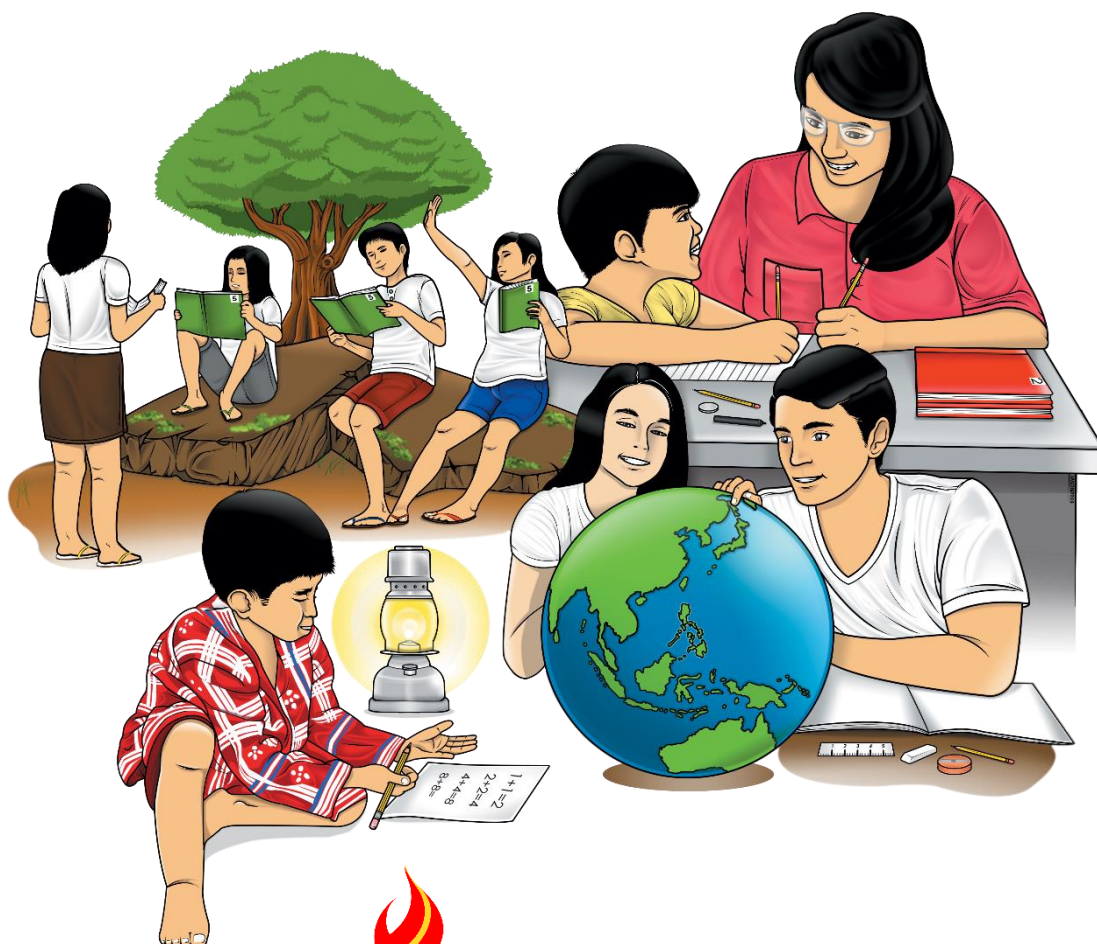


Senior High School

Earth Science for STEM

Quarter 2 – Module 13: The History of Earth



**Earth Science for STEM
Alternative Delivery Mode
Quarter 2 – Module 13: The History of Earth
First Edition, 2021**

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Senior High School

Earth Science for STEM

Quarter 2 – Module 13:

The History of Earth

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.

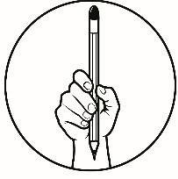


What I Need to Know

This module was designed and written with you in mind. It is here to help you describe the history of earth through geologic time. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lesson follows the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

After going through this module, you are expected to:

1. trace the history of the early Earth,
2. discuss the history of the Earth through geologic time scale and
3. appreciate the planet Earth and life forms evolution in the last 4.6 billion years



What I Know

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

1. Which branch of science deals with the study of the origin, history and structure of the Earth?
 - a. Biology
 - b. Geology
 - c. Mineralogy
 - d. Paleontology

2. Which division of the geologic time scale is the longest?
 - a. eon
 - b. epoch
 - c. era
 - d. period

3. How old do scientists believe the Earth is?
 - a. 4000 years old
 - b. 3.6 billion years old
 - c. 4.6 billion years old
 - d. 6.6 million years old

4. Approximately, 90 percent of the most important events in Earth's history happened in _____ era.
 - a. Cenozoic
 - b. Mesozoic
 - c. Paleozoic
 - d. Precambrian

5. If Pangea is the supercontinent before the Mesozoic era, what is the biggest body of water that covers the Pangea?
 - a. Gondwana
 - b. Laurentia
 - c. Panthalassa
 - d. Romundina

6. Jose is a Grade 11 student and ask to arrange the correct order of geologic time in his science class. Which of the following order is correct?
 - I. era>eon>period>epoch
 - II. eon>era>period>epoch
 - III. epoch>period>era>eon
 - IV. eon>era>epoch>period
 - a. I
 - b. II
 - c. III
 - d. IV

