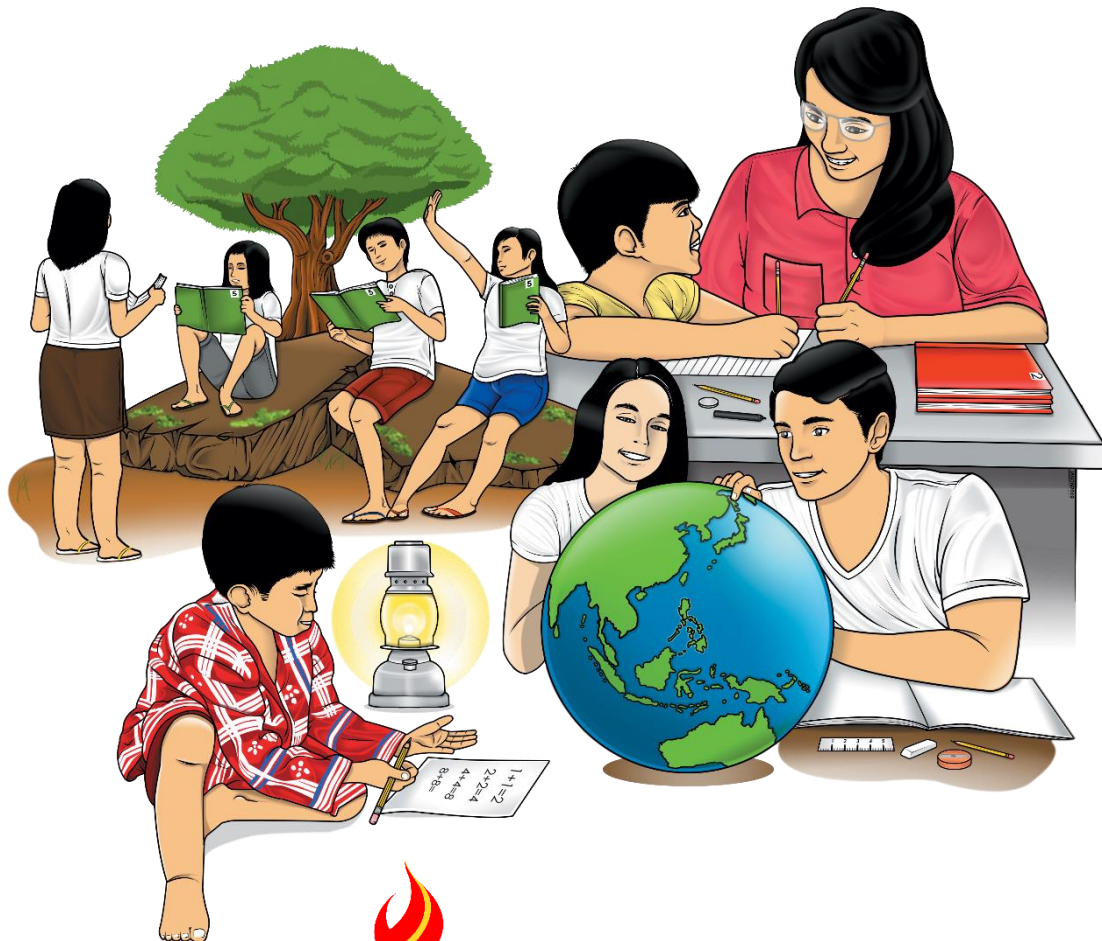


Senior High School

# Earth Science for STEM

## Quarter 2 – Module 11: Relative and Absolute Dating



**Earth Science for STEM  
Alternative Delivery Mode  
Quarter 2 – Module 11: Relative and Absolute Dating  
First Edition, 2021**

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Senior High School

# **Earth Science for STEM**

## **Quarter 2 – Module 11:**

### **Relative and Absolute Dating**

## **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.



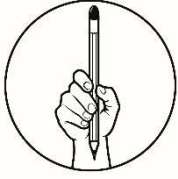
## ***What I Need to Know***

This module was designed and written with you in mind. It is here to help you master the nature of Biology. 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 lessons are arranged to follow 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.

