Senior High School

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# EARTH SCIENCE for STEM
# Quarter 2 – Module 9: How Layers of Rocks (Stratified Rocks) are Formed

ALTERNATIVE DELIVERY MODE
ADM

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**Alternative Delivery Mode**
**Quarter 2 – Module 9: How Layers of Rocks (Stratified Rocks) are Formed**
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# Quarter 2 – Module 9:
# How Layers of Rocks (Stratified Rocks) are Formed

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# 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.

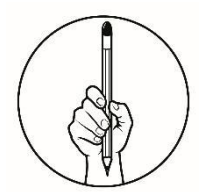
Thank you.

# *What I Need to Know*

This module was designed and written to introduce to you a better understanding of stratification and how layers of rocks (stratified rocks) are formed. It includes the study of how these rocks relate to time. The learners will study Earth's history by studying the record of past events that is preserved in the rocks.

At the end of this module, the successful learner will be able to:

1. identify different types of rocks and how they are formed
2. describe how layers of rocks (stratified rocks) are formed
3. explain the processes in the formation of sedimentary rocks



## *What I Know*

Read and analyze the following questions. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. What are the three types of rocks?
   a. weathering, erosion, deposition
   b. sedimentary, deposition, igneous
   c. igneous, sedimentary, metamorphic
   d. metamorphic, sedimentary, deposition

2. In which type of rock do most fossils appear?
   a. deposition
   b. igneous
   c. metamorphic
   d. sedimentary

3. Which type of rock is formed when bits of rocks are layered and cemented together?
   a. deposition
   b. igneous
   c. metamorphic

4. sedimentary Which of the following is **NOT** an example of sedimentary particles?
   a. gravel
   b. limestone
   c. sandstone
   d. shale

5. Which of the following refers to a series of processes on earth's surface and in the crust and mantle that slowly changes rocks from one kind to another?
   a. crystallization
   b. erosion
   c. rock cycle
   d. water cycle

6. What step in the rock cycle would be required to change an igneous rock into a sedimentary rock?
   a. heat and pressure
   b. melting and cooling
   c. melting and pressure
   d. weathering, erosion, deposition, compaction, and cementation

7. During which process does layer upon layer of sediment build up and exert pressure on the layers below?
   a. compaction
   b. deposition
   c. erosion
   d. weathering

8. What is the moving of sediments from their original position called?
   a. deposition
   b. erosion
   c. lithification
   d. weathering

9. What is the settling out of the sediment called?
   a. compaction
   b. deposition
   c. lithification
   d. weathering

10. Which of the following choices best describes the statements below?
   I. The layers or rocks are piled one on top of the other.
   II. Sedimentary rocks are formed particles by particles and bed by bed.
   III. In sequence of layered rock, a given bed must be younger than any bed on top of it.

   a. Only statement I is true.
   b. Only statement II is false.
   c. Statements I and II are true.
   d. Statements I and III are true.

11. What is the process called where sediment is glued together when minerals are dissolved?
   a. cementation
   b. compaction
   c. deposition
   d. weathering

12. Which of the following describes the law of superposition?
   a. Objects are more than 1 million years old.
   b. Older layers are generally deeper than more recent layers.
   c. More recent layers are generally deeper than older layers.
   d. Older layers are generally thicker than more recent layers.

13. Which of the following is a process that leads to the formation or deposition of rock layers?
   a. compaction
   b. metamorphism
   c. sedimentation
   d. stratification

14. Which of the following does NOT lead to the formation of rock layers?
   a. change in particle size
   b. erosion and weathering
   c. rock sediments remained on its position
   d. successive lava flow

15. Which of the following principles states that all rock layers are continuous until they encounter other solid bodies that block their deposition?
    a. Law of Deposition
    b. Law of Lateral Continuity
    c. Law of Original Horizontality
    d. Law of Superposition

# Lesson 9 How Layers of Rocks (Stratified Rocks) Are Formed

Look around your backyard. A single, large rock, such as a boulder, or little bits, such as gravel and sand, can be seen. According to geologists, rocks are generated in a variety of ways, and the differences between them are due to how they are formed.

