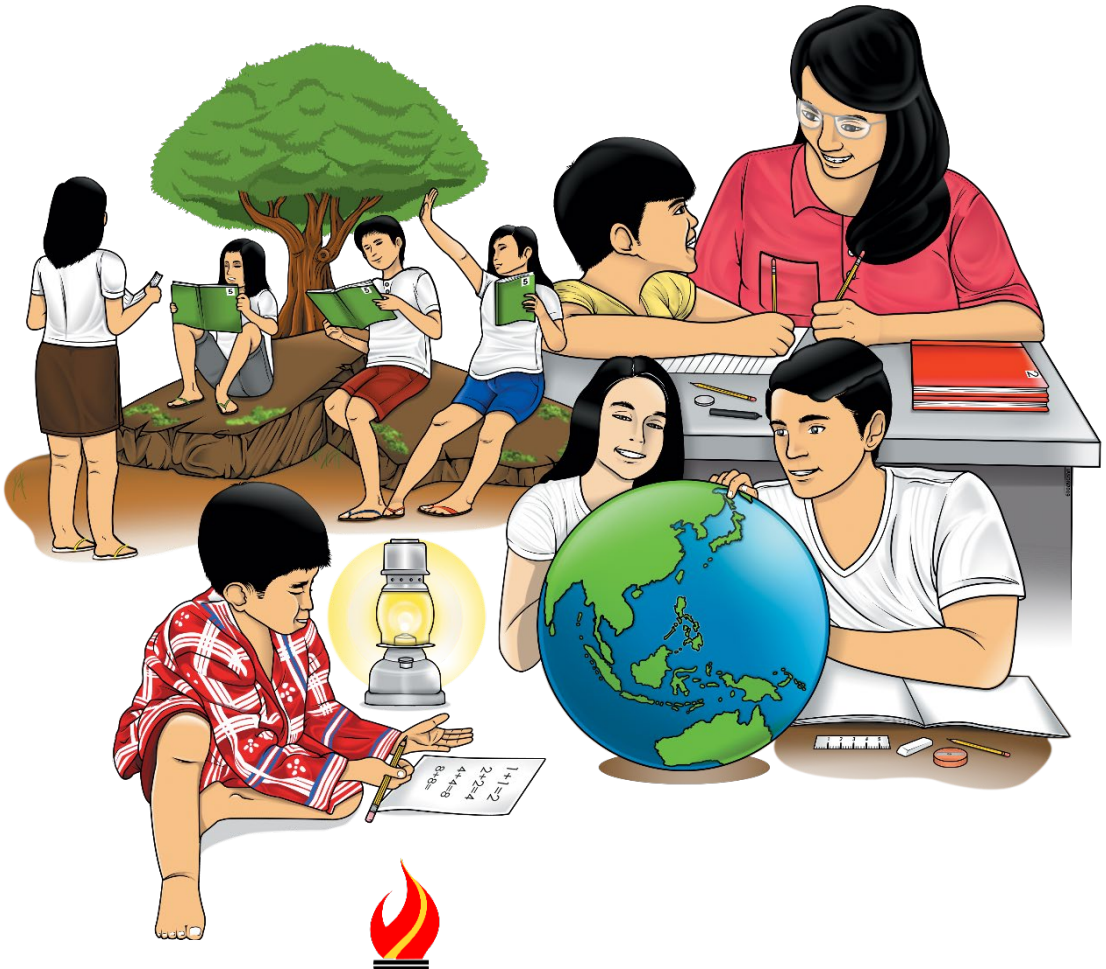
Senior High School

DepED
DEPARTMENT OF EDUCATION

Earth and Life Science

Quarter 1 – Module 13:
Geologic Time Scale:
Relative and Absolute Dating



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ADM

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Quarter 1 – Module 13: Geologic Time Scale: Relative and Absolute Dating
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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 covers the scientific principles that the historical geologists used to describe the Earth's past. This will also serve as a guide to the clues that were left on Earth, the different events, and the time it took these events to happen which are depicted in the geologic time scale.

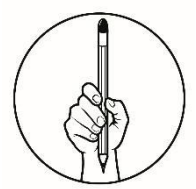
In this module, you will be able to determine the different divisions that comprise the geologic time scale which uses the two methods of record: the absolute and the relative dating.