7. Mount Everest is the tallest land form in the planet. Which period did the top rocks of Mount Everest form?
- Cambrian
 - Devonian
 - Ordovician
 - Permian
8. In _____ period, three northern continents collided and formed the supercontinent Euramerica.
- Carboniferous
 - Ordovician
 - Permian
 - Silurian
9. When did mammals become the most dominant organisms?
- Cenozoic
 - Mesozoic
 - Paleozoic
 - Precambrian
10. When identifying period under Mesozoic era, Jana knows that _____, _____ and _____ are correct.
- Cambrian, Devonian and Jurassic
 - Cretaceous, Jurassic and Triassic
 - Paleozoic, Tertiary and Quaternary
 - Devonian, Ordovician, Silurian
11. How do we separate the geologic time scale into eras?
- Every 100 million years
 - Every 10 billion years
 - Based on major changes to life on Earth
 - Based on the appearance of new reptiles
12. Archean eon is the time when the Earth cooled down and able to support continents and oceans while Phanerozoic eon is the time when rapid expansion of life occurred.
- Both statements are true.
 - Both statements are false.
 - Only the first statement is true.
 - Only the second statement is true.
13. Which era is also known as the time of the hidden life and ranges from 4.6 billion years ago to 544 million years ago?
- Archaean
 - Phanerozoic
 - Precambrian
 - Silurian

14. Which event was largely responsible for the demise of great coral reefs, jawless fishes and trilobites?

- a. Coal Event
- b. Cooksonia Event
- c. Kellwasser Event
- d. Miocene Event

15. All are parts of the Tertiary period EXCEPT:

- a. Eocene
- b. Holocene
- c. Miocene
- d. Paleocene

The History of Earth



Figure 1. The Planet Earth

Earth is an active place. The Earth's history is recorded in the rocks of the crust. Earthquakes rip along plate boundaries, volcanoes spew fountains of molten lava, and mountain ranges and seabed are constantly created and destroyed. Earth scientists have long been concerned with deciphering the history – and predicting the future – of this active planet. Over the past four decades, Earth scientists have made great strides in understanding Earth's working. Scientists also used an assumption called uniformitarianism in order to relate what we know about present-day processes to past events – the present is the key to the past. Uniformitarianism states that the natural laws we know today have been constant over the geologic past.

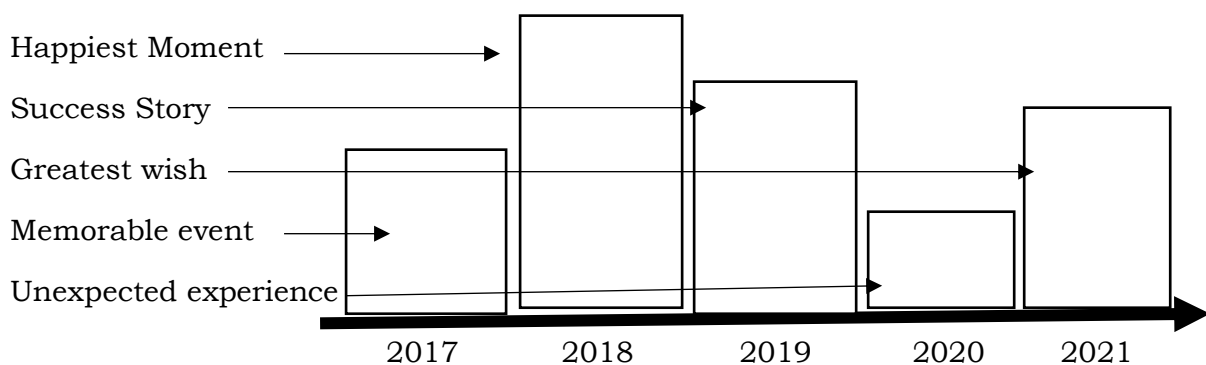


What's In

The geologic time scale is a system of chronological measurement that relates stratigraphy to time. It is used by geologists to describe the timing and relationships between events that have occurred throughout Earth's history. Geologists have divided Earth's history into a series of time intervals using significant events in the history of Earth. It is like the series of events in your life.

Do this! *The Time of my life!*

Copy the time line in your answer sheet. Fill out the boxes below with only one answer.



Self-Reflection: Questions below did not require answers but self-reflection will do.

Imagine how time flies.

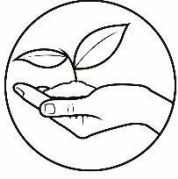
Are you achieving what you desire and making a difference?

Did today matter? How do you see yourself ten years from now?



Notes to the Teacher

It is important to use variety of approaches and activities that will keep the learners interested. It is also vital to track the progress of the learners and ask yourself whether you are meeting their needs.



What's New

Read the Early Earth's History and do the activity below.

A Glimpse to Early Earth's History to Present

Scientists believe the Earth began its life about 4.6 billion years ago. The Earth formed as cosmic dust lumped together to form larger and larger particles until 150 million years had passed. Lighter gases like hydrogen and helium escaped to space. All water was held in the atmosphere as vapor because of high temperatures. Continued release of gases from the lithosphere and water vapor clouds are common in the lower atmosphere. Chemosynthetic bacteria appear on Earth at some time between 3.9 billion years ago. Life begins to modify the atmosphere.

As the Earth continued to cool, the water vapor found in the atmosphere condensed to form the oceans and other fresh water bodies on the continents. Oxygen began accumulating through photo-dissociation from water and by the way photosynthesis. The emergence of living organisms was extremely important in the creation of atmospheric oxygen and ozone. Without ozone, life could not exist on land because of harmful ultraviolet radiation.

Development, evolution and growth of life increases the quantity of oxygen in the atmosphere from <1% to 21%. Five hundred million years ago, concentration of atmospheric oxygen levels off. Human begin modifying the concentrations of some gases in the atmosphere beginning around 1700.

Activity A: Remember me!

Read the sentences below. Write the word SURE if the statement is correct, UNCERTAIN if is wrong and CLUELESS if it was not taken from the selection.