## *What's In*

Sedimentary, igneous, and metamorphic rocks are the three basic types of rocks. Physical changes, such as melting, cooling, eroding, compacting, or deforming, are responsible for the formation of each of these rocks that are part of the rock cycle. The rock cycle is a concept that describes how the three fundamental rock types are related and how earth's activities convert a rock from one kind to another over geologic time. The continual recycling of rocks is due to plate tectonic action, as well as weathering and erosional processes. Igneous rocks are formed by melting, cooling, and crystallization of other rocks and are results of volcanic activity, hot spots, and melting that occurs in the mantle. Sedimentary rocks are formed by weathering, erosion, deposition, compaction, and cementation of other rocks that are mostly found in areas where water, wind, or gravity deposit sediments. Metamorphism is the process through which existing rock transforms into new types of rock, resulting in metamorphic rocks.

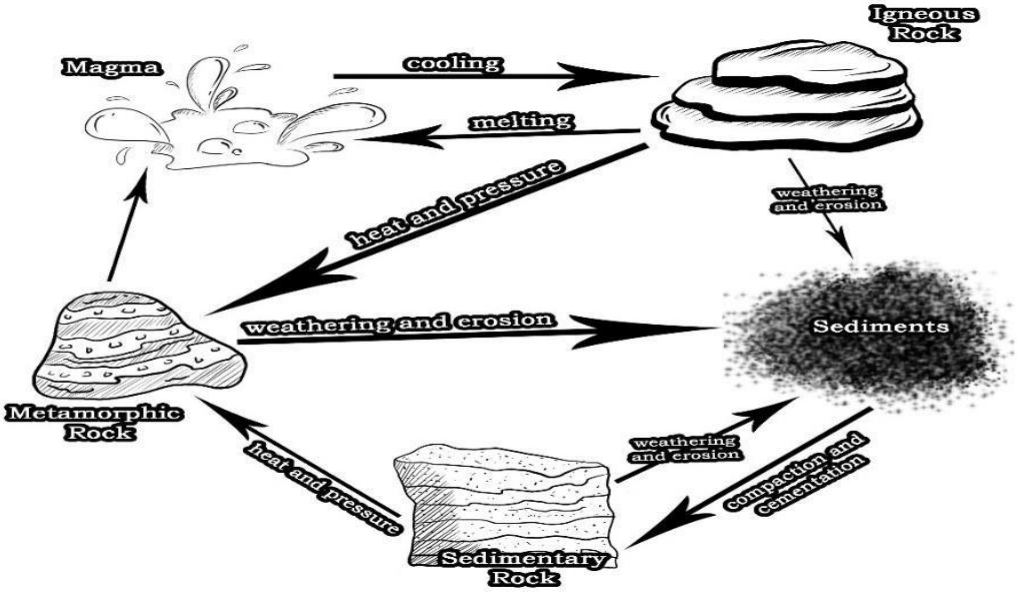



**Figure1.** The Rock Cycle

## Activity 1

Analyze Figure 1 which depicts the transformational processes that lead to the transition of one type of rock into another. This will show the full formation of rocks as they change over millions of years.

Based on your knowledge in rock cycle, indicate if the given process and rock properties lead to the formation of igneous rock, sedimentary rock, or metamorphic rock. Use another sheet of paper in answering the activity. Your answer should be numbered in accordance with the number of process and rock properties listed on the table.

| **Process and Rock Properties** | **Igneous Rock/Sedimentary rock/Metamorphic rock** |
|---|---|
| 1. Weathering and erosion | |
| 2. Intense heating and pressure | |
| 3. Magma cools and solidifies | |
| 4. Melting of rocks | |
| 5. Cementation of grains | |
| 6. Rocks never contain fossils | |
| 7. Crystallization of magma | |
| 8. Foliated rocks | |
| 9. Rocks contain fossils of animals and plants | |
| 10. Compaction of sediments | |
| 11. Rocks are more compact and denser | |

***Notes to the Teacher***

Have the students be guided on their basic needs in learning activities, practically necessities like materials needed in school, at home or personal protective equipment during such situation when they are necessary. The teacher may share the link https://tinyurl.com/majestyofpetra for the image of Majesty of Petra so that the students may correctly answer the activity in ***What's New***.

