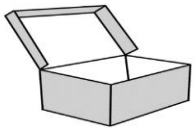
City of Good Character
DISCIPLINE • GOOD TASTE • EXCELLENCE



What I Need to Know

This module was designed and written with you in mind. It is here to help you understand what the different Earth's Subsystems are. 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.

The module has one lesson which is Earth's Subsystems: Geosphere, Hydrosphere, Atmosphere, and Biosphere

After going through this module, you are expected to:

1. explain that the Earth is consists of four subsystems in which there is a constant flow of matter and energy across boundaries (S11/12ES-Ia-e- 4); and
2. list down ways in reducing the negative impacts we make toward Earth's subsystems.

What I Know

Read each question carefully and encircle the letter of the correct answer.

1. Which of the following layers contains most of Earth's mass?
   A. Core
   B. Mantle
   C. Oceanic crust
   D. Continental crust

2. What shows the correct order of Earth's discontinuities?
   A. Conrad, Mohorovicic, Gutenberg, Repetti, Lehmann
   B. Conrad, Mohorovicic, Lehmann, Repetti, Gutenberg
   C. Conrad, Mohorovicic , Gutenberg, Lehmann, Repetti
   D. Conrad, Mohorovicic , Repetti, Gutenberg, Lehmann

3. Asthenosphere is the part of the mantle that flows and moves the plates of the Earth. What are these plates that are like a big jigsaw puzzle?
   A. Lithosphere
   B. Oceanic Crust
   C. Tectonic Plates
   D. Continental Crust

4. Icebergs, ice caps, and glaciers are solid components and part of what subsystem?
   A. Atmosphere
   B. Biosphere
   C. Geosphere
   D. Hydrosphere

5. Which of the following is **NOT** part of hydrosphere?
   A. Boundaries
   B. Ocean
   C. Stream
   D. Vapor

6. How many percent of the Earth's water is considered safe for human consumption?
   A. 1% B. 2% C. 75% D. 97%

7. What is the layer of gases that surround Earth and is retained by our planet's gravity?
   A. Atmosphere
   B. Biosphere
   C. Geosphere
   D. Hydrosphere

8. In what layer of Earth's atmosphere is air suitable for plant photosynthesis and life respiration be found?
   A. Exosphere
   B. Mesosphere
   C. Stratosphere
   D. Troposphere

9. In the water cycle, which process accumulates water as vapor in clouds?
   A. Evaporation
   B. Condensation
   C. Precipitation
   D. Siltation

10. The atmosphere is comprised of layers based on temperature. Which is the correct arrangement of the layers of the atmosphere from the ground?
   A. Mesosphere, Stratosphere, Troposphere, Thermosphere, Exosphere
   B. Troposphere, Stratosphere, Mesosphere, Thermosphere, Exosphere
   C. Stratosphere, Troposphere, Thermosphere, Exosphere, Mesosphere
   D. Stratosphere, Troposphere, Thermosphere, Mesosphere, Exosphere

11. Which biome has a salt level of less than 1% making it safe for drinking?
   A. Coral reef
   B. Estuary
   C. Freshwater
   D. Ocean

12. Which Earth's sphere is heavily affected when Taal Volcano erupted and plants and animals died within and near the volcano?
   A. Atmosphere
   B. Biosphere
   C. Geosphere
   D. Hydrosphere

13. Water vapor is released in the air when a volcano erupts. This may contribute to global warming on Earth. What spheres are affected by such event?
    A. Hydrosphere and Atmosphere
    B. Geosphere and Hydrosphere
    C. Biosphere and Geosphere
    D. Atmosphere and Biosphere

14. Tsunami is known as the secondary effect of earthquake. These two disasters occur in which Earth's subsystems?
    A. Atmosphere and Hydrosphere
    B. Hydrosphere and Geosphere
    C. Biosphere and Geosphere
    D. Atmosphere and Biosphere

15. Landslide is a kind of disaster that can severely affect which Earth's subsystems?
    A. Atmosphere and Hydrosphere
    B. Hydrosphere and Geosphere
    C. Geosphere and Biosphere
    D. Atmosphere and Biosphere

Lesson	Earth's Subsystems: Geosphere, Hydrosphere Atmosphere, and Biosphere

Earth is considered a complete system. As a system, it's a collection of interconnected things or parts forming a full complex. Earth is made of interdependent components called subsystems. These subsystems make the planet unique among all the other planets allowing life to exist in our planet.

Everything in Earth's system may be placed into one in every of four major subsystems: land, water, air, and living things. These four (4) subsystems are also called "spheres" because they're round, a bit like the world. The four spheres are the Geosphere (all the rock and land), Hydrosphere (all the water), Atmosphere (all the gases surrounding the Earth), and Biosphere (all the living things).

What's In

One of the factors that make life possible here in our planet is the Earth's subsystems and its features. Each of these subsystems is important playing a vital role in the function and sustainability of our planet, just as how these subsystems are interrelated to one another. How well do you know our planet?

Activity 1. Picture analysis

Look at the picture below. Can you tell how the components are affecting one another? For example, how does the water here play an integral part to the land? Are the living things present here affected by the type of land? Give at least three (3) observations. Write your answers on the blanks provided on the next page.

Fig. 1. How does the water affect the land, animals, and plants?
Source: Overhulse, Ann. Deer, Wildlife, Vertebrate, Mammal, Herd, Terrestrial Animal, White Tailed Deer, Impala, Fawn, Waterbuck, Adaptation, National Park. January 3, 2019. Pxhere.Com. https://pxhere.com/en/photo/1550785.

1. _____
_____

2. _____
_____

3. _____
_____

What's New

Activity 2. Unscramble me

Unscramble the following letters to find the correct word. Write your answers on the space provided after each number.

1. O I N A E C C C S U R T - _____
2. C A T N E N I T N O L C S R U T - _____
3. C Y O S E R P R H E - _____
4. W E T A R C L C Y E - _____
5. T E N I C T O C P T E L A S - _____
6. T O O H S P R E P R E - _____
7. O N O Z E L E Y A R - _____
8. B M E I O S - _____
9. T O A P I R C L F R O S E T - _____
10. A Q U T A I C B O M I E S - _____

What Is It

Geosphere

Earth's land is part of the subsystem **geosphere** (*geo* means "earth"). The Earth's geosphere, sometimes also called the *Lithosphere* (litho = stone or rock), is the portion of the planet that features rocks and minerals particularly in crust and layer. We depend upon the Geosphere to produce natural resources and an area to grow food. Volcanoes, mountain ranges, deserts, and other natural resources are all a part of the Geosphere.