In this lesson, the learner will identify relative and absolute dating. To achieve this learning competency, the learner should explain how relative and absolute dating was used to determine the subdivisions of geologic time.

After going through this lesson, you are expected to:

1. Define relative and absolute dating
2. Analyze the different methods (relative and absolute dating) of determining the age of stratified rocks.
3. Portray the subdivisions of geologic time.



## ***What I Know***

Choose the letter of the correct answer and write it in your answer sheet.

1. Which is true about absolute dating?
  - a. breakdown isotopes
  - b. arrange the historical remains in order of their ages
  - c. depends on the traces of radioactive isotopes found in fossils
  - d. all of the above
  
2. Which absolute dating technique depends on the traces of radioactive isotopes found in fossils?
  - a. Amino acid
  - b. Dendrochronology
  - c. Radiometric
  - d. Thermo luminescence
  
3. Which geological dating technique is very effective in estimating the age of fossils through comparing it with fossils of known ages?
  - a. Relative Ages
  - b. Relative Dating
  - c. Radiometric Dating
  - d. Radioactive Isotopes
  
4. Which of the following refers to the breakdown of isotopic energy?
  - a. Half-life
  - b. Isotopes
  - c. Radioactive decay
  - d. Radioactive metric dating
  
5. Which of the following refers to atoms of the same element that have the same number of protons but different numbers of neutrons?
  - a. Absolute dating
  - b. Isotopes
  - c. Radioactive Decay
  - d. Relative Dating
  
6. What do you mean by strata?
  - a. Rock ages
  - b. Rock layers
  - c. Rock particles
  - d. Rock sediments
  
7. Which law of stratigraphy describes that sedimentary rocks are formed particle by particle and bed by bed, and the layers are piled one on top of the other?
  - a. Law of deposition
  - b. Law of superposition
  - c. Law of lateral continuity
  - d. Law of cross-cutting relationships

8. What is the science that deals with all the characteristics of layered rocks and how these rocks relate to time?
  - a. Absolute Dating
  - b. Relative dating
  - c. Stratigraphy
  - d. Unconformities
9. Which law of stratigraphy states that any rock, fault or structure that cuts another rock or other structure is younger than the rock or structure it cuts?
  - a. Law of deposition
  - b. Law of superposition
  - c. Law of lateral continuity
  - d. Law of cross-cutting relationships
10. Which is true about sedimentary rocks?
  - a. Formed from particles of older rocks that have been broken apart by water or wind
  - b. May contain remnants from dead animals and plants settled at lake or sea bottom
  - c. 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.
  - d. all of the above
11. What is the originally deposited horizontal layers that folded or tilted and then eroded?
  - a. Angular unconformity
  - b. Disconformity
  - c. Nonconformity
  - d. Paracomformity
12. Which of the following refers to the layer of sediments which are uplifted without folding but exposed to erosion and weathering?
  - a. Angular unconformity
  - b. Disconformity
  - c. Nonconformity
  - d. Paracomformity
13. Which system is used by scientists to relate stratigraphy and time to any geologic events?
  - a. Time scale
  - b. Period scale
  - c. Half-life Scale
  - d. Geological time scale
14. Which of the following is commonly used to date rocks?
  - a. Carbon-14
  - b. Potassium-Argon
  - c. Rubidium
  - d. Uranium
15. Which of the following is a layer that indicates a period of uplift and erosion?
  - a. Angular unconformity
  - b. Disconformity
  - c. Nonconformity
  - d. Paracomformity

## Lesson

# 11

# Relative and Absolute Dating

Geologists often need to know the age of material that they find. They use absolute dating methods, sometimes called numerical dating, to give rocks an actual date, or date range, in number of years. This is different from relative dating, which only puts geological events in time order. Relative dating is used to arrange geological events and the rocks they leave behind, in a sequence. Relative dating does not provide actual numerical dates for the rocks. Most absolute dates for rocks are obtained with radiometric methods which use radioactive minerals in rocks as geological clocks.