## *What's New*

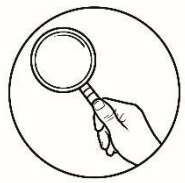
The Majesty of Petra is considered as one of the New Seven Wonders of the World located in Jordan. Petra's two most significant attractions are the Treasury and the Monastery which are massive temples carved into the side of sandstone cliffs. Sandstone is a sedimentary rock composed of sand-size grains of mineral, rock, and organic material. Layering is the most obvious feature of sedimentary rocks which is also called stratification which can be observed in Jordan's most-visited tourist attraction. Study Figure 2 - The *Majesty of Petra* carefully then answer Activity 2.

**Figure 2.** The Majesty of Petra, Jordan

## Activity 2

Match the description in column A with the appropriate term in column B. On your answer sheet, write only the letter of your correct answer.

| COLUMN A | COLUMN B |
|---|---|
| _____1.Types of rocks formed by the accumulation or deposition of minerals or organic particles at the earth's surface | A. Strata |
| _____2. The type of rock *The Majesty of Petra* is made of | B. Stratified Rocks |
| _____3. It is the layering seen in the most sedimentary rocks and it is also the pattern of rock formation depicted in *The Majesty of Petra.* | C. Sandstone |
| _____4. A layer or a series of layers of rocks in the ground | D. Stratification |
| _____5. Sedimentary rocks that are formed by accumulation and hardening of sediments over **a period** | E. Sedimentary rocks |
| | F. Limestone |



## *What is It*

**PROCESSES IN THE FORMATION OF SEDIMENTARY ROCKS**

Most of the rocks exposed at the surface of earth are sedimentary which is formed from particles of older rocks that have been broken apart by water or wind. The gravel, sand, and mud settle to the bottom in rivers, lakes, and oceans. These sedimentary particles may bury living and dead animals and plants on the lake or sea bottom.

Sedimentary rocks are those rocks formed from sediment- material consisting of sand, gravel, mud, ions in solution derived from pre-existing rocks or organic debris derived from living organisms.

With the passage of time and the accumulation of more particles, and often with chemical changes, the sediments at the bottom of the pile become rock. Gravel becomes a rock called conglomerate, sand becomes sandstone, mud becomes mudstone or shale, and the animal skeletons and plant pieces can become fossils.