Earth's layers provide scientists some clues on how the Earth was formed, what layers that make other planetary bodies; and where the source of earth's resources is. Earth's layers, like an onion, can be dissected to describe the physical and chemical properties of every layer, and its influence on the remainder of the earth. In general, our planet has four layers, namely, *crust* (where we live); plastic-like *mantle*; liquid o*uter core*; and solid *inner core*. Earth's crust consists of two basic rock types: granite and basalt. The *continental crust* consists mostly of granite, while *oceanic crust* consists of a volcanic lava rock called basalt. The crust and the upper layer of the mantle together form up a zone of rigid, brittle rock called the *Lithosphere*. A layer below the rigid lithosphere is called *Asthenosphere*, an area with asphalt-like consistency. Asthenosphere is part of the mantle that flows and moves the plates of the world. These plates, called *tectonic plates*, are sort of a gigantic puzzle.

The plates described above are in relative motion, moving at just 3 to 5 cm. per year. It may be associated with heat-driven convection currents within the mantle below. Depending on the connection and geologic setting, there are three varieties of tectonic plate boundaries: *convergent* (moving one toward the other), *divergent* (moving far away from the other) and *transformant* (moving laterally). The actions of boundaries cause most earthquakes and formation of volcanoes. These plates "float" on the soft, plastic layer.

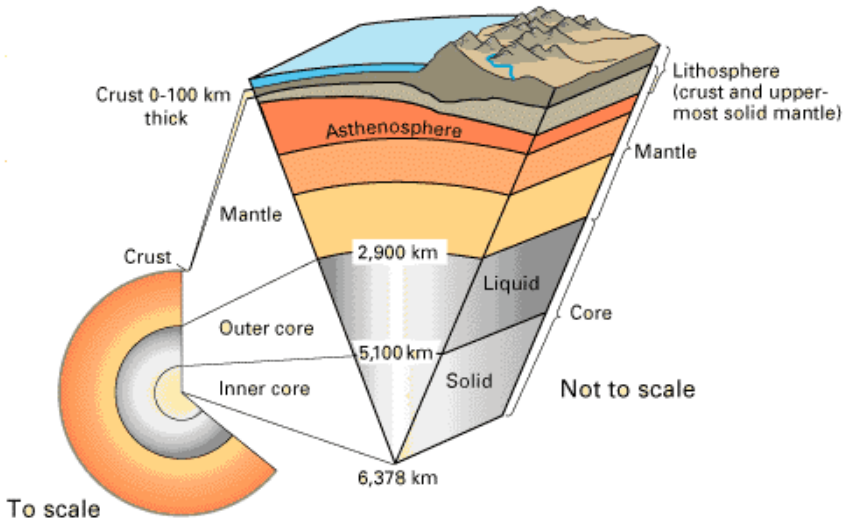


Fig. 2. Layers of the Earth

Source: USGS. *Cutaway Diagram of Earth's Internal Structure (to Scale) with Inset Showing Detailed Breakdown of Structure (Not to Scale).* May 5, 1999. *Wikimedia Commons*. https://commons.wikimedia.org/wiki/File:Earth_cutaway_schematic-en.png.

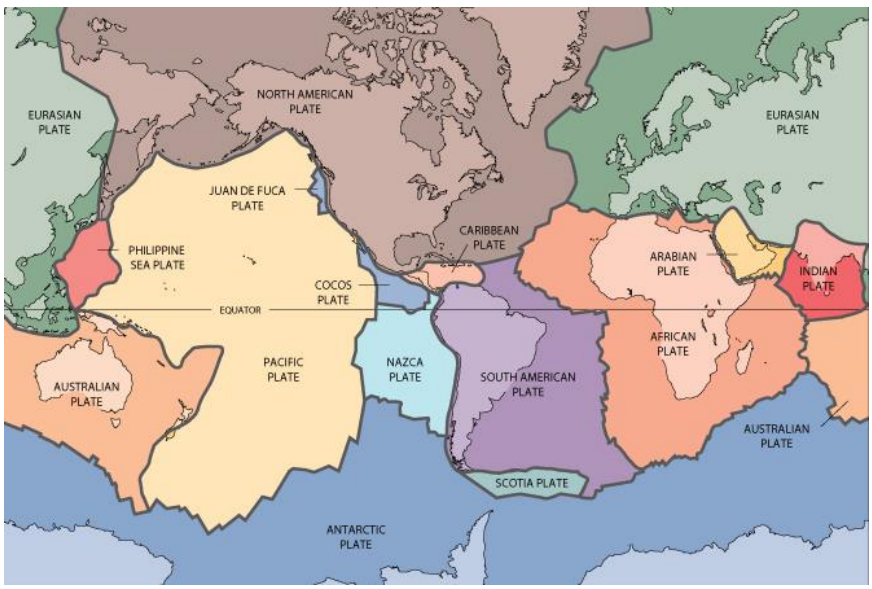


Fig. 3. Earth's Tectonic Plates

Source: USGS. *Tectonic Plates of the Earth.* December 30, 2004. *Wikimedia Commons*. https://commons.wikimedia.org/wiki/File:Tectonic_plates.png.

All the aforementioned layers are separated from each other through a *transition zone*. These transition zones are called Discontinuities. These boundaries appear beneath continents but not usually beneath oceans.