The module is composed of the:

- Lesson 1: Geologic Time Scale: Relative and Absolute Dating

After going through this module, you are expected to:

1. Name the divisions of the geologic time scale.
2. Characterize each major and subdivisions in the geologic time scale.
3. Describe how relative and absolute dating provide evidence of geologic history.



What I Know

Before you use this module, take the **Pretest** below**.**

Directions: Read each item carefully. Choose the letter of the best answer and write the chosen letter on a separate sheet of paper.

1. This division comprises a time span of 88% in the geologic time scale, where rocks containing the earliest evidence of complex forms of life were discovered. Which division is being described by these statements?
   A. Cenozoic Era
   B. Mesozoic Era
   C. Paleozoic Era
   D. Precambrian

2. As climate change sea levels rose worldwide and seas expanded across the center of North America. Some of the discovered fossils include dinosaur bones, teeth, and diverse plant fossils. Which division is being referred to in the given statement?
   A. Cenozoic
   B. Mesozoic
   C. Paleozoic
   D. Precambrian

3. If you will study the relative age of a rock layer, which indicator below is the more appropriate to use?
   A. The thickness of the layer
   B. The chemical makeup of the layer
   C. The distance of the layer extends over the Earth
   D. The position of the layer compared to other layers

4. Where are the oldest rocks found in an undisturbed rock profile?
   A. at the bottom
   B. in the middle
   C. on the top
   D. anywhere

5. Radiometric dating is used to estimate how geologic rocks are formed and infer the ages of fossils contained within those rocks. In which of the given rocks is Radiometric dating least useful?
   A. basaltic
   B. granitic
   C. metamorphic
   D. sedimentary

6. When naming the subdivisions of the Earth's geology in a specific order, which method must be considered?
   A. Absolute dating
   B. Isotopic dating
   C. Radiometric dating
   D. Relative dating

7. Which division in the geologic time shows evidence of molten rocks in the Earth's surface due to its high temperature?
   A. Mesozoic Era
   B. Miocene Epoch
   C. Precambrian
   D. Tertiary Period

8. The geologic time scale is a system of chronological dating that relates geological strata to time. In which portion of the Earth's history is embraced by the geologic time scale?
   A. Evolution of life
   B. Formation of Earth
   C. Formation of universe
   D. Formation of the solar system

9. How are the geologic eras largely determined?
   A. Average global temperature
   B. Distribution of rock sequences
   C. Earth's orbital position
   D. Shifts in the fossil record

10. In what geological periods did trilobites and other early arthropods appear?
    A. Cambrian
    B. Devonian
    C. Eocene
    D. Permian

11. The Holocene epoch is Earth at present. It is during this period when the recorded history of man existed. In which geologic era does the Holocene epoch include?
    A. Cenozoic
    B. Mesozoic
    C. Paleozoic
    D. None of the above

12. The earliest fossils that appeared during this time were large colonies of bacteria. If you were to trace when these bacteria evolved in the geologic time scale, what Eon will it be?
    A. Archaean Eon
    B. Hadean Eon
    C. Phanerozoic Eon
    D. Proterozoic Eon

13. Which of the given statements does NOT represent the geologic time scale?
    A. The geologic history of the universe.
    B. The fossil record of flora and fauna.
    C. The age of the Earth and its inhabitants.
    D. Evolution of life dating back 4.6 billion years ago.

14. What probability will take place when organisms have not adapted to their environment due to new diseases, new predators, and climate change?
    A. They will become extinct.
    B. Their bodies will be fossilized.
    C. Their bodies will be petrified.
    D. They will be buried as sedimentary materials.

15. What causes the extinction of dinosaurs?
    A. Climate and geological changes that interrupted their food supply.
    B. An event impact of an asteroid or a comet may have caused the extinction.
    C. Small mammals ate dinosaur's eggs thereby reducing their populations.
    D. Dinosaurs were cold-blooded animals which obtained body heat from the Sun-they would not have been able to survive in cooler climates.

Lesson 1 Geologic Time Scale

Deposition of sediments contribute to reshaping the surface of the Earth. Deposits are laid down by different environmental factors such as volcanic eruption, erosion, weathering debris of rocks (clay and silts), and even all its fossil content and historical information.

Earth history including its rock strata, the rock study, and discovery, as well as the fossils, are engraved in one of the most important materials known as geologic records. The geologic time scale is the "calendar" for events in Earth's history.