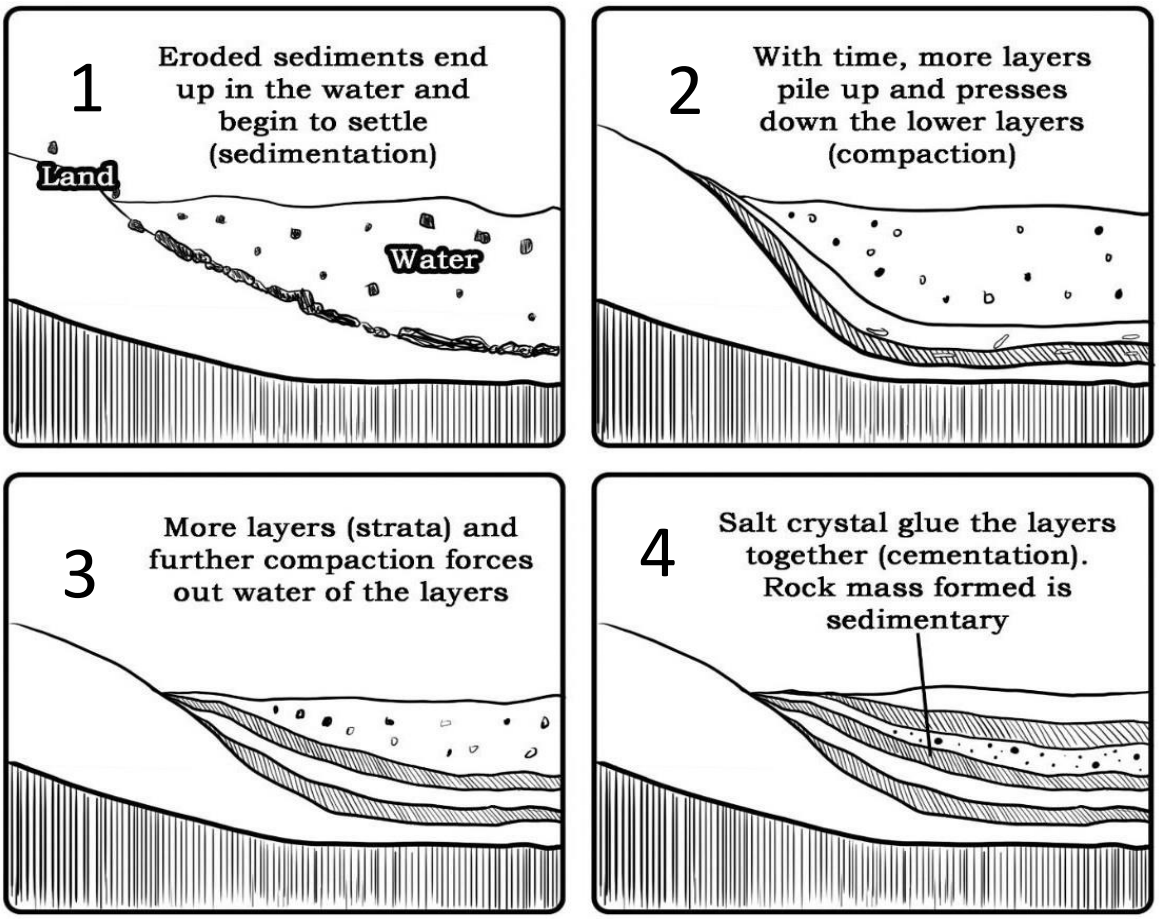



**Figure 3.** Basic Steps in the Formation of Sedimentary Rocks

**Stratification** is the process leading to the formation or deposition of layers, especially of the sedimentary rocks. The layers range from several millimeters to many meters in thickness and vary greatly in shape. Strata may range from thin sheets that cover many square kilometers to thick lens like bodies that extend only a few meters lateral.

Referring on Figure 3, you may recognize this as sedimentary rock. It. is a rock that is formed by layers of sediment being laid down over the course of time. These sediment layers create the banding pattern visible in stratified rock. The sediments themselves also teach us about the environment in which the rock is formed.

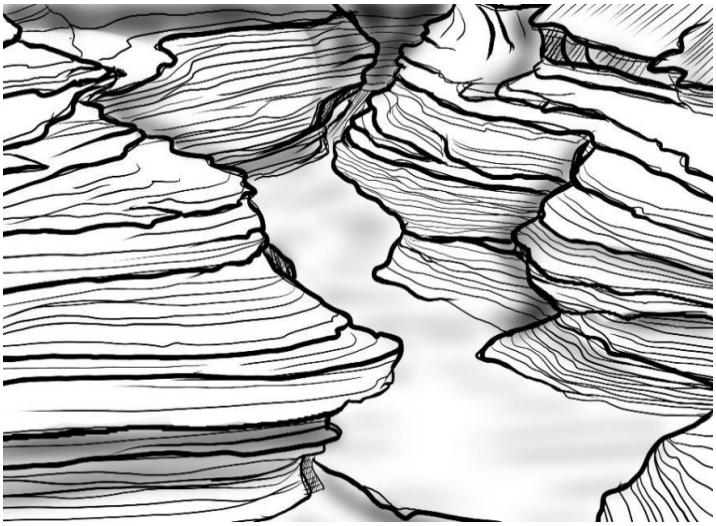


**Figure 4.** Stratification of Sedimentary Rocks

## How layers of rocks are formed

The rock layers are formed by erosion and weathering of mountains and the particles are transported and deposited in the sedimentary basin, then the sediment particles are cemented over hundreds of years to form layers. These sediments are deposited horizontally by gravity.

Layered rocks may also result from successive lava flow or from the formation of extrusive igneous rocks. We study Earth's history by studying the record of past events that is preserved in the rocks. Most of the rocks which are exposed at the surface of the earth are called sedimentary rocks.

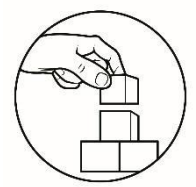
Slight changes in particle size or composition result in the formation of layers, also called beds in the rock. Layering, or bedding, is the most obvious feature of sedimentary rocks.