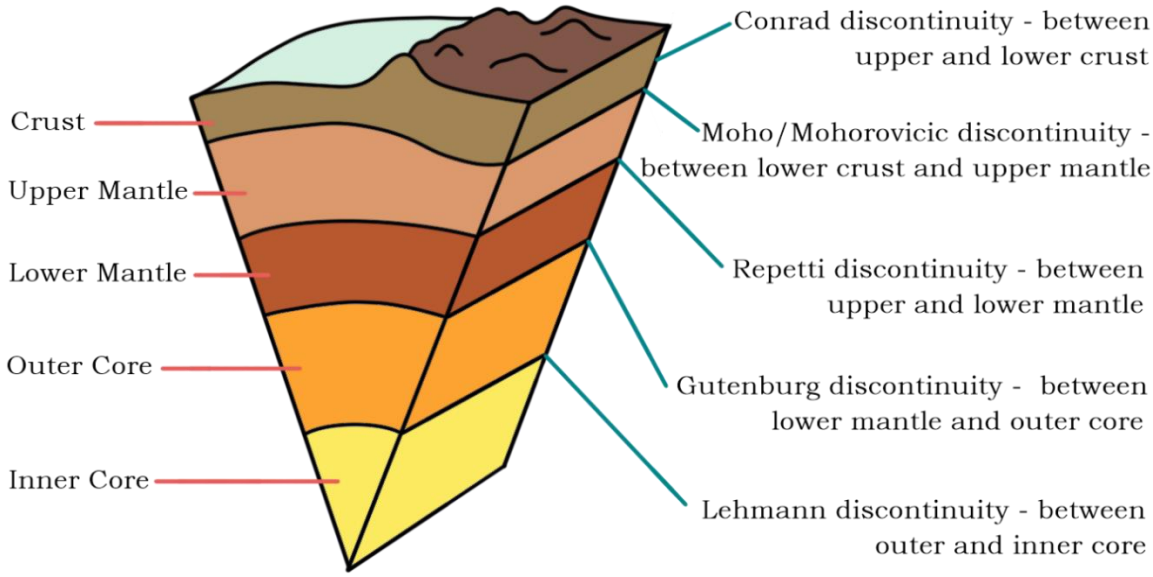


Fig. 4. Earth's discontinuities or boundaries

Five (5) discontinuities inside the Earth *(CoMoReGuLe)*:

1. *Conrad discontinuity*: zone that separates the upper crust from lower crust
2. *Mohorovicic discontinuity*: separates the crust from the asthenosphere
3. *Repetti discontinuity:* found between upper mantle and lower mantle
4. *Gutenberg discontinuity:* separating the lower mantle from the core
5. *Lehmann Discontinuity:* separates the outer core from the inner core

Hydrosphere

The subsystem that features all of the various types of water, which make our planet unique, belong to the **hydrosphere** (*hydro* means "water"). Water is one amongst the most important substances. Without water, life wouldn't be possible. Ninety seven percent (97%) of the hydrosphere is found in salty oceans, a minimum of 2% is in ice sheets, and less than 1% is accessible as freshwater, which is good for human use.

The hydrosphere includes all the solid, liquid, and gaseous water of the world. The solid or frozen part of hydrosphere is in the forms of ice which are the glaciers, ice caps, and icebergs, or collectively called the *cryosphere*. The liquid water is in the form of the bodies of water we all know of oceans, lakes, rivers, streams, groundwater, among others. The gaseous kind of water includes vapor, cloud, or fog. Hydrosphere makes *water cycle* (also known as hydrologic cycle) possible as water undergo processes (evaporation, condensation, and precipitation), that help sustain life.

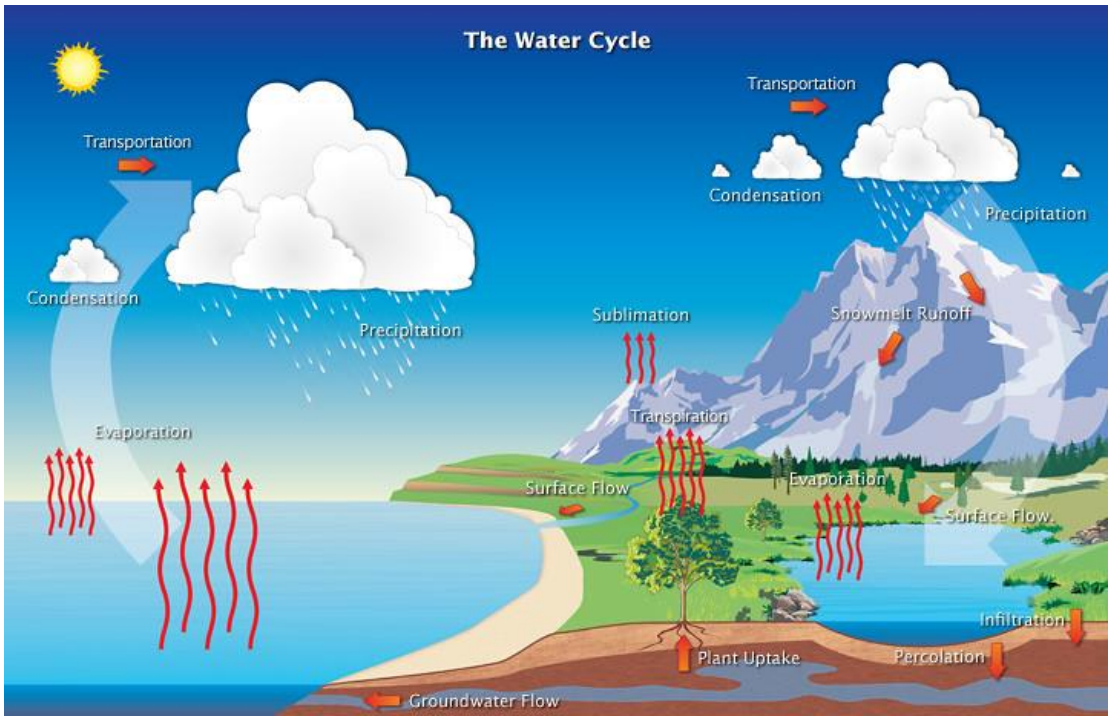


Fig. 5. The water cycle (including some water forms: ocean, stream, groundwater, glacier
Source: AIRS. *The Water Cycle*. December 11, 2012. *Flickr*. https://www.flickr.com/photos/atmospheric-infrared-sounder/8265072146.

Atmosphere

Atmosphere (*atmos* means "air") includes all the gases surrounding the planet. Among all planets, only Earth has the combination of gases to support life.

The atmosphere consists of five (5) layers, and is responsible for Earth's weather. The layers of the atmosphere are shown on the next page. While it looks as if air is formed from nothing, it consists of particles too small to be seen. These particles have weight push down on Earth. The weight of air above us is termed *gas pressure*. The atmosphere has all the air within the Earth's system and each components of it: air, winds, weather, climate, gaseous elements (like dioxide and oxygen), and of others. Each layer of the atmosphere has its functions. The upper portions protect us from sun's UV radiation within the lower atmosphere, weather occurs as temperature changes.

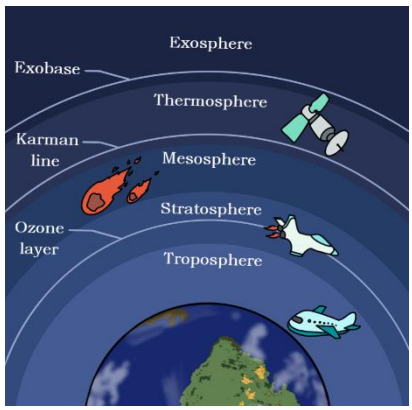


Fig. 6. Layers of the Atmosphere

Biosphere

The biosphere consists of all the parts of Earth where life exists. *Bio* means "life", and it refers to any or all the living things on Earth. This refers to the

complex root systems of trees, to the deep and dark environment of ocean trenches, to abundant rain forests and high mountaintops. It also include fish, birds, insects, other animals, plants, people, and even microscopic organisms like bacteria and fungi.