1. Five hundred million years ago, the earth's concentration of hydrogen levels off.
2. Due to continued cooling of the earth, the water vapor found in the atmosphere condensed to form the oceans and other fresh water bodies on the continents.
3. The emergence of living organisms was extremely important in the creation of atmospheric oxygen and ozone that shield living organisms against harmful ultraviolet radiation.
4. Development, evolution and growth of life increases the quantity of oxygen in the atmosphere from <21% to 1%.
5. The geological time scale divides the history of Earth into eons, eras, periods and epochs.

Activity B: Unveiling Secrets!

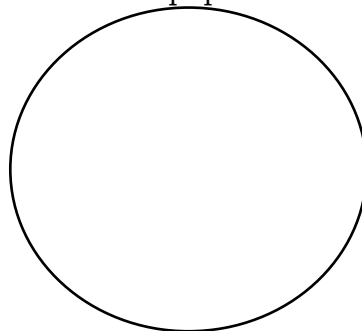
Analyze the table and do the activity below.

The system used by scientist to relate stratigraphy and time to any geologic events is called geologic time scale. They have divided Earth’s 4.6 billion age history into different spans of time to conveniently indicate events. These time spans include *age* (millions of years), *epoch* (tens of millions of years), *period* (one hundred million years), *era* (several hundred million years) and *eon* (half a billion years or more).

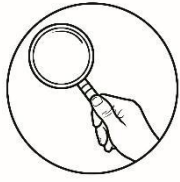
Table 1. The Geologic Time Scale

| Eon | Era | Period | Epoch | Age (mya) | Time Span (mya) |
|-------------|-------------|----------------------|-------------------------------|-----------|-----------------|
| Phanerozoic | Cenozoic | Quaternary | Holocene | 0.01 | |
| | | | Pleistocene | 1.8 | 1.79 |
| | | Tertiary | Pliocene | 5.3 | 3.5 |
| | | | Miocene | 23.0 | 17.7 |
| | | | Oligocene | 33.9 | 10.9 |
| | | | Eocene | 55.8 | 21.9 |
| | | | Paleocene | 65.5 | 9.7 |
| | Mesozoic | Cretaceous | | 145 | 79.5 |
| | | Jurassic | | 200 | 55 |
| | | Triassic | | 251 | 51 |
| | Paleozoic | Permian | | 299 | 48 |
| | | Pennsylvanian | | 318 | 19 |
| | | Mississippian | | 359 | 57 |
| | | Devonian | | 416 | 28 |
| | | Silurian | | 444 | 28 |
| | | Ordovician | | 488 | 44 |
| | Precambrian | Proterozoic | Bacteria and blue green algae | | 2500 |
| Archean | | Oldest fossils | | 3800 | 1300 |
| Hadean | | (Beginning of Earth) | | 4600 | 800 |

Time span of the Earth’s past is so great that geologists use the geologic time scale to show Earth’s history. The geologic time scale is a record of geologic events and the evolution of the life forms. Create a pie chart in a sheet of paper to show the percentage of time each Era of geologic time represent in the geologic time scale. Label each part. Use a separate sheet of paper.



Pie Chart showing Percentage (%) of Geologic History of Earth



What is It

The Geological Time Scale

The ideas of superposition and evolution provide the basis of the geological time scale, which was developed in a somewhat random fashion (mostly in Europe) during the 19th century. The geologic time scale is a system of chronological dating that relates geological strata to time. It is used by geologists, paleontologists and other Earth scientists to describe the timing and relationships of events that have occurred during Earth's history.

The geological time scale divides the history of Earth into eons, eras, periods and epochs.

- A. **Eons.** It has the largest intervals of geologic time. A single eon covers a period of several hundred million years. The history of the Earth has been divided into three eons: Archaean, Proterozoic and Phanerozoic.

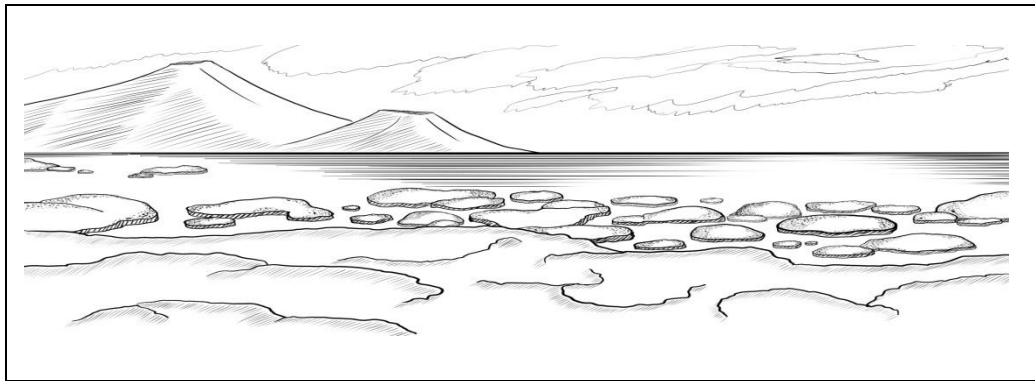


Figure 2. Archaean Eon

Archaean Eon – it is the period where life first formed on Earth, archa and bacteria. Earth cooled down and was able to support continents and oceans.

Proterozoic Eon – it is the period just before the proliferation of complex life on Earth. There were extensive shallow epicontinental seas and rocks are less metamorphosed than Archean age.

Phanerozoic Eon – it is the period of visible life where rapid expansion and evolution of life forms occur and fill the various ecological niches available on Earth.

The time between Earth's formation and the beginning of the Paleozoic era are often collectively called the **Precambrian time** or also known as the “time of hidden life”. This era ranges from 4.6 billion years ago when the Earth formed to about 544 million years ago when abundant microscopic life appeared.