Sedimentary rocks are formed particle by particle and bed by bed, and the layers are piled one on top of the other. Thus, in any sequence of layered rocks, a given bed must be older than any bed on top of it.

***Law of Superposition*** is a basic law of geochronology, stating that in any undisturbed sequence of rocks deposited in layers, the youngest layer is on top and the oldest on bottom, each layer being younger than the one beneath it and older than the one above it. Because at any one location, it indicates the relative ages of rock layers and the fossils in them.

***Law of Original Horizontality*** was first proposed by Danish geological pioneer Nicholas Steno in the 17th century. The law states that layers of sediment were originally deposited horizontally under the action of gravity. It suggests that all rock layers are originally laid down (deposited) horizontally and can later be deformed. This allows us to infer that something must have happened to the rocks to make them tilted. This includes mountain building events, earthquakes, and faulting.

***The Law of Lateral Continuity*** states that the layers of rock are continuous until they encounter other solid bodies that block their deposition or until they are acted upon by agents that appear after deposition takes place such as erosion and fault movements.

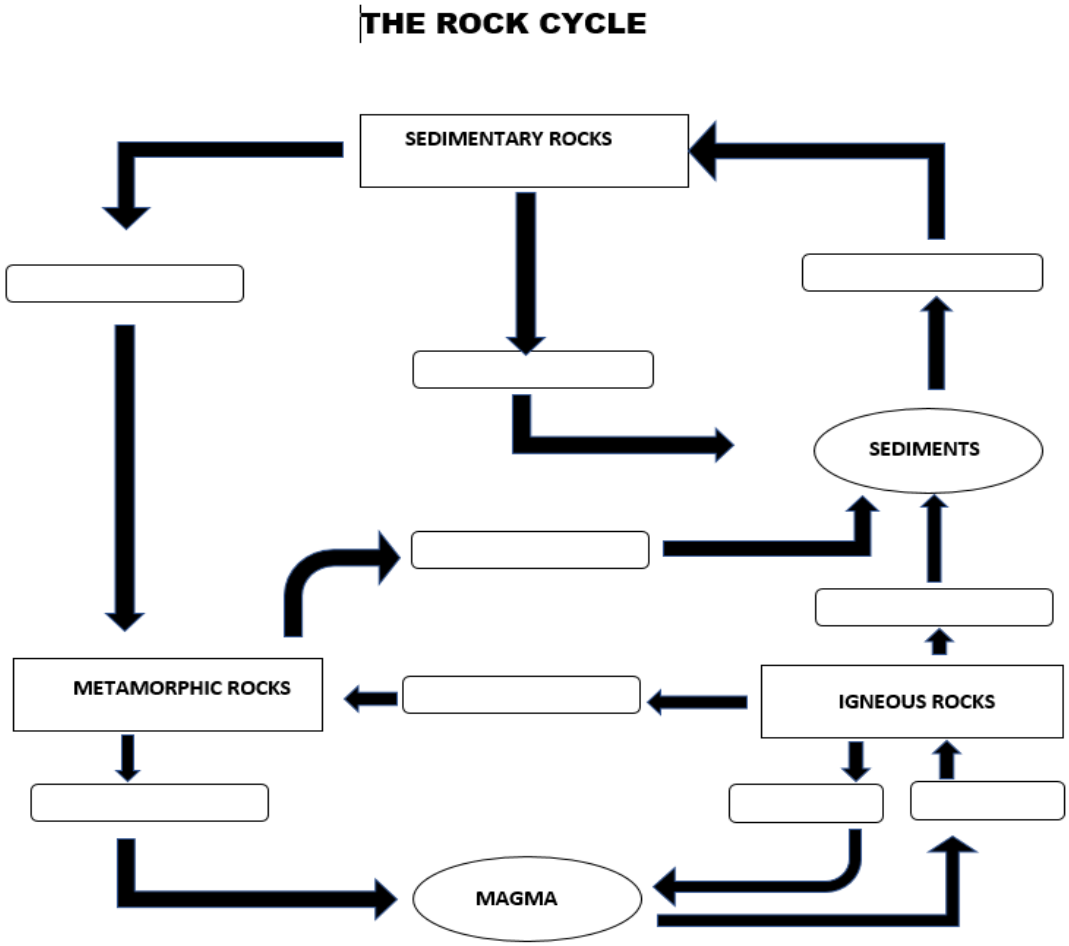


## *What's More*

**Activity 3**

Copy the organizer and demonstrate your knowledge of the rock cycle. Place the relevant phrases in the designated area to represent the required process that the rock must go through. Do this on a separate sheet of paper.