The addition of oxygen to the biosphere allowed more complex life-forms to evolve like millions of various plants and other photosynthetic species developed. Animals, which consume plants (and other animals) also evolved. Bacteria and other organisms developed to decompose, or break down the remains of dead animals and plants. The biosphere benefits from this *food cycle*. The decomposing dead plants and animals discharged nutrients into the soil and ocean. These nutrients are re-absorbed by growing plants. This interchange of food and energy makes the biosphere a system that can supporting and regulate itself.

Biosphere is sometimes thought of as a very large *ecosystem*—a complex community of living and nonliving things functioning mutually as a unit. More often, however, biosphere is described as having many ecosystems.

Biomes

Biosphere is distributed in major life zones called *biomes*. The importance of biomes cannot be underestimated. Biomes have changed and moved over and over during the history of life on Earth. At present, human activities have significantly changed these communities. Thus, conservation and preservation of biomes should be a significant concern to us all. Here we grouped biomes to which they are further classified into sub-groups:

1. *Aquatic Biomes* - Freshwater, and Marine
2. *Desert Biomes* - Hot and dry Desert, Semi-arid Desert, Coastal Desert, and Cold Desert
3. *Forest Biomes* - Tropical (Rain)forest, Temperate, and Boreal (Taiga)
4. *Grassland Biomes*- Tropical Grassland (Savanna), Temperate Grassland
5. *Tundra Biomes* - Arctic Tundra, and Alpine Tundra

Fig. 7. Some examples of Biomes

Source:

(1) Strzelecki, Michal, Wojtek Strzelecki, and Jerzy Strzelecki. *Underwater Life of Klein Bonaire - Composite of 8 Photos from Snorkeling on a Flat Coral Reef off the Islet Klein Bonaire.* December

1, 2008. *Wikimedia Commons*. https://commons.wikimedia.org/wiki/File:Kleine_Bonaire-Underwater_life(js).jpg.
(2) Sand Dune, Desert Landscape, Habitat, Ecosystem, Mongolia, Sahara, Erg, Gobi, Natural Environment, Geographical Feature, Aeolian Landform, Singing Sand. February 27, 2017. Pxhere.Com. https://pxhere.com/en/photo/873947.
(3) Miller, K. An Aerial View of Lake Clark's Boreal Forests. 2010. Www.Nps.Gov. https://www.nps.gov/lacl/learn/nature/forests.htm.
(4) Adesgo. *Nature, Field, Agriculture, Vegetation, Crop, Grassland, Plain, Land Lot, Farm, Prairie, Pasture, Grass, Rural Area, Biome, Shrubland, Ecoregion, Soil, Grass Family, Meadow, Plantation, Tree, Plant Community*. January 11, 2018. *Pxhere.Com*. https://pxhere.com/en/photo/1419264.
(5) Kirsh, Michael. *Snow Fields Lie on the Tundra at Rocky Mountain National Park. In This Scene, Rock in the Foreground Gives Way to a Series of High Altitude Pine Forests and Snow Fields. Distant Mountains Lie under Stormy Clouds*. June 1, 2012. *Wikimedia Commons*. https://commons.wikimedia.org/wiki/File:Tundra_Snow_Fields.jpg.

The living part of the Earth interrelates with all the other spheres. Living things need water (hydrosphere). They also live on land (geosphere), and chemicals from the atmosphere, and nutrients gained by eating things in the biosphere. Since life occurs on the ground, in the air, and in water, the biosphere therefore intersects with all other spheres.

Even though the four systems have their different identities, there is a significant interaction between them. As you can see below, each of the subsystem is connected to certain event or a given component. The said event or component connects one subsystem to other subsystems, hence, the back and forth arrows.

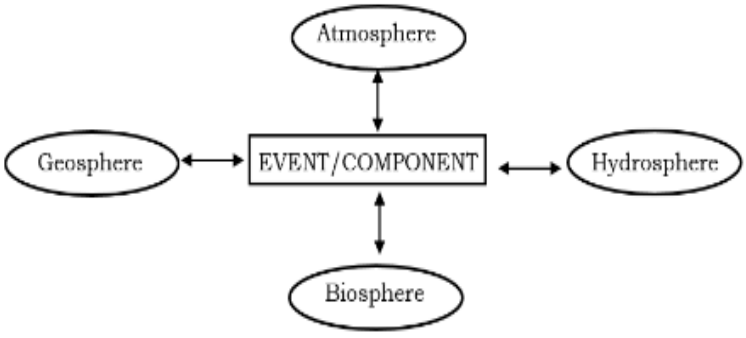


Fig. 8. An interaction between Earth's subsystems, with event or component that connects all four spheres

Look at the next figure (Fig. 9). Living things such as insects and flowers are tiny parts of the biosphere, and yet, they are being affected by the other bigger parts of other subsystems.

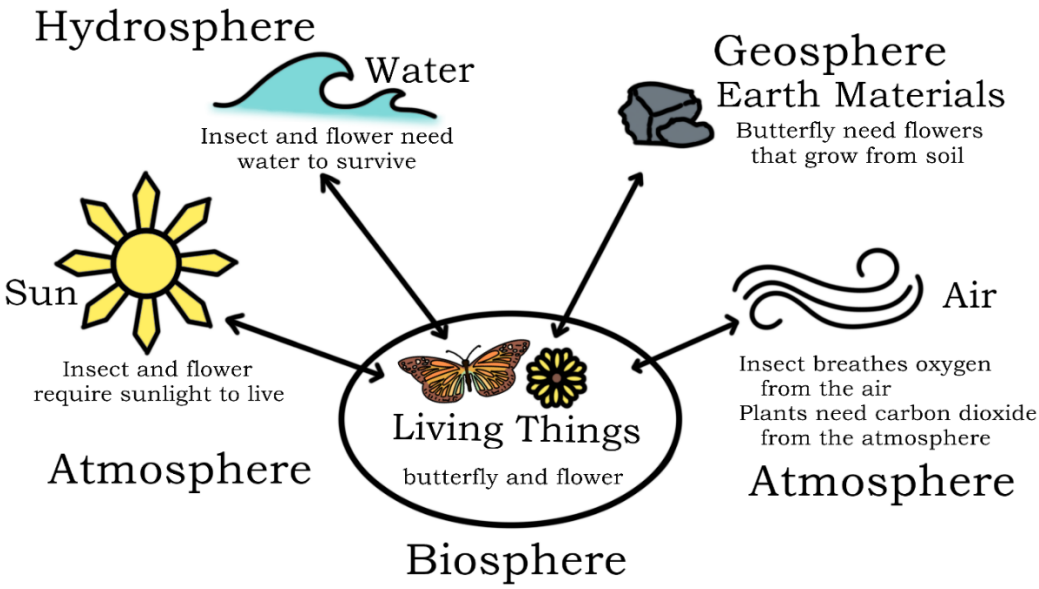


Fig. 9. An example of interaction between Earth's subsystems

Aside from the four interactions mentioned above, each subsystem also affects other spheres (as indicated by the red arrows in the next diagram), creating additional six (6) cause-effect relationships among the subsystems that go in both directions. These total of ten (10) interactions (black and red arrows) that occur in our Earth system often result to a series of chain reactions or ripple effects among and through the subsystems.