The importance of the geologic time scale is, it serves as a standard timeline used to describe the age of rocks, fossils, and the events that formed them. It is a device which is of great help to the science of geology, and it is owed to the explorations and studies recorded by geologists.

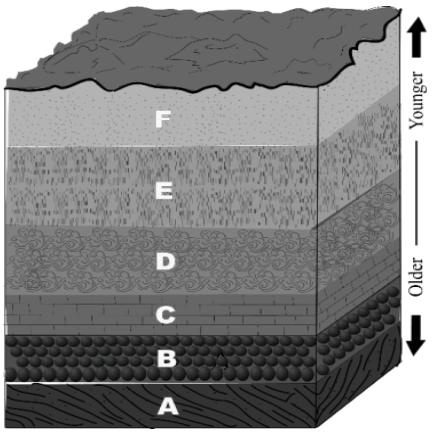
Knowing about how life began in the past, the events, and principles behind the Earth's history enables us to conform with the alterations or consequences that we might encounter or experience in the near future. As a part of the new generation, we should be appreciative and accept that all things that are present in our time were the outcomes of the Earth's history.

What's In

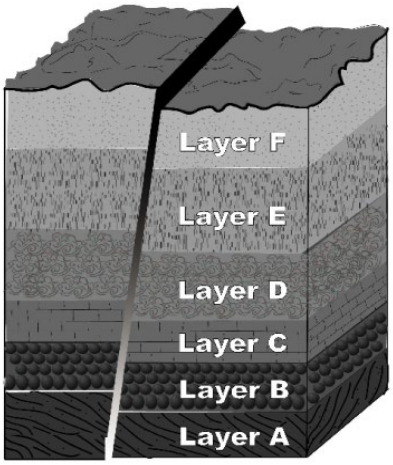
In the previous lessons, you had learned that stratified rocks are products of sedimentary processes which include weathering and erosion of pre-existing rocks. Wherein, these sediments will be transported by the agent of erosion such as water, wind, or ice, and deposited in seas and acted upon by the process of compaction and lithification. As time goes by, these sedimentary rocks will form layers or stratification representing periods of deposition of sediments. Based on this, there are several laws that govern stratigraphy as proposed by Nicolas Steno.

Nicolas Steno's Law of Stratigraphy opens our eyes to the world of rock layers and its formation. It also shows how endogenic and exogenic geological processes cause alteration in rocks that lead to the formation and deformation of rock layers.

Let us find out if you can still recall how these laws are depicted in the rock strata. Identify the law of stratigraphy the following diagrams represent.



A



B

Guide questions:

1. What laws of stratigraphy does the picture in letter A tell us?_____
2. In picture B, new rocks were introduced. What law is best explained in this kind of rock stratum? _____
3. How old is the rock that was intruded in stratum B? _____
4. What geologic processes existed in stratum B which causes its deformation? _____
5. If you want to determine the age of the rocks in the rock layer, what method are you going to use? _____

Notes to the Teacher

Let the learners describe how the laws explain the formation of rock strata. Give the learners enough time to review what they had learned in the previous lesson regarding relative and absolute dating.

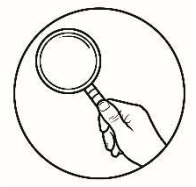
What's New

Sequence Drill

In a sequential manner, make five to seven relative events that happened in your life. For example, the day you were born, the day your brother or sister was born, or your first date with your boyfriend or girlfriend. Write your answer in the table below.

Time Scale			
Relative Scale		*Absolute Scale*	
I was born		I was born	Example (Jan.28,2001)

The way the relative events are arranged in your data is similar to how the geologists studied the Earth's history: its geological time scale of Earth's age and how it is determined.



What Is It

Since the beginning, geologists have been studying the Earth to unwrap the secrets of the past. They have been analyzing rock samples gathered from different continents in the world including its layers and its correlation with the fossils. This helps in relating the sequence of events in the Earth's history which is clearly presented in the geologic time scale.

The geologic time scale is divided into a series of time intervals which are equal in length. These time intervals are different from that of a clock. They are divided according to the significant events in the history of Earth such as the mass extinction of a large population of fauna and flora.