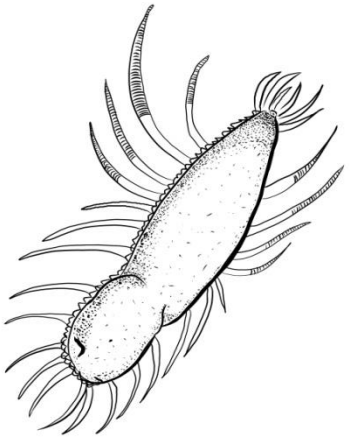
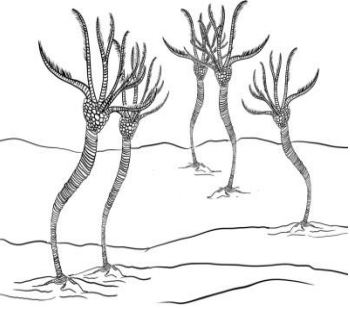
- B. **Era.** It is the subdivision of eons. The geologic time scale is divided into three eras – Paleozoic (time of ancient life), the Mesozoic (time of middle life) and the Cenozoic (time of recent life).

Table 1. Summary of Events from Different Eras

| Name of era | Transition events | Ma |
|---------------|--|-----|
| Paleozoic era | First appearance of organisms with hard parts – specific event: The Cambrian Explosion | 544 |
| Mesozoic era | Extinction of over 90% of living organisms including trilobites | 250 |
| Cenozoic era | Extinction of dinosaurs and many other organisms | 65 |

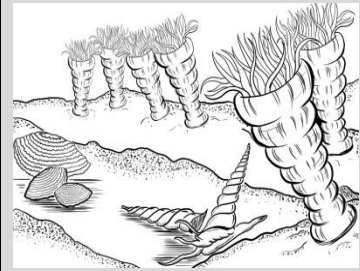
- C. **Periods and Epochs.** Each era is further divided into periods and further into epochs.

Table 2. The Six Major Periods of Paleozoic Era

| | |
|--|---|
| <p>Cambrian Period</p> <p>Almost all marine organisms came into existence as evidenced by abundant fossils. One important event is the development of organisms having the ability to secrete calcium carbonate and calcium phosphate for the formation of shells. The evolution of chordates, animal with dorsal nerve cord, hard resembled clams and arthropods ancestors of spiders, insects and crustaceans. There were two supercontinents during this period, Gondwana and Laurentia.</p> |  |
| <p>Ordovician Period</p> <p>This period marked the earliest appearance of vertebrates and the jawless fish known as Agnatha. Ordovician rocks have distinction of occurring at the highest elevation on Earth – the top of Mount Everest. During this period, the level of carbon dioxide was several higher than today. There were four major continents separated by three major oceans.</p> |  |

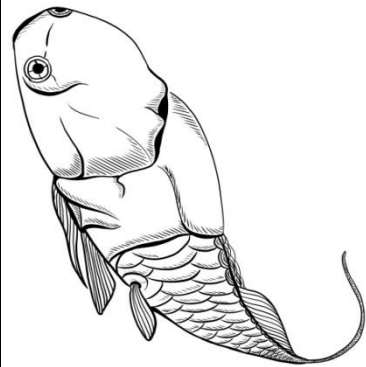
Silurian Period

This period brought the emergence of terrestrial life, the earliest well developed circulatory system (vascular plants) known as Cooksonia. As plants move ashore so did other terrestrial organisms. Air-breathing scorpions and millipedes were common during the period. Romundina, a primitive armoured fish with a cartilage skeleton is the earliest fish known to have jaws. Three northern continents collided forming the new supercontinent Euramerica.



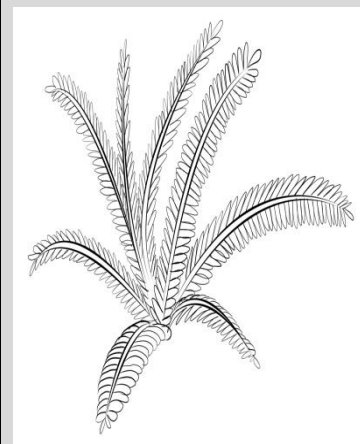
Devonian Period

This period was known as the “age of fishes”. Lowland forests of seed ferns, scale trees and true ferns flourished. Sharks and bony fishes developed. Today the lung fishes and coelacanth, a “living fossil” have such internal nostrils and breathe in a similar way. The first amphibians made their appearance, although able to live on land, they need to return to water to lay their eggs. The Kellwasser Event was largely responsible for the demise of the great coral reefs, jawless fishes and trilobites.



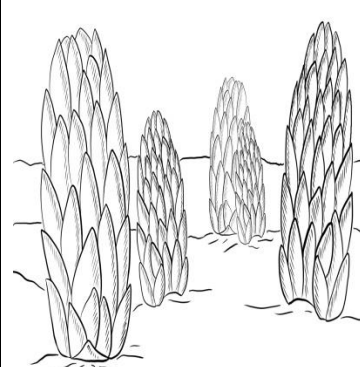
Carboniferous Period

Warm, moist climate conditions contributed to lush vegetation and dense swampy forests. Insects under rapid evolution led to such diverse forms of giant cockroaches and dragonflies. The evolution of the first reptiles took place with the development of the amniotic egg, a porous shell containing a membrane that provided an environment for embryo. The Coal Age, the formation of organic deposits of coal in plant debris formed the world’s first extensive coal deposits.



Permian Period

A dramatic climatic shift may have been partially triggered the assembly of smaller continents into a supercontinent, Pangea which was surrounded by an immense ocean called Panthalassa. The reptiles were well-suited to their environment that they ruled the Earth for 200 million years. The two major groups of reptiles – diapsids and synapsids dominated this period. Diapsids gave rise to the dinosaurs while synapsids gave rise to mammals.