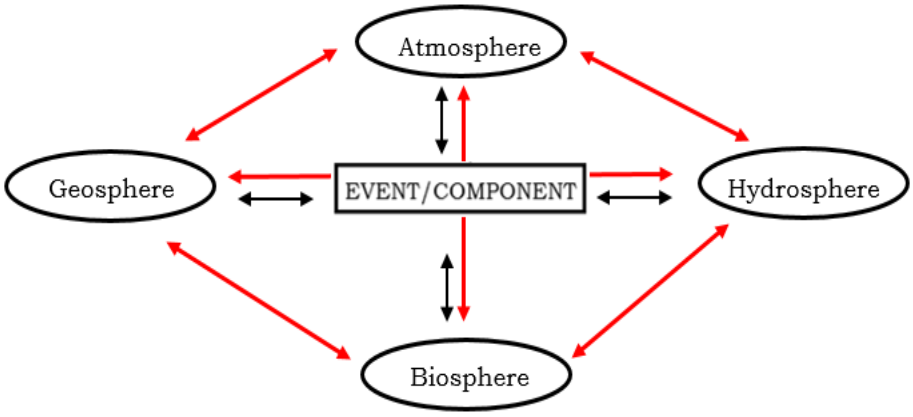


Fig. 10. An interaction between Earth's subsystems, with event or component that connects all four spheres, and how they all affect one another

See the following example:

Volcanic eruption (an example of event happening in the geosphere) releases a large amount of particulates like ash into the atmosphere. These particles helped in the formation of water droplets found in hydrosphere. Rainfall (hydrosphere) usually occurs following an eruption, that later help in plant growth (biosphere). Particulate matter in the air (atmosphere) goes down, consequently enriching the soil (geosphere) and can promote plant growth (biosphere). Soil which came from volcanic eruption can be used by man and animal (biosphere). Years go by, the soil can be part of the volcano (geosphere).

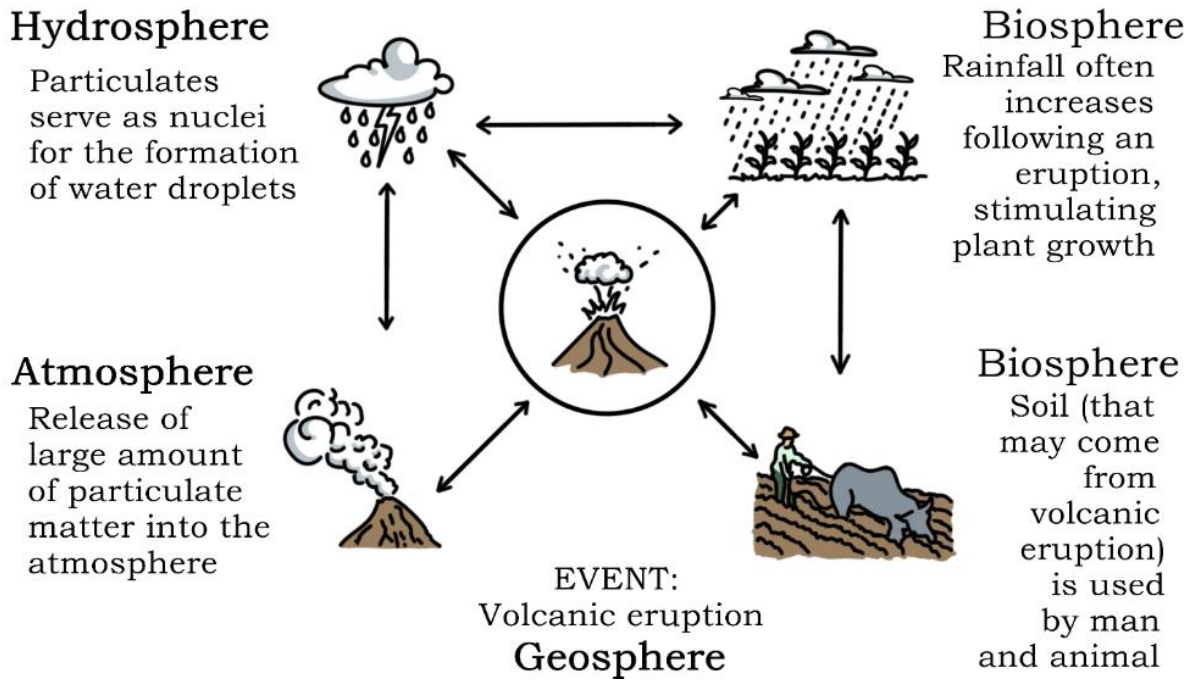


Fig. 11. Another example of interaction between Earth's subsystems, With event or component that connects all four spheres

Energy and Matter Flow in the Biosphere

A massive amount of energy reaches Earth from the Sun. At the same time, there is a never-ending loss of energy from the Earth. The energy is considered lost in the form of heat when it goes back out from Earth's surface, beyond Earth's atmosphere. The Earth's atmosphere is able to trap some of this heat, warming the atmosphere and making Earth habitable due to its temperature. Matter is used repeatedly as it moves through Earth's four spheres. The different nutrients or *biogeochemical cycles* presented below (Nitrogen cycle, Oxygen cycle, and Carbon cycle) show this concept. The nutrients may transform or take lots of years to have their cycle complete, but no matter is lost as they go through Earth's four spheres.