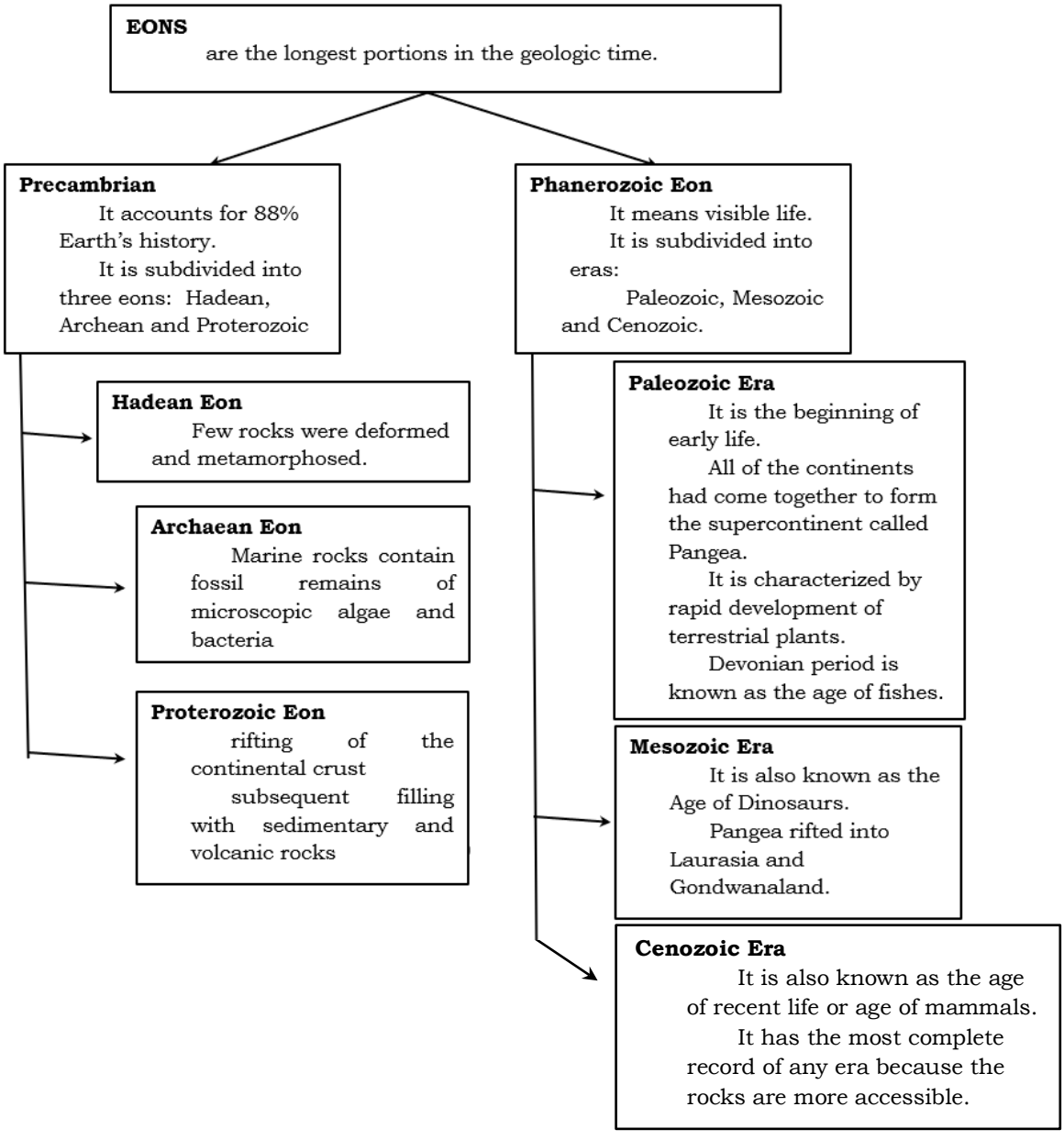
Table 2. Geologic Time Scale

Eons	*Era*	*Period*	*Epoch*	*Age (Mya)*
Phanerozoic	Cenozoic	Quaternary	Holocene	0.01
			Pleistocene	1.8
		Tertiary	Pliocene	5.3
			Miocene	23.0
			Oligocene	33.9
			Eocene	55.8
			Paleocene	65.5
	Mesozoic	Cretaceous		145
		Jurassic		200
		Triassic		251
	Paleozoic	Permian		299
		Pennsylvanian		318
		Mississippian		359
		Devonian		416
		Silurian		444
		Ordovician		488
		Cambrian		542