The Mesozoic Era

Known as the age of reptiles, Mesozoic Era is made up of three periods: Triassic, Jurassic and Cretaceous. The most significant event was the rise of the dinosaurs. A famous Jurassic deposit is the Morrison Formation, within which the world's richest storehouse of dinosaurs was preserved. True pines and red woods appeared and rapidly spread. Flowering plants arose and their emergence accelerated the evolution of insects. A major event of this era was the breakup of Pangea. At the end of this era, the dinosaurs and reptiles were completely wiped out.

The Cenozoic Era

This era is known as the “age of mammals” because mammals replaced the reptiles as the dominant land animal. It is also sometimes called the “age of flowering plants” because angiosperms replaced gymnosperms as the dominant land plants. This era is made up of two periods: Tertiary and Quaternary. From oldest to youngest the periods are broken up into the Paleocene, Eocene, Oligocene, Miocene and Pliocene for the Tertiary period and the Pleistocene and Holocene for the Quaternary period.

Climates cooled during this era, hence the widespread glaciation. This era also brought about the advent of humans. The lowered sea level resulted in the land bridges connections between land masses. One of these land bridges provided the route for human migration from Asia to North America , also throughout the world.

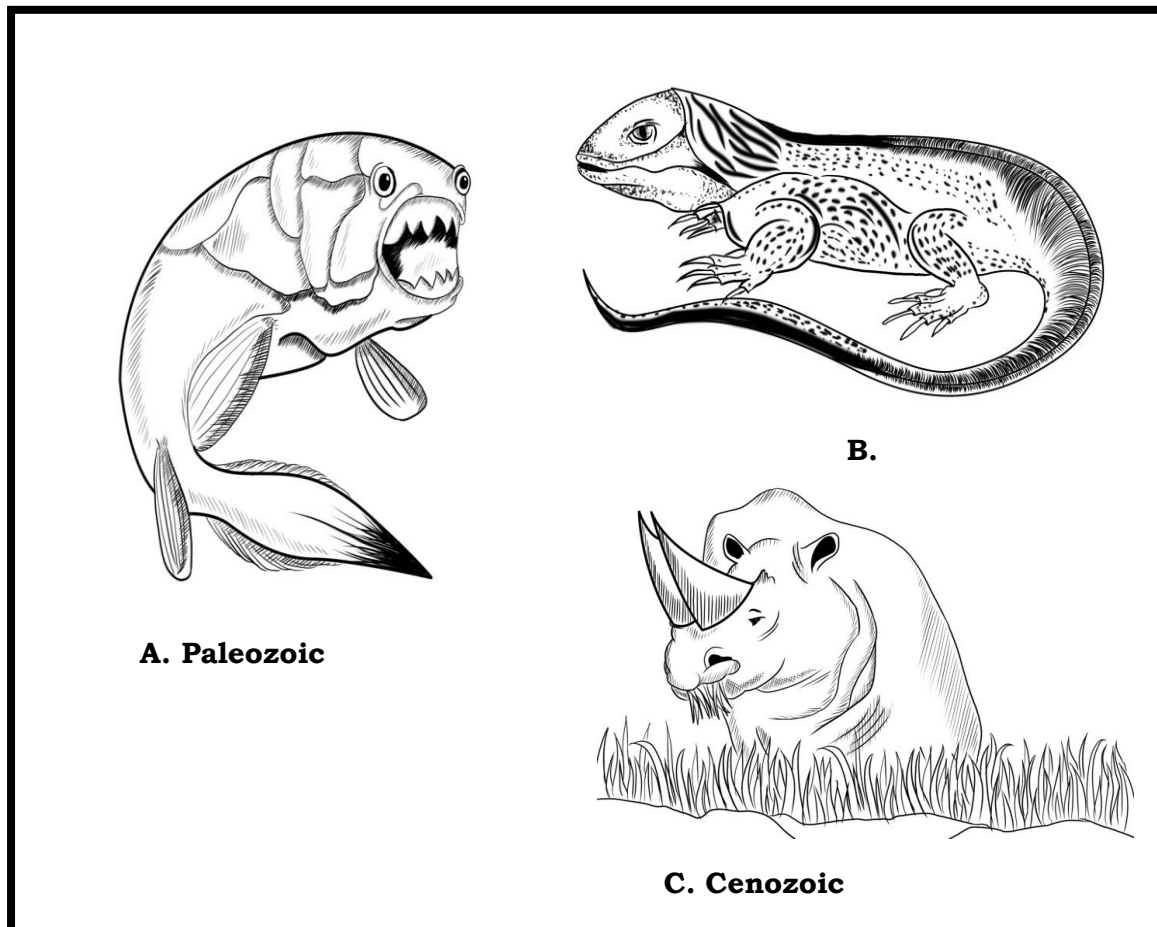


Figure 3. Common Species in the Three Different Eras

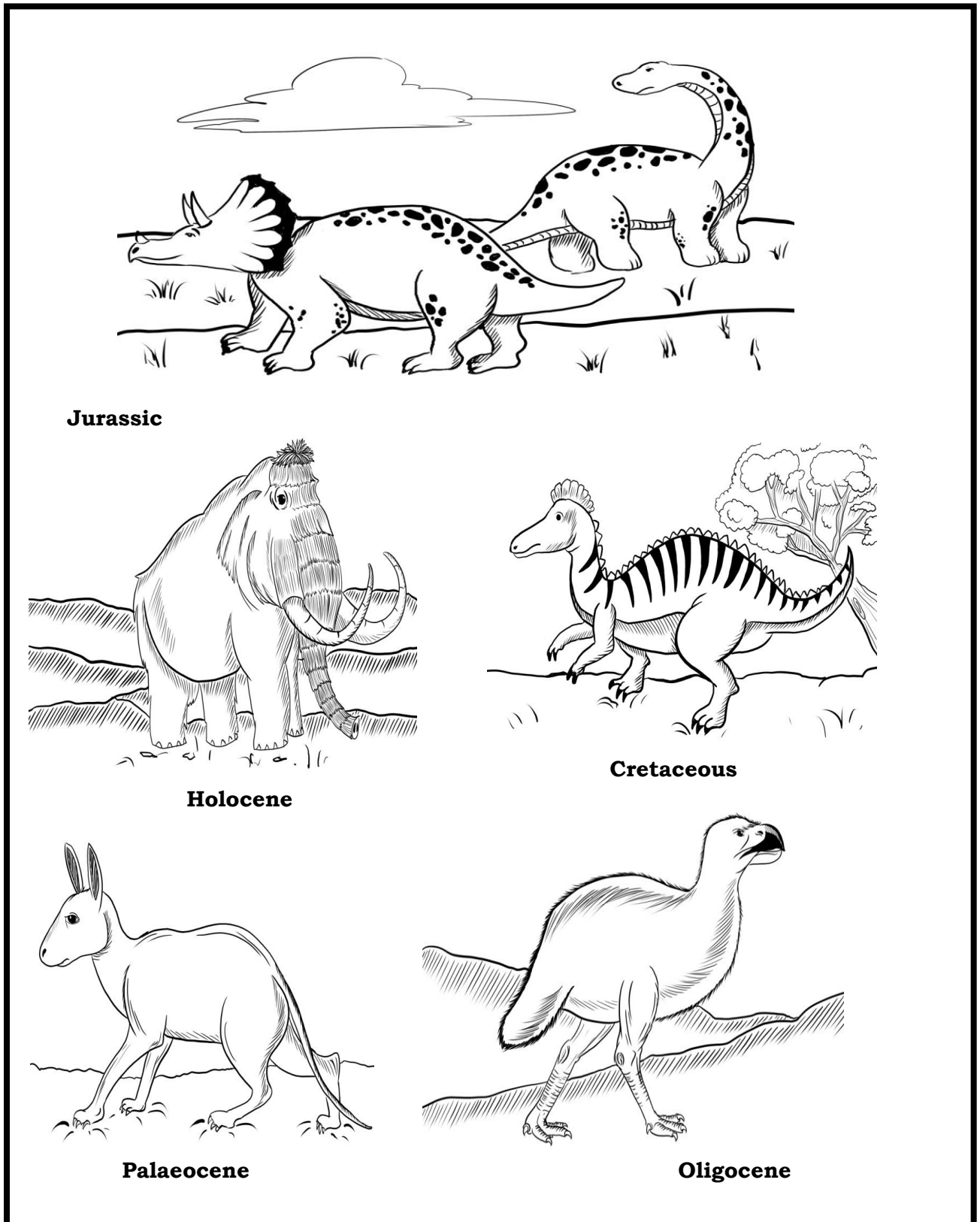
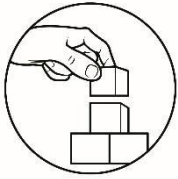


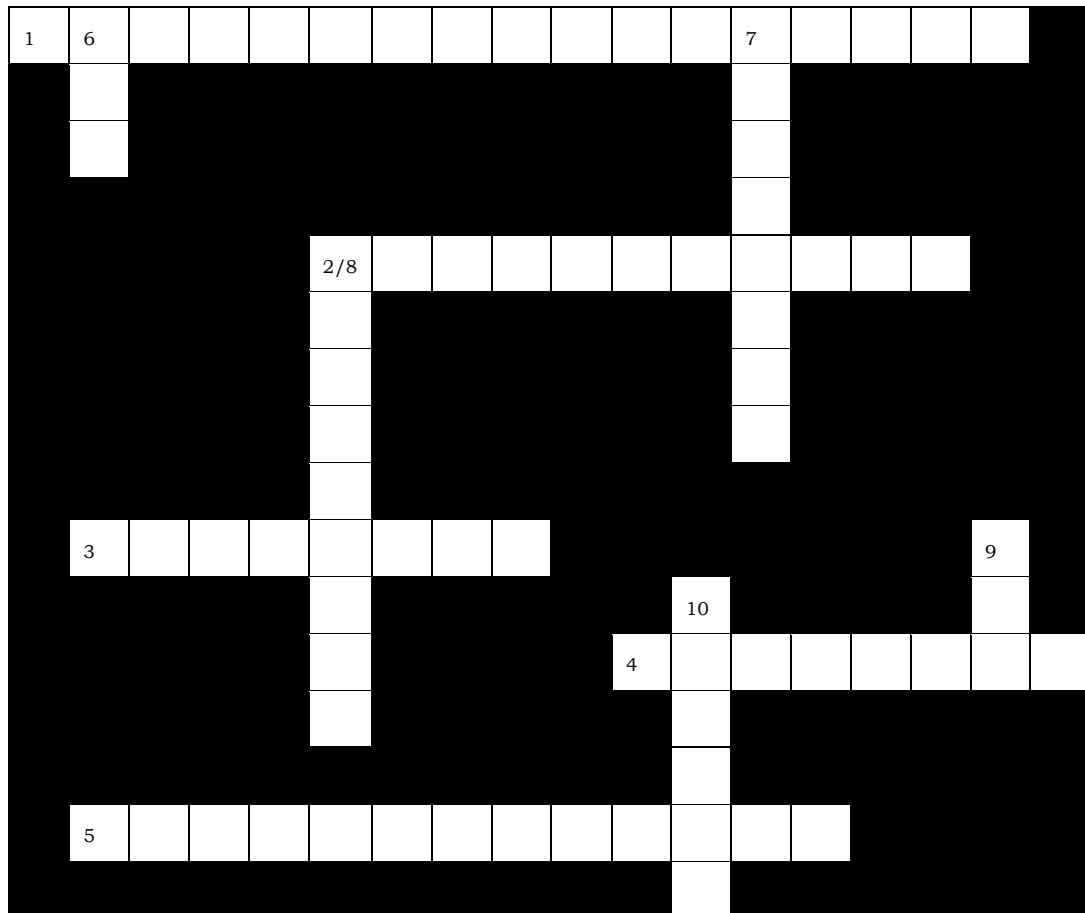
Figure 4. Common Species in the Different Periods and Epochs



What's More

Activity A: Try me!