Why relative dating does not provide actual numerical dates for the rocks?

How absolute dating and relative dating used to determine the age of rocks?



## *What's In*

In our past lesson, you learned how layers of rocks are formed. You also learned that Earth's history can be studied through past event that is preserved in the rocks. Most of the rocks which are exposed at the surface of the earth are called sedimentary rocks.

Let us find out the different methods of relative and absolute dating in determining the age of stratified rocks by rounding up the activity.

Read the paragraph and answer the question below. Can you write the exact time when you do the following activities?

Geological specimens that are unearthed need to be assigned an appropriate age. To find their age, two major geological dating methods are used. These are called relative and absolute dating techniques. Absolute dating also called numerical dating, arranges the historical remains in order of their ages. Whereas relative dating arranges them in the geological order of their formation. The relative dating techniques are very effective when it comes to radioactive isotope or radiocarbon dating. However, not all fossils or remains contain such elements. Relative techniques are of great help in such types of sediments.

1. Doing homework \_\_\_\_\_
2. Going to school \_\_\_\_\_
3. Eating your lunch \_\_\_\_\_
4. Waking up \_\_\_\_\_
5. Praying \_\_\_\_\_





### Notes to the Teacher

In monitoring students' progress, you may use notes and place a check mark once a lesson is done to give the learners an idea of their progress and create a sense of accomplishment as they progress through the lessons. Encourage and engage the learners as they do the tasks included in the module by allowing them to manage their own learning.



### What's New

How are relative and absolute dating used to determine the subdivisions of geologic time? Let us try to find out by accomplishing the next activity.

Activity: Illustration Case Analysis

Geologic cross section for relative age analysis. Place the letters on the lines along the right-side section to indicate the relative age of the rock units from oldest (first) to youngest (last). Copy the column and write the letter on your answer sheet.

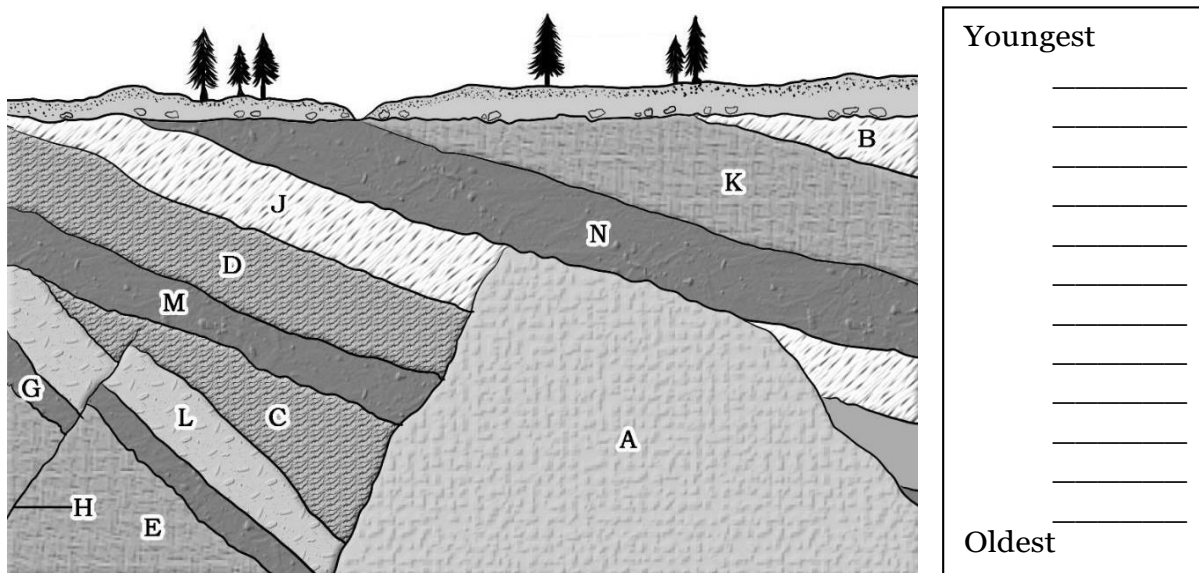


Figure 1. Geologic Cross Section



## What is It

Based on the previous activity, how are relative and absolute dating used to determine the subdivisions of geologic time? What is relative and absolute dating?