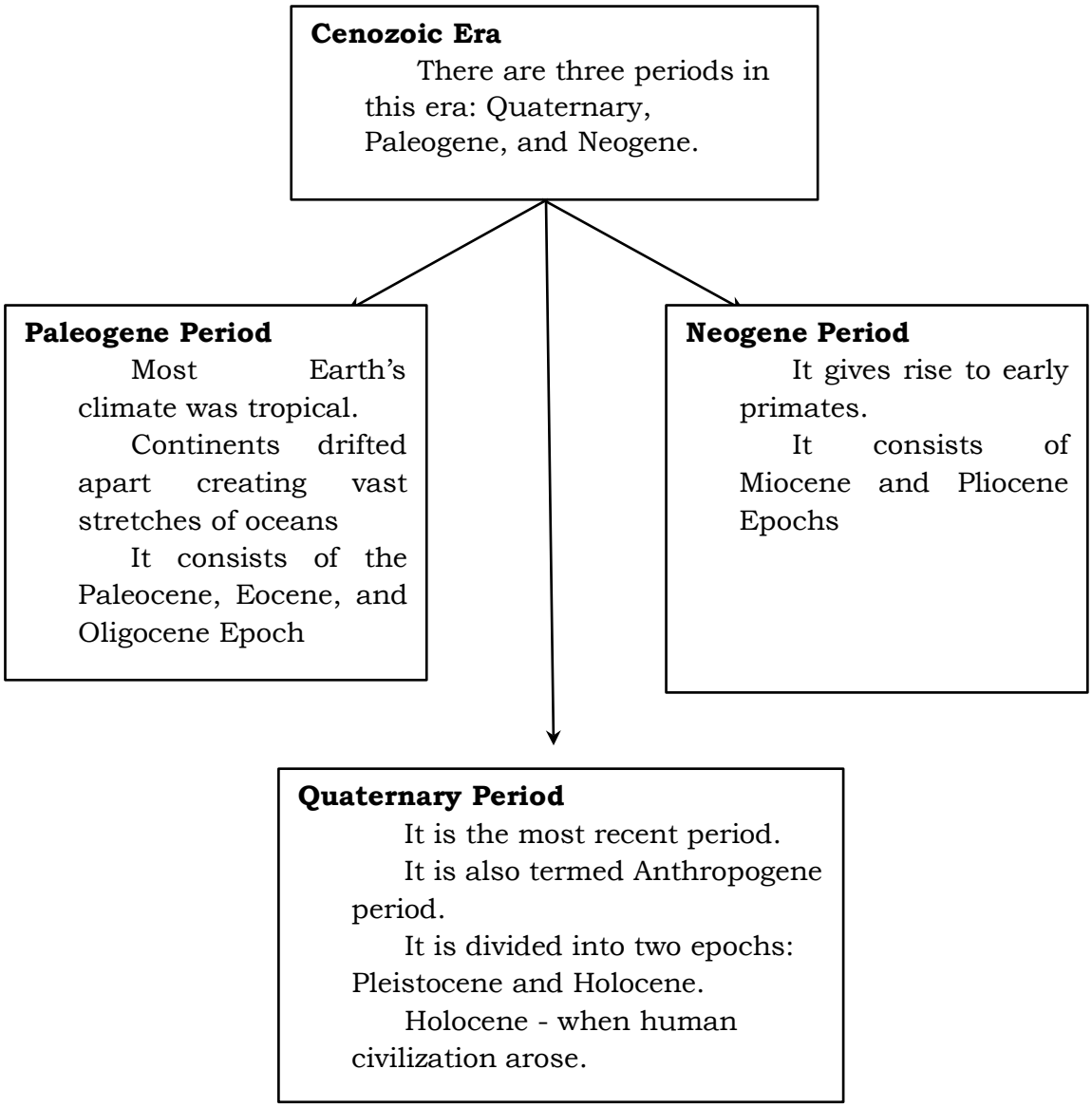
Precambrian	Proterozoic		bacteria and blue green algae		2500
	Archean		oldest fossil		3800
	Hadean		Beginning of earth		4600

The table represents the divisions of the geologic time in Earth's history that are separated into eons, periods, and epochs. The Earth's age which is 4.6 billion years, was separated into different spans of time to handily indicate the events.