Fill the crossword puzzle with the terms being described related to the history of earth. Write the answer on a separate sheet of paper.



ACROSS

1. It refers to the system of chronological dating that relates geological strata to time.
2. It refers to the time of hidden life.
3. It is also known as the age of mammals.
4. This is the time where first amphibians made their appearance.
5. The evolution of first reptiles took place.

DOWN

6. It refers to a unit of geological time equal to billion years.
7. It is the time where first terrestrial life and vascular plants appeared.
8. It is an era that began about 544 million years ago and lasted about 300 million years.
9. It is a period of time in history that is a subdivision of an eon.
10. It refers to the subdivision of an era.

Activity B: Finding Nemo and Friends

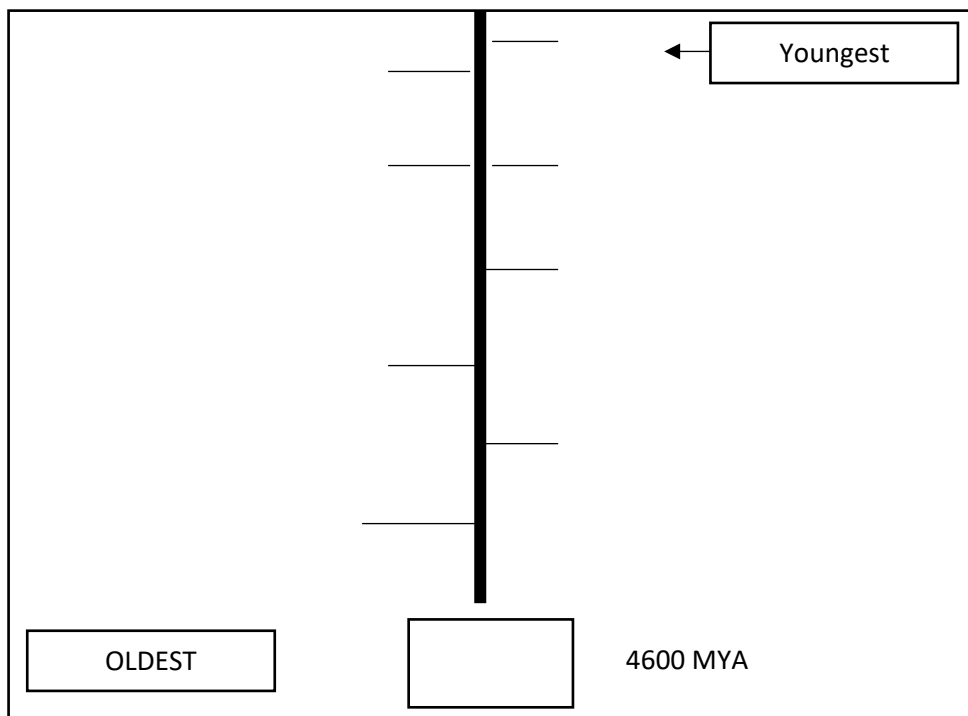
Do the activity on a separate sheet and follow the procedures below.

1. Study the table given. Help Nemo and friends to find their origin using geologic time scale.

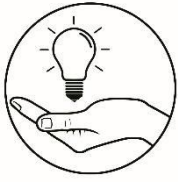
| Event | Approximate Time (Million years Ago) | inches |
|--------------------------------|--------------------------------------|--------|
| The Earth | 4600MYA | 0 |
| Oldest Known rocks | 4200 MYA | 1 |
| First animal cell | 1800 MYA | 2 |
| Nemo and friends (Fish) | 416 MYA | 10 |
| Youngest rock | 290 MYA | 4 |
| First Dinosaurs | 225 MYA | 6 |
| Last Dinosaurs | 65 MYA | 10 |
| Ice Age begins | 2 MYA | 11.95 |
| Earliest Human | 0.3 MYA | 12.0 |

2. Cut a picture/draw all the given event on the data table in one-eighth (1/8) sheet of bond paper.

3. Copy the given figure below in a long bond paper and paste the picture/drawing from their geologic time scale (in inches). Use a ruler to measure their actual distance from the point of origin.




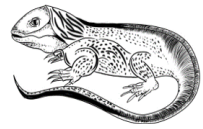
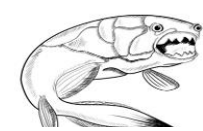

Template for Geologic Time Mini Project



What I Have Learned

Pretend that you are working in a museum. You are assigned to discuss events that occurred during early earth's history to a group of grade 11 students from Batangas City. Copy the template in a separate sheet and write the important details to enrich their knowledge on the Early History of Earth to make their group tour informative, meaningful, and memorable.

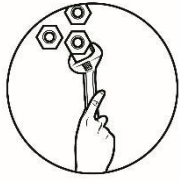
MY STORY BOARD

| EON | ERA | DETAILS |
|---|---|---------|
| P H A N E R O Z O I C | CENOZOIC  | |
| | MESOZOIC  | |
| | PALEOZOIC  | |
| PRE-CAMBR EAN | THE EARTH  | |

Template for Writing a Story Board

Rubric:

| INDICATORS | Master (5) | Expert (4) | Rookie (3) |
|-------------|--|---|--|
| Information | All topics are addressed, information is complete and goes beyond task and no factual errors | All topics are addressed, information is complete and no factual errors | All topics are addressed, but information is limited and there are 1 to 2 factual errors |
| Originality | The story board shows a large amount of original thought and ideas and creatively written | The story board shows some original ideas and creatively written | Work is not original and basic recall of information is listed |



What I Can Do

Photographs and Memories sealed with a kiss! Making my Time Capsule

Create memories of your life during pandemic to review later or show others how you live, conquer and accept the new normal.