| | | |
|---|---|---|
| Weathering and Erosion | Compaction and Cementation | Melting |
| Heat and Pressure | Cementation | Cooling |



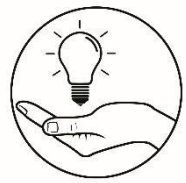
**Activity 4**

Complete the paragraph by filling in the blank spaces with the appropriate words or phrases inside the box. Write it on a separate sheet of paper.

| | | | |
|---|---|---|---|
| Bed by bed gravity | layers | igneous rocks | rock layers |
| Fossils | extrusive | particle by particle | deposited |
| Law of Superposition | | Erosion and weathering | |

The rock layers are formed by (1) _____ of mountains and the particles are transported and (2) _____in the sedimentary basin, then the sediment particle is cemented over hundreds of years to form layers. These sediments are deposited horizontally (3)_____. Layered rocks may also result from successive lava flow by or from the formation of (4) _____. Most of the rocks which are exposed at the surface of the earth are called sedimentary rocks.

Sedimentary rocks are (5) _____ and (6) _____, and the (7) _____ is piled one on the top of other . Thus, in any sequence of layered rocks, a given bed must be older than any bed on top of it. This (8) _____is fundamental to the interpretation of Earth's history, because at any one location, it indicates the relative ages of (9)_____ and the (10) _____ in them.



## *What I Have Learned*

**Activity 5**

Answer the following questions clearly and correctly. Write your answers in a separate sheet of paper.