DIVISION IN THE GEOLOGIC TIME SCALE



DIVISION OF THE CENOZOIC ERA

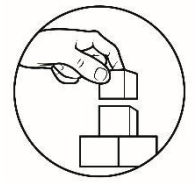


Relative and Absolute Dating

Scientists first developed the geologic time scale by studying rock layers and index fossils. The information gathered by the scientists placed the Earth rock strata in order by relative age. Geologic time is often discussed in two forms: relative time and absolute time.

Relative time is a subdivision of the Earth's geology in a specific order based upon the relative age relationships (commonly, vertical, or stratigraphic position). Relative time can be established usually based on fossils. On the other hand, absolute time refers to the numerical ages in millions of years or some other measurement. These are obtained by radioactive dating methods performed on appropriate rocks.

Relative time can be referred to as the physical aspects found in rocks while absolute time refers to the measurements taken upon those to determine the actual time it expired. The time scale is depicted in its traditional form with the oldest at the bottom and the youngest at the top.



What's More

Activity 1.1 it's a Date

1. Fill in the data table to show the number of millions of years each era lasted based on relative and absolute dating. Choose your answer from the given choices below.

   a. 4.048 mya c. 299 mya e. 4,600mya
   b. 69 mya d. 184mya

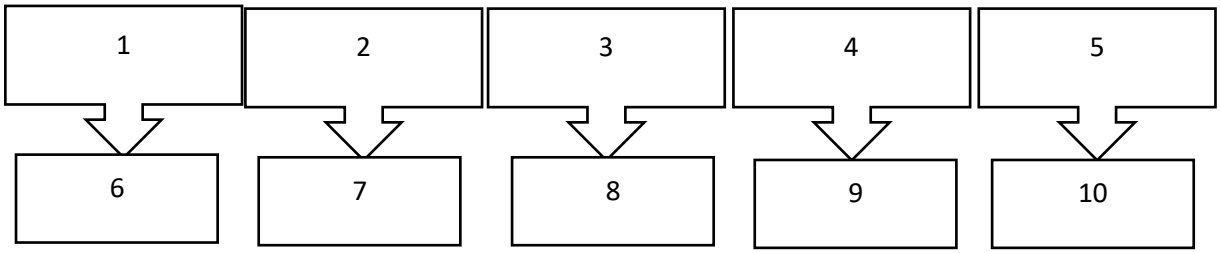
The Divisions of Geologic Time	***Percent***	***Millions of years***
The Age of the Earth	100%	
A. Cenozoic Era	1.5%	
B. Mesozoic Era	4%	
C. Paleozoic Era	6.5%	
D. Precambrian Time	88%	

Guide Questions:

1. Based on the data table, which is the oldest era? _____
2. How old is the shortest era? _____
3. How old is the Cenozoic Era? _____
4. What dating method is applied in the activity? Why? _____
5. Where can we apply the relative dating method? _____

Activity 1.2 You Complete it

Complete the timeline of the geologic time scale starting from the oldest to recent time. Indicate each division and year. Use the data table in Activity 1.1 as reference.

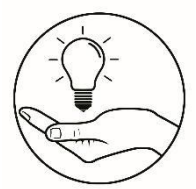


Activity 1.3 Word Pool

Identify the term being described by the given statement. Select your answer from the word pool below.

Geologic record	Eons	Dinosaurs
Relative dating	Cenozoic	Sedimentary
Absolute dating	Holocene	Devonian
Archaean	Paleozoic	

_____1. It is where all traces of history of earth is recorded in rocks that make up the crust.
_____ 2. It is a way on how the age of rocks and fossils can be determined by its numeric value.
_____ 3. It is the largest division in the geologic time scale.
_____ 4. It refers to the rocks that are deposited and used in dating methods.
_____ 5. It is used to determine the geological events in rock strata.
_____ 6. It refers to prominent reptiles that evolved during the Mesozoic Era.
_____ 7. The fitting of supercontinent Pangea happened in this era.
_____ 8. The present human evolved during this age.
_____ 9. It refers to the age of the fish.
_____ 10. Ancient bacteria and blue green algae existed during this age.