Materials: You will need small or medium container, everyday items, souvenir items, location for safe keeping and epoxy or glue stick.

Procedures:

1. Set retrieval date 1 to 3 years from the time of storage and when the capsule will be recovered or opened. Label the container with the retrieval date.
2. Choose a container for the time capsule. You may use plastic, metal, bottle or box. You will seal the lid with epoxy or glue stick for safekeeping.
3. Pick items for storage that are representative of your quarantine life along with the few articles about Covid 19 and its variant taken from the newspaper, clippings and photos.
4. Find a location where the capsule will be kept and not be disturbed. You may keep it in a storage room, basement or burying it by a well-known landmark on the site for retrieval.
5. Have a sealing ceremony. Invite your sibling to examine the capsule and its contents before sealed and stored. Take a photo and make a collage of the ceremony and post it in your group account.
6. Seal the time capsule and wait until the retrieval date (after 3 years) and see your time travelling treasure again and enjoy a glimpse to the past on how you survived the New normal (covid 19 pandemic).

Rubric:

| Indicators | Best (5 pts) | Better (4 pts) | Good (3 pts) |
|----------------------------|--|---|---|
| Container for time capsule | Durable and safe for keeping | Durable but not safe for keeping | Not durable and not safe for keeping |
| Items for keeping | Exceeds expectations | Meet expectations | Did not meet expectations |
| Sealing Ceremony | Well documented and the collage of photos was uploaded/submitted on time | Well documented and the collage of photos was uploaded/submitted 1 day after the due date | Well documented but the collage of photos was uploaded/submitted 2 or 3 days after the due date |



Assessment

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

1. What is the smallest main unit of geologic time?
 - a. eon
 - b. era
 - c. epoch
 - d. period
2. Which is the present eon that began 541 million years ago?
 - a. Cenozoic
 - b. Holocene
 - c. Phanerozoic
 - d. Quaternary
3. When did the breakup of Pangea happen where all dinosaurs and reptiles also wiped out?
 - a. Cenozoic
 - b. Mesozoic
 - c. Paleozoic
 - d. Precambrian
4. Which of these was believed to be the first life form on Earth?
 - a. amphibians
 - b. bacteria
 - c. mammals
 - d. reptiles
5. Which of these is correctly paired?
 - a. *eon* (half a billion years)
 - b. *epoch* (hundreds of millions of years)
 - c. *era* (several hundred million years)
 - d. *period* (one hundred million years)
6. How many years did reptiles rule the Earth?
 - a. 100 million years
 - b. 300 million years
 - c. 200 million years
 - d. 400 million years
7. Myra understands the characteristics of Agnatha when she describes it as:
 - a. a primitive jawless fish
 - b. a primitive armored fish with cartilage skeleton
 - c. a fish with jaw
 - d. a fish with legs

8. In what order do the following organisms appear in the geologic record from oldest to youngest?
 - a. bacteria, fish, birds, humans
 - b. bacteria, birds, fish, humans
 - c. human, fish, birds, bacteria
 - d. fish, bird, humans, bacteria

9. When is the time where proliferation of life occurred and rocks became less metamorphosed?
 - a. Archaean eon
 - b. Proterozoic eon
 - c. Phanerozoic eon
 - d. Paleozoic era

10. Joan was asked to identify the current period we are in. Which is the correct answer of Joan?
 - a. Holocene
 - b. Jurassic
 - c. Quaternary
 - d. Tertiary

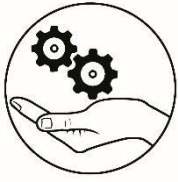
11. Devonian period is the age of fishes while Silurian period is the age of vascular plants.
 - a. The first statement is true while the second is false.
 - b. The first statement is false while the second is true.
 - c. Both statements are true.
 - d. Both statements are false.

12. In which period did the level of carbon dioxide is several higher than today?
 - a. Devonian
 - b. Ordovician
 - c. Permian
 - d. Silurian

13. Which period did sharks and bony fishes develop?
 - a. Cambrian
 - b. Devonian
 - c. Permian
 - d. Silurian

14. All statements are true about the Cenozoic era EXCEPT:
 - a. It is also known as the “age of mammals”.
 - b. It is also known as the “age of flowering plants”.
 - c. It is the time of widespread glaciation.
 - d. It is the time when gymnosperms replaced angiosperms.

15. Which describes the geologic time scale correctly?
 - a. It is a record of old geologists.
 - b. It refers to the history of rocks and minerals.
 - c. It is a record of the known history of rocks and fossils.
 - d. It refers to the division of period in history.

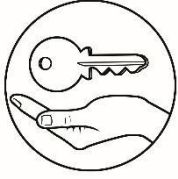


Additional Activities

Take Me Back!

Read the situation below. Make a comic strip about your time travel.

Do you believe in Time Machine? It was popularized in 1895, a time machine is a vehicle or device to travel purposely and selectively forward or backward through time. If you could travel back in time, which Era would you choose and what would you do? Who are the persons you want to be with? Why?



Answer Key

What's More

Activity A

Across:

1. Geologic Time Scale
2. Precambrian
3. Cenozoic
4. Devonian
5. Carboniferous

Down:

6. Eon
7. Silurian
8. Paleozoic
9. Era
10. Period

What's New

1. uncertain
2. sure
3. sure
4. uncertain
5. Clueless

What I Know

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

Assessment

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

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