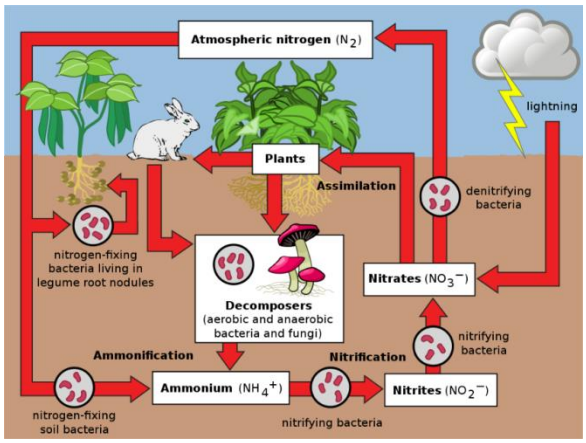


Fig. 12. Nitrogen cycle, one of the biogeochemical cycles
Source: Dréo, Johann. *Nitrogen Cycle*. August 2, 2019. *Wikimedia Commons*. https://commons.wikimedia.org/wiki/File:Nitrogen_Cycle_2.svg.

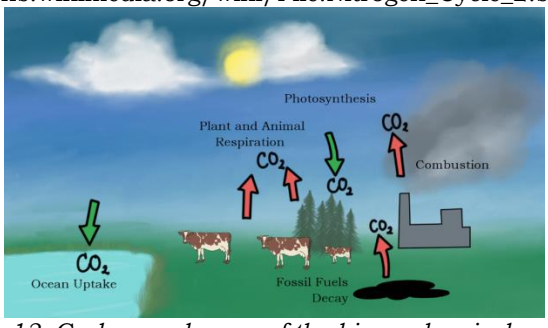


Fig. 13. Carbon cycle, one of the biogeochemical cycles

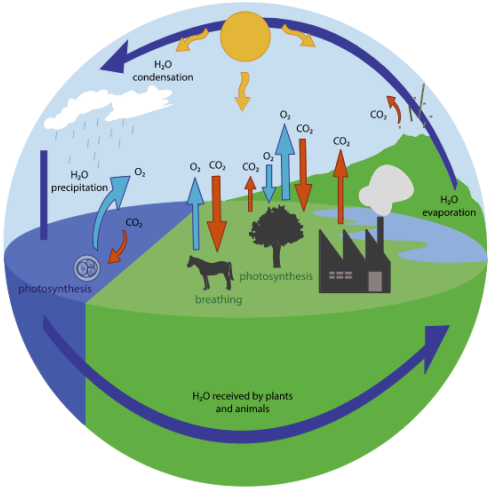
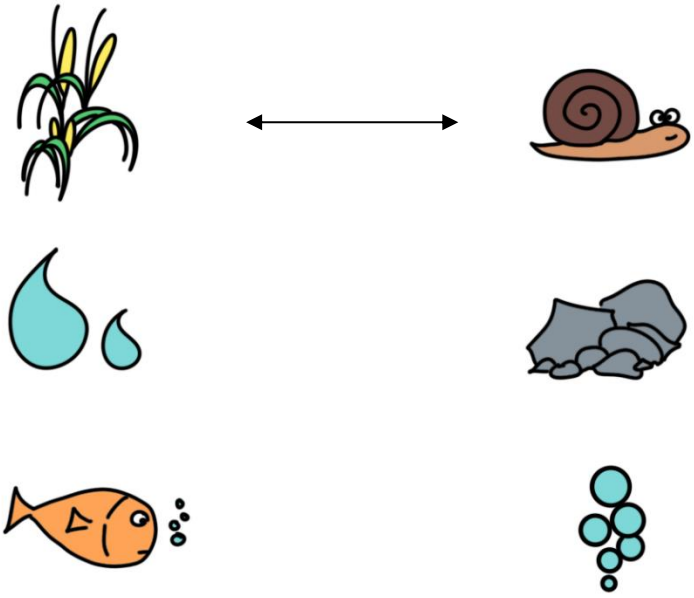


Fig. 14. Oxygen cycle, one of the biogeochemical cycles
Source: Chicano, Eme. *Oxygen Cycle. Water (H_2O) Falls as Rain over Land and over the Sea, and Animals and Plants Receive It. A Part of the Remaining Water Evaporates so That It Condenses Again to Form Clouds. Another Part of the Water Fallen on Land Either Seeps into the Interior of the Earth or Flows through Streams and Rivers. Through Photosynthesis, Phytoplankton, Plants and Trees Incorporate CO_2 and Release O_2 into the Atmosphere.* June 15, 2015. *Wikimedia Commons*. https://commons.wikimedia.org/wiki/File:Oxigen_cycle_1.svg.

What's More

Activity 3. Mix and match

1. Look at the following figures below.
2. Draw one (1) back and forth arrow (⟷) between two organisms of your choice.
3. Give the relationship between the two organisms you chose to connect with one another.
4. Identify also the subsystem where each organism belongs.
5. Write your answers on the blanks provided. One (1) example is given for your reference.



Example: Plant (Biosphere) ⟷ Snail (Biosphere): The plant serves as food for the snail, while the snail's leftovers or the nutrients from snail's decomposing body will be absorbed by the plant as it grows.

1. _____ ⟷ _____: _____
   _____
   _____

2. _____ ⟷ _____: _____
   _____
   _____

3. _____ ⟷ _____: _____
_____
_____

4. _____ ⟷ _____: _____
_____
_____

5. _____ ⟷ _____: _____
_____
_____

What I Have Learned

Activity 4. Now I know

Answer the following questions based on the lesson learned. Write your answers on the blank provided for you.

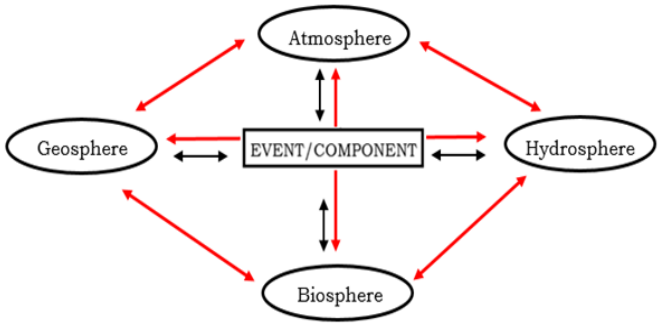
1. How is Oceanic crust different from Continental crust?
   _____
   _____
2. How does water sustain life on Earth?
   _____
   _____
3. How will the quality of air affect living things?
   _____
   _____
4. What makes Biosphere considered as the zone of life?
   _____
   _____
5. What will happen if one of the biogeochemical cycles is not completed?
   _____
   _____

What I Can Do

Activity 5. All subsystems go!

Do the following activity that shows how one environmental event can affect all the Earth's subsystems.