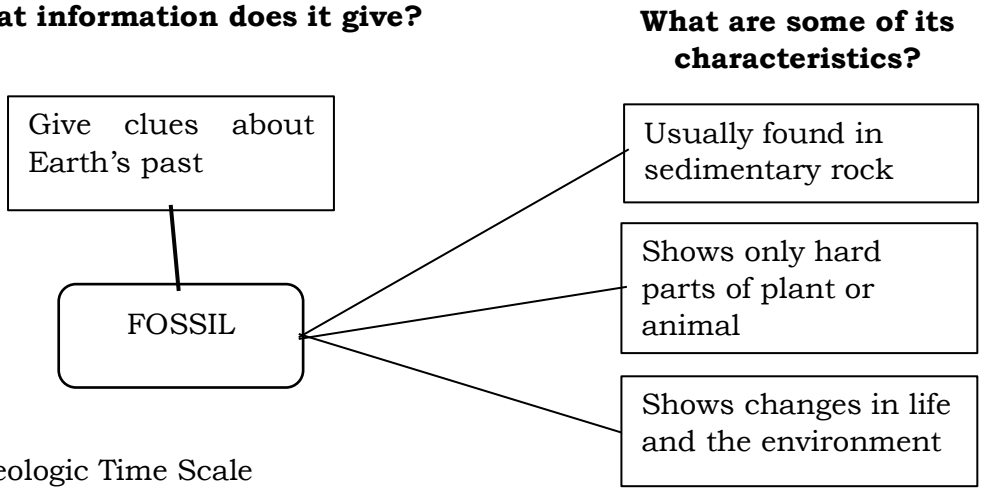


What I Have Learned

Activity 1.4 Vocabulary Building

Make a concept definition map for each of the vocabulary terms listed below. Write the term in the central box. Fill in the other boxes by answering the questions. The first term is done for you.

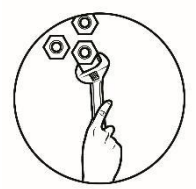
A. Fossil



B. Geologic Time Scale
C. Relative Dating
D. Absolute Dating

Things to Ponder

- Geologic time scale is a timeline that illustrates Earth's past.
- Geologic time scale describes the order of duration of major events on Earth for the last 4.6 billion years.
- Geologic time scale was developed after the scientist observed changes in the fossils and rocks going from oldest to youngest sedimentary rocks.
- Geologic time scale was divided into four divisions which include the Eons, Era, Period, and Epoch.
- Eons is the largest division in the geologic time scale.
- Relative dating or age is the order of the rocks from oldest to youngest.
- Relative dating does not determine the exact age of rock or fossils but does learn which one is older or younger than the other.
- Relative age of rocks based on the order gives its physical division in the geologic time scale.
- Absolute dating or age measures the number of radioactive elements in rocks to give the ages to each division of time in the geologic time scale.
- Absolute time refers to the numerical ages in millions of years or some other measurement.



What I Can Do

Make a diary noting the important events that happened in your life for the day which you can associate with the geologic time scale.

DATE	***DAYS OF THE WEEK***	***EVENT/ACTIVITY***
	Monday	
	Tuesday	
	Wednesday	
	Thursday	
	Friday	
	Saturday	
	Sunday	

Assessment

Directions: Read each statement and choose the letter of the correct answer. Shade the circle that corresponds to the correct answer.

1. What information does the geologic time record provide?
   A. The rate of fossil formation.
   B. The thickness of sedimentary rock layers.
   C. The time since the evolution of dinosaurs.
   D. The life forms and geologic events in Earth's history.

2. How do geologists separate time into period?
   A. By the time the fossil is discovered.
   B. By looking at the relative time of a fossil.
   C. By special events that have happened in that period.
   D. By counting the years that a fossil has been preserved.

3. What do you call the method of placing geologic events in sequential order as determined by their position in the rock record?
   A. Absolute dating
   B. Correlation
   C. Relative dating
   D. Uniformitarianism

4. What is the relevance of absolute time?
   A. It is useful if fossils are present.It gives a specific date in an object.
   B. It gives a non-specific date in an object.
   C. It only gives the sequence in which events have taken place.

5. Which of the following is the primal in absolute dating method?
   A. Cross-cutting relationships
   B. Educated estimates
   C. Fossils
   D. Radioactive decay

6. If geological time will be recognized, which method is primarily used?
   A. Calculation of alpha decay of isotopes.
   B. Calculation of beta decay of isotopes.
   C. Correlation of rock types across vast.
   D. Distances correlation of magnetic signatures in rocks.