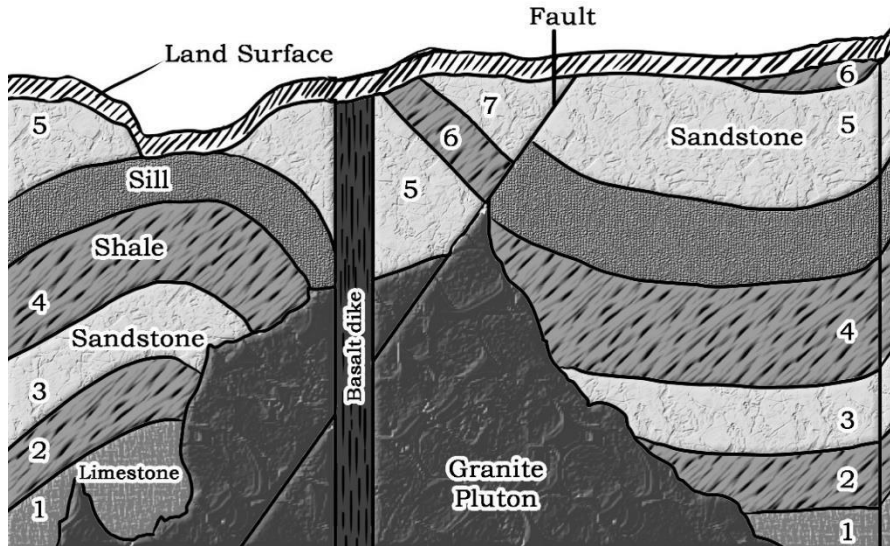


Figure 2. Subdivision of Geologic time

**Relative dating** – subdivisions of the Earth's geology in a specific order based upon relative age relationships most commonly in vertical/stratigraphic position. These subdivisions are given names, most of which can be recognized globally, usually on the basis of fossils.

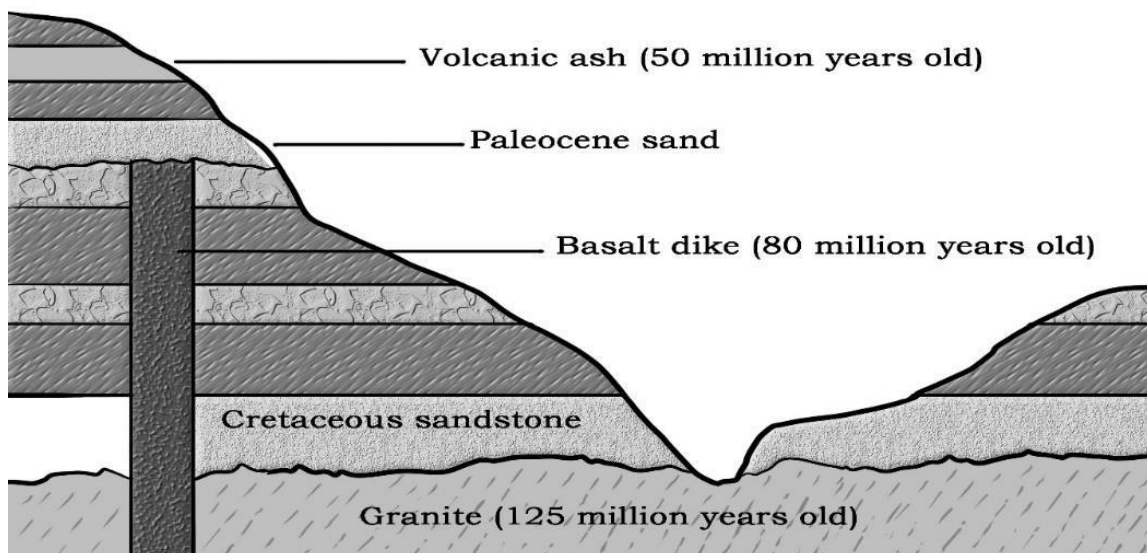


Figure 3. Subdivision of Geologic time

**Absolute dating** – numerical ages in "millions of years" or some other measurement. These are most obtained via radiometric dating methods performed on appropriate rock types.