1. Choose one (1) environmental event or problem that you would like to work on. Here are some suggestions: Deforestation; Flooding; Ozone depletion; Tsunami; Wildfire; Drought.
2. Think how this event may affect the Earth's subsystems (black arrows): geosphere/lithosphere, atmosphere, hydrosphere, and biosphere; and how one subsystem affects the other subsystems (red arrows).You may use the format given in the volcanic eruption above (like with illustrations) or like the diagram here:



3. Create a simple diagram that will show the connection among the subsystems and how the processes in subsystems affect us all.
4. Use another sheet of paper for your diagram.
5. Make your output complete, clean, organize, and creative. See to it that you submitted your output on the given time.

RUBRICS FOR GRADING:
Contents – 40% Information – 30% Presentation – 30%

Posttest

Read each question carefully and encircle the letter of the correct answer.

1. Asthenosphere is the part of the mantle that flows and moves the plates of the Earth. What are these plates that are like a big jigsaw puzzle?
   A. Lithosphere
   B. Oceanic Crust
   C. Tectonic Plates
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2. Which of the following layers contains most of Earth's mass?
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   D. Conrad, Mohorovicic , Repetti, Gutenberg, Lehmann

4. Which of the following is **NOT** part of hydrosphere?
   A. Boundaries
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   C. Stream
   D. Vapor

5. How many percent of the Earth's water is considered safe for human consumption?
   A. 1% B. 2% C. 75% D. 97%

6. Icebergs, ice caps, and glaciers are solid components, and part of what subsystem?
   A. Atmosphere B. Biosphere C. Geosphere D. Hydrosphere

7. What is the layer of gases that surround Earth and is retained by our planet's gravity?
   A. Atmosphere
   B. Biosphere
   C. Geosphere
   D. Hydrosphere

8. In the water cycle, which process accumulates water as vapor in clouds?
   A. Evaporation B. Condensation C. Precipitation D. Siltation

9. The atmosphere is comprised of layers based on temperature. Which is the correct arrangement of the layers of the atmosphere from the ground?
   A. Mesosphere, Stratosphere, Troposphere, Thermosphere, Exosphere
   B. Troposphere, Stratosphere, Mesosphere, Thermosphere, Exosphere
   C. Stratosphere, Troposphere, Thermosphere, Exosphere, Mesosphere
   D. Stratosphere, Troposphere, Thermosphere, Mesosphere, Exosphere

10. In what layer of Earth's atmosphere is air suitable for plant photosynthesis and life respiration be found?
A. Exosphere B. Mesosphere C. Stratosphere D. Troposphere

11. Which biome has a salt level of less than 1% making it safe for drinking?
A. Coral reef B. Estuary C. Freshwater D. Ocean

12. Which Earth's sphere is heavily affected when Taal Volcano erupted and plants and animals died within and near the volcano?
A. Atmosphere
B. Biosphere
C. Geosphere
D. Hydrosphere

13. Landslide is a kind of disaster that can severely affect which Earth's subsystems?
A. Atmosphere and Hydrosphere
B. Hydrosphere and Geosphere
C. Geosphere and Biosphere
D. Atmosphere and Biosphere

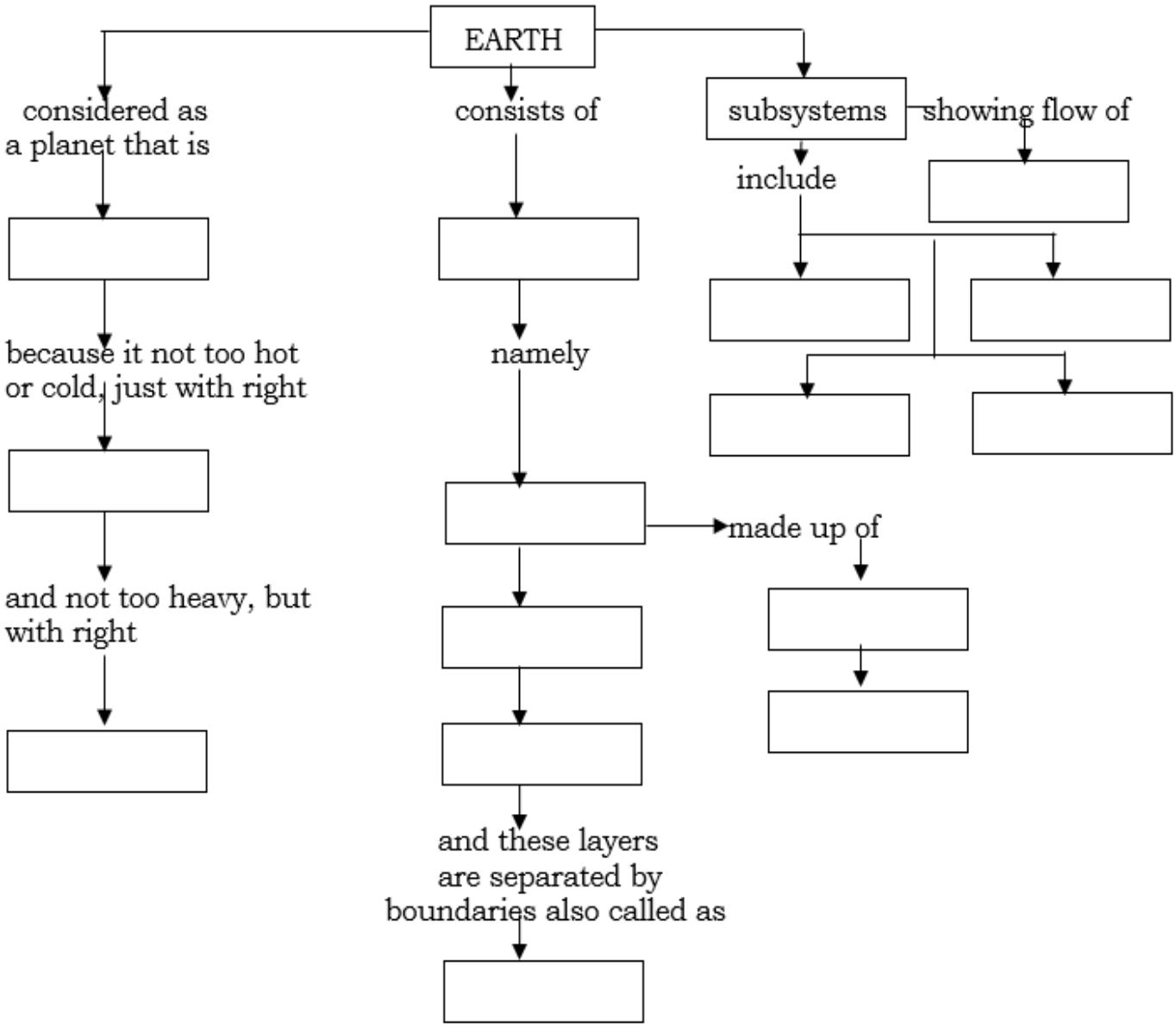
14. Water vapor is released in the air when a volcano erupts. This may contribute to global warming on Earth. What spheres are affected by such event?
A. Hydrosphere and Atmosphere
B. Geosphere and Hydrosphere
C. Biosphere and Geosphere
D. Atmosphere and Biosphere