2. Which of the following era is sometimes called “the age of fish” or “ancient life”?
   A. Cenozoic
   B. Mesozoic
   C. Paleozoic
   D. Precambrian

3. What will be the sequence of division in the geologic time scale, if the order of position is from shortest to longest?
   A. era, period, epoch
   B. epoch, period, era
   C. period, epoch, era
   D. epoch, era, period

4. Scientists use a criterion to decide where to place the boundaries between the major divisions of the geologic time scale. They consider major changes. Where can these major changes be found?
    A. written in the fossil record
    B. occurring in the solar system
    C. in structure of the Earth's layer
    D. in the arrangement of the continent

5. In which division in the geologic time scale did the continents come together to form the supercontinent called Pangaea?
    A. Paleozoic Era
    B. Cenozoic Era
    C. Triassic Period
    D. Jurassic Period

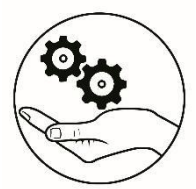
6. How do eras differ from periods?
    A. They have a longer span of time.
    B. They have subdivided into epochs.
    C. They have longer durations than eons
    D. They have boundaries marked by mass extinctions.

7. Which epoch in the geologic time scale designates human lives in a very short period of time?
    A. Eocene
    B. Holocene
    C. Pliocene
    D. Pleistocene

8. Why are fossils recorded in the geologic time scale said to be incomplete?
    A. Most organisms never became fossils.
    B. The absence of tools to be used for tracing.
    C. The remains of past organisms decayed faster.
    D. All of the above

9. How will you describe the arrangement of the rock in the geologic time scale?
    A. They arranged an absolute dating.
    B. They are based on its composition.
    C. They are based on relative dating.
    D. They are arranged in decades and centuries.

10. What makes fossils essential to scientists and the history of the Earth?
    A. It predicts what organisms will become extinct.
    B. It analyzes the composition of sedimentary rock
    C. It describes the history of past life and environment.
    D. It presents the temperature of the oceans in different depths.



Additional Activities

Create your own representation of a geologic time scale on rocks indicating the relative and absolute dating. Use discarded material in your output.

The rubrics below will serve as a basis for grading your output.

Criteria/Points	4	3	2	1
Organization	Products appears finished and organized appropriately	Products is exactly finished /organized appropriately	Products is minimizing arts and it is not organized appropriately	Products is not organized
Creativity	Informing, engaging, and visually stimulating Use of color, visuals, interest, motivation, and time are clearly reflected. Discarded materials used are keenly observed	Use pictures and colors are engaging but not stimulating. Some are interesting, motivated and time span are clearly reflected Use limited discarded materials in the output	With little use of colors. Not stimulating. Too little interest and motivation. Time is not clearly reflected.	Did not use color. Not stimulating or motivating with little interest. Time span and effort is not reflected
Content	The content provides detailed information regarding the geologic time scale and the organisms that live in the past are well presented.	The content provides a few information regarding the geologic time scale and the organisms were also few.	Limited information regarding the geologic time scale as well as the organisms	The information regarding the geologic time scale does not contain appropriate details, the organisms was not included

Answer Key

Pretest

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

What's More
Activity 1.4

1.Geologic Time Scale
-timeline that illustrates
Earth's past
Characteristics
-divided into
eons,era,period,epoch
- uses the relative and
absolute dating
Relate dating
-gives relative age of rocks
Characteristics;
Uses the position of rocks
-follows the law of
stratigraphy
Absolute Dating
-gives the numeric age of
rocks

What's More
Activity 1.3

1. Geologic records
2. Absolute dating
3. Eons
4. Sedimentary
5. Relative dating
Dinosaurs
Paleozoic
Holocene
Devonian
Archaean

Assessment

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

What's More

Activity 2
Precambrian
Paleozoic
Mesozoic
Cenozoic
Recent time
4.048mya
299mya
184mya
69mya
4600mya

What's More

Activity1.1 Its a Date
1.E
2.A
3.B
4.D
5. C
Answer:
1.D
2.A
3.B
4.Absolute dating
5.Precambrian is the oldest
era because it is located at
the bottom.

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