1. How do you categorize rocks?

2. Why do some sedimentary rocks have layers and how are these layers formed?

3. How do we learn about Earth's history through the formation of rock layers?

## *What I Can Do*

### What stories can sedimentary rocks tell us?

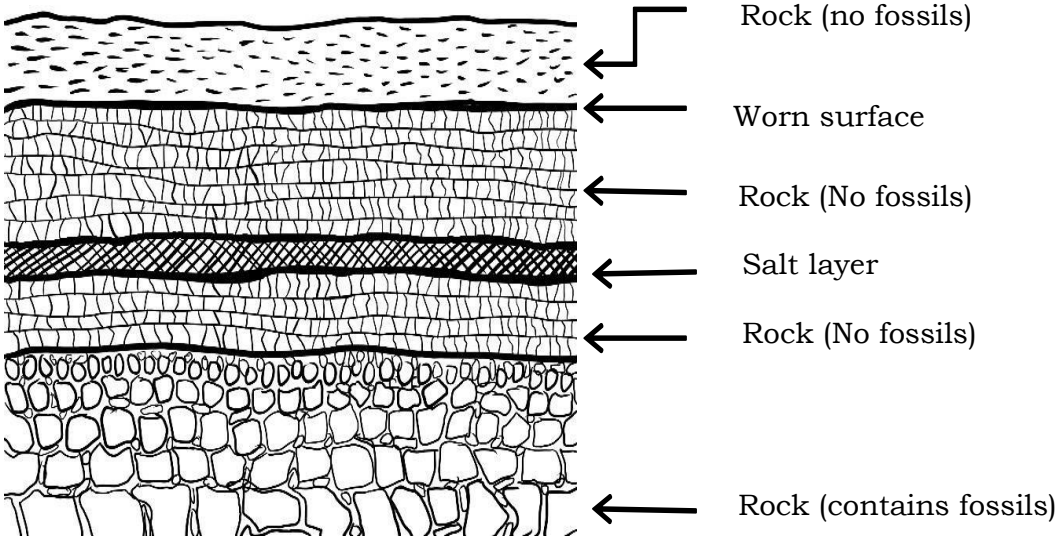



**Figure 5.** Rock at the Earth's Surface

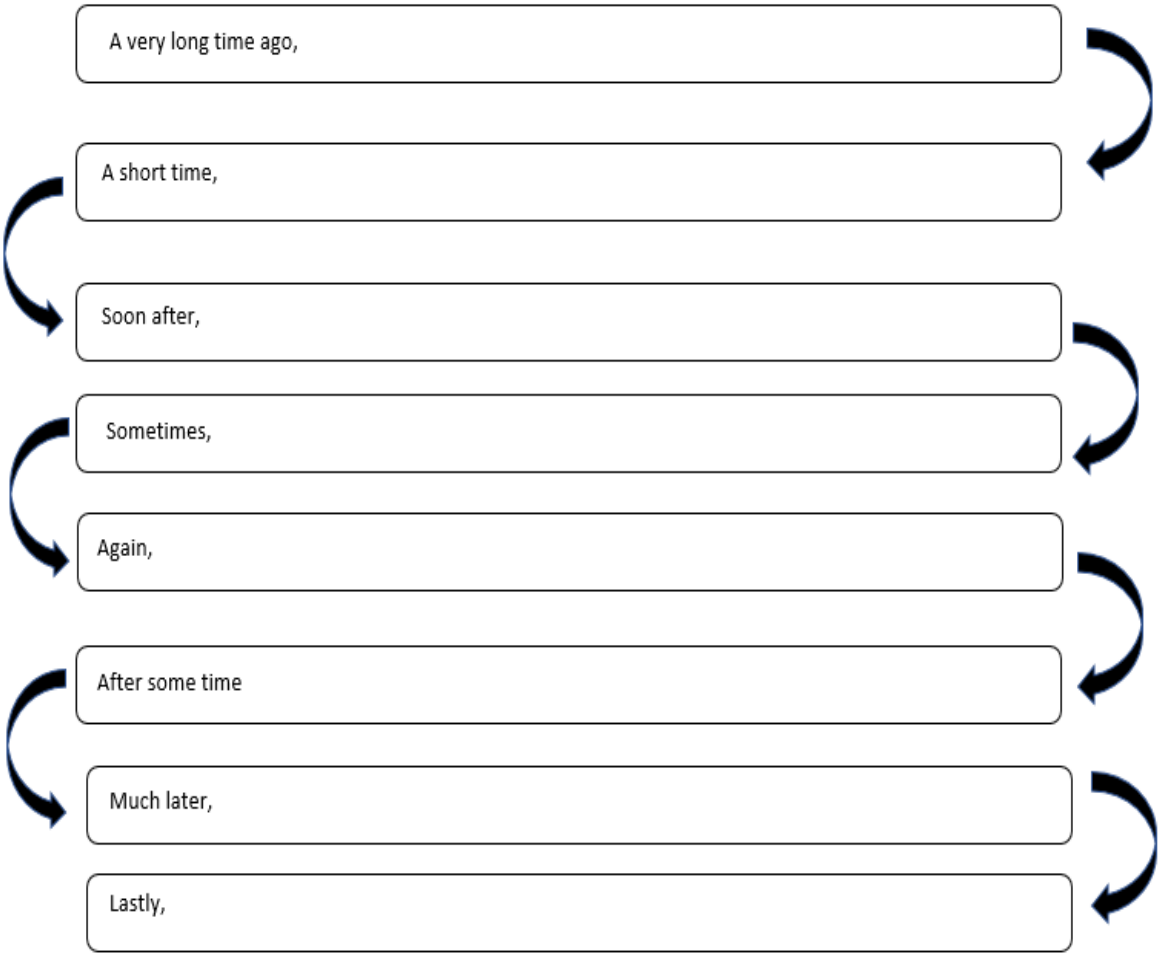
### Activity 6

The labelled drawing of sediment strata above is based on the story about rock sediments to be written by you. Arrange the given sentences below chronologically in order to make a short story about rock sediments. On a separate sheet of paper, copy the chronological graphic organizer and write your answer on the space provided

### ROCK SEDIMENTS

- The rivers stopped flowing again and the rock became hard.
- Much later, rivers covered the Earth's surface again and they wore away the rocks.
- The rivers stopped flowing and the rock became hard.
- Rivers covered the Earth's surface.
- Sometimes, lakes formed and then dried up to form salt layers.
- Rivers covered the Earth's surface.
- The salty water moved back.
- The Earth's surface was covered by salty water in which there were living organisms.