15. Tsunami is known as the secondary effect of earthquake. These two disasters occur in which Earth's subsystems?
A. Atmosphere and Hydrosphere
B. Hydrosphere and Geosphere
C. Biosphere and Geosphere
D. Atmosphere and Biosphere

Additional Activities

A. Complete the concept map below by filling out the boxes with the appropriate concepts using the linking words/phrases as guide on how these concepts are related to each other.

temperature	layers	geosphere	matter and energy
habitable	biosphere	atmosphere	hydrosphere
core	mantle	crust	discontinuities
oceanic crust	mass	continental crust	



B. Match Column A with the words in Column B. Write your answers on the blank provided. Use capital letters only.

A	B
_____1. It contains oxygen, water vapor and other gases that help living things survive.	A. Asthenosphere
_____ 2. This subsystem is also known as the zone of life.	B. Atmosphere
_____3. This part of a subsystem includes ice, glaciers, ice caps, and icebergs.	C. Biogeochemical Cycles
_____4. These components of a subsystem describe that Earth has boundaries in between layers.	D. Biomes
_____5. It contains all the solid, liquid, and gaseous water in the planet.	E. Biosphere
_____6. This subsystem shows what is inside the Earth, especially where the energy is coming from.	F. Cryosphere
_____7. This part of a subsystem is the portion of the Earth that includes rocks and minerals particularly in crust and upper mantle.	G. Discontinuities
_____8. This layer is a zone of asphalt-like consistency just below lithosphere.	H. Geosphere
_____9. They are considered as the world's major communities.	I. Hydrosphere
_____10. These processes show how energy and matter flow in the biosphere.	J. Lithosphere

References

(1) "8.6 Earth Systems Interactions." Earth Systems Interactions. Accessed July 28, 2020. https://www.csun.edu/science/books/sourcebook/chapters/8-organizing/files/earth-systems-interactions.html.

(2) "Biomes and Climate - NYBG Professional Learning for Teachers." Google Sites. Accessed July 28, 2020. https://sites.google.com/site/nybgpd/lesson-plans/biomes-and-climate.

(3) "Carbon Cycle – Definition, Human Impacts, Importance & Diagram." Science Facts, February 25, 2020. https://www.sciencefacts.net/carbon-cycle.html.

(4) "Connect the Spheres: Earth Systems Interactions." NASA. NASA. Accessed July 28, 2020. https://pmm.nasa.gov/education/lesson-plans/connect-spheres-earth-systems-interactions.

(5) "Earth System Definitions." Start page. Accessed July 28, 2020. http://www.igbp.net/globalchange/earthsystemdefinitions.4.d8b4c3c12bf3be638a80001040.html.

(6) “Layers of the Atmosphere: Exosphere; Thermosphere; Mesosphere; Stratosphere and Troposphere. Vert...: Earth's Atmosphere Layers, Earth Atmosphere, Earth's Atmosphere.” Pinterest. Accessed July 28, 2020. https://www.pinterest.ph/pin/227431849918714585/.
(7) “Lithosphere–Asthenosphere Boundary.” Wikipedia. Wikimedia Foundation, June 26, 2020.
(8) “Next Generation Science Videos For K-5.” Generation Genius, March 25, 2020. https://www.generationgenius.com/earths-spheres/.
(9) “Nitrogen Cycle.” Wikipedia. Wikimedia Foundation, July 20, 2020. https://en.wikipedia.org/wiki/Nitrogen_cycle.
(10) “Oxygen Cycle and Bibliography.” Cycles Around The World. Accessed July 28, 2020. http://cyclesaroundtheworld.weebly.com/oxygen-cycle-and-bibliography.html.
(11) “Plate Tectonics.” Plate tectonics - SEG Wiki. Accessed July 28, 2020. https://wiki.seg.org/wiki/Plate_tectonics.
(12) Al-Attili, A. “Unit 1 The Earth System and Its Components.” 2.2 Defining the earth system. Accessed July 28, 2020. https://www.soas.ac.uk/cedep-demos/000_P500_ESM_K3736-Demo/unit1/page_15.htm.
(13) Earth System Science. Accessed July 28, 2020. http://www.cotf.edu/ete/ESS/ESSmain.html.
(14) Friedman, Janice. “Everything You Need To Know About The Water Cycle and Different Phases.” Conservation Institute, November 2, 2018. https://www.conservationinstitute.org/water-cycle/.
(15) Geiger, Beth. “Explainer: Earth - Layer by Layer.” Science News for Students, February 24, 2020. https://www.sciencenewsforstudents.org/article/explainer-earth-layer-layer.
(16) Harwood, Jessica, Douglas Wilkin, Doris Kraus, Niamh Gray-Wilson, Jean Brainard, Sarah Johnson, Jane Willan, and Corliss Karasov. “Ecology Overview.” CK. CK-12 Foundation, July 20, 2020. https://www.ck12.org/c/life-science/ecology-overview/lesson/Introduction-to-Ecology-MS-LS/.
(17) HQ, Learn Astronomy. “Learn Astronomy HQ.” 15 "Goldilocks" Factors That Allow Life on Earth to Exist. Accessed July 28, 2020. https://www.learnastronomyhq.com/articles/15-goldilocks-factors-that-allow-life-on-earth-to-exist.html.
(18) Micu, Alexandru. “What Are the Layers of the Earth?” ZME Science, August 21, 2018. https://www.zmescience.com/other/science-abc/layers-earth-structure/.
(19) National Geographic Society. “Earth's Systems.” National Geographic Society, September 11, 2019. https://www.nationalgeographic.org/article/earths-systems/.
(20) Shakopee Public Schools Follow. “Energy Transfer in Ecosystems.” LinkedIn SlideShare, September 14, 2012. https://www.slideshare.net/SeanHildebrandt/energy-transfer-in-ecosystems.
(21) Squires, Dwayne. “Chapter 9.3: Matter and Energy in Ecosystems.” LinkedIn SlideShare, February 9, 2009.

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