**Chronological Graphic Organizer**




## *Assessment*

Read and analyze the following questions. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which is NOT true about the rock cycle?
    a. Rocks are recycled.
    b. It shows that rock is lost forever.
    c. It shows the rock's journey as it changes.
    d. It is a summary of the processes that change rock from one kind to another.

2. Which best defines a sedimentary rock?
    a. It is formed by heat and cooling.
    b. It is formed by heat and pressure.
    b. It is a layered rock formed by compaction.
    a. All of the above

3. Limestone is formed from layers of sand, shells and animal remains that have been compacted together. Which type of rock is a limestone?
    a. igneous
    b. indigenous
    c. metamorphic
    d. sedimentary

4. What process is used to form a sedimentary rock?
    a. Lava cools and hardens to form a rock.
    b. Magma trapped under the Earth's surface cools and solidifies.
    c. Bits of sand and gravel form layers that turn into rock from pressure.
    d. Extreme heat and pressure from inside the Earth turn rocks into new rocks.

5. Which type of rock usually contains fossils?
    a. all types of rocks
    b. igneous
    c. metamorphic
    d. sedimentary

6. Where do sediments come from?
    a. Rock weathering produces sediment.
    b. There have always been sediments on Earth.
    c. Sediment is transported and deposited all over the Earth.
    d. Sediments accumulated as dust fell to Earth from outer space.

7. What is the Law of Superposition?
    a. a. Igneous rock is older than nearby sedimentary rock, which is older than nearby metamorphic rock.
    b. A sedimentary rock layer in its original position is older than
    a. the layer above it and younger than the layers below it.
    c. Metamorphic rock is older than nearby sedimentary rock because the latter is deposited before the former.
    a. d. The exact age of a sedimentary rock layer can be found using the layers above and below it.

8. In a cliff, where are the oldest layers of rocks made of sedimentary rocks usually found?
    a. at the bottom
    b. at the top
    c. in the middle
    d. nowhere to be found

9. Which of the following are the processes of compaction and cementation commonly associated with?
    a. erosion
    b. lithification
    c. sedimentation
    d. transportation

10. Which of the following do sedimentary rocks provide clues about?
    a. polar climates
    b. tropical climates
    c. temperate climates
    d. Earth surface conditions at the time the sediment was deposited.

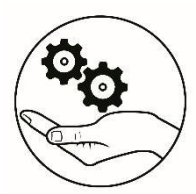
11. Which statement is FALSE on how layers of rocks are formed?
    a. A break-down of igneous rocks forms layers of rocks.
    b. Sediments are deposited vertically by gravity.
    c. Erosion and weathering that occur on a flat field form layer of rocks.
    d. Sediments are cemented over hundreds of years and form layers.

12. Superposition means that in an undisturbed sequence of sedimentary rocks, which of the following is true?
    a. the oldest rocks are on top
    b. the youngest rocks are on top
    c. the youngest rocks are in the middle
    d. there is no way to know which layers are older

13. Which of the following causes the formation of rock layers?
    a. inactive volcanoes
    b. erosion and weathering
    c. Rock remains on its position.
    d. Particle size does not change.

14. An undeformed sedimentary layer is_____than the layer above and_____then the layer below. Which of the following pairs of words best completes the sentence?
    a. older, older
    b. older, younger
    c. younger, older
    d. younger, younger

15. Which of the following describes the Principle of Original Horizontality?
    a. In rare cases, horizontality of rock layers occurs.
    b. In most cases, sedimentary beds are deposited as horizontal units.
    c. Not all layers of the rock are deposited horizontally.
    d. Both b and c



## *Additional Activities*

Reflect Upon: Explain how you relate the processes in the formation of sedimentary rocks to your life from your birth up to the present in a minimum of two (2) paragraph.

Congratulations! You have successfully finished Module 9. You may now proceed to Module 10. Please do an advanced reading on the different methhods on relative and absolute dating of determining the age of stratified rocks or recall your elementary and junior high school discussions on this topic. Good lick! You may advance to the next level.

# *Answer Key*

**What I Know**

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

**What's More**

Erosion And
Weathering
Deposited
Gravity
Extrusive
Igneous rock
Particle
Bed
Layers
Law of Superposition
Rock layers
fossils

**Assessment**

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

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