It is important to realize that with new information about subdivision or correlation of relative time, or new measurements of absolute time, the dates applied to the time scale can and do change.

In addition, like any good scientific measurement, every dated boundary has an uncertainty associated with it, expressed as "+- X millions of years". These cannot be included in the diagram for practical reasons but can be found in Harland et al. (1990), along with a detailed description of the history of earlier-proposed time scales and the terminology, methodology and data involved in constructing this geological time scale.

Let us now differentiate relative and absolute dating.

**Relative Vs. Absolute Dating: The Ultimate Face-off**

Relative Dating	Absolute Dating
<ul style="list-style-type: none"> <li>▶ It determines if an object/event is younger or older than another object/event from history.</li> <li>▶ Relative dating is qualitative.</li> <li>▶ This technique helps determine the relative age of the remains.</li> <li>▶ It is less specific than absolute dating.</li> <li>▶ Relative dating is comparatively less expensive and time-efficient.</li> <li>▶ It works best for sedimentary rocks having layered arrangement of sediments.</li> </ul>	<ul style="list-style-type: none"> <li>▶ It determines the age of a rock/object using radiometric techniques.</li> <li>▶ Absolute dating is quantitative.</li> <li>▶ This technique helps determine the exact age of the remains.</li> <li>▶ It is more specific than relative dating.</li> <li>▶ Absolute dating is expensive and time-consuming.</li> <li>▶ It works best for igneous and metamorphic rocks.</li> </ul>

The following are the major methods of relative dating.

**Stratigraphy:** The oldest dating method which studies the successive placement of layers. It is based on the concept that the lowest layer is the oldest and the topmost layer is the youngest.

**Biostratigraphy:** An extended version of stratigraphy where the faunal deposits are used to establish dating. Faunal deposits include remains and fossils of dead animals.

**Cross dating:** This method compares the age of remains or fossils found in a layer with the ones found in other layers. The comparison helps establish the relative age of these remains.

**Fluorine dating:** Bones from fossils absorb fluorine from the groundwater. The amount of fluorine absorbed indicates how long the fossil has been buried in the sediments.

The following are the major methods of absolute dating.

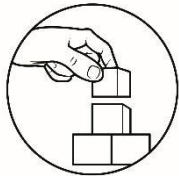
**Radiometric dating:** This technique solely depends on the traces of radioactive isotopes found in fossils. The rate of decay of these elements helps determine their age, and in turn the age of the rocks.

**Amino acid dating:** Physical structure of living beings depends on the protein content in their bodies. The changes in this content help determine the relative age of these fossils.

**Dendrochronology:** Each tree has growth rings in its trunk. This technique dates the time or period during which these rings were formed.

**Thermoluminescence:** It determines the period during which certain object was last subjected to heat. It is based on the concept that heated objects absorb light and emit electrons. The emissions are measured to compute the age.

The Law of Superposition states that younger strata lie on top of older strata. The Principle of Cross-Cutting Relationships states that intrusions and faults that cut across rock are necessarily younger than that rock. Inclusions, or foreign bodies, found inside the rock are necessarily older than that rock.



## ***What's More***

### **Activity 1:** Differentiation Using a Venn diagram

A Venn diagram tells both dating methods as two individual sets. The area of intersection of both sets tells the purpose common to both. Although absolute dating methods determine the accurate age compared to the relative methods, both are good in their own ways. Look at the diagram to understand their common purpose. When you observe the intersection in this diagram comparing these two dating techniques, we can conclude that they both have two things in common:

- a. give an idea of the sequence in which events have occurred and
- b. tell the age of fossils or rocks.

Complete the Venn diagram using the words inside the box. Write the letter of your correct answer on your answer sheet.

**A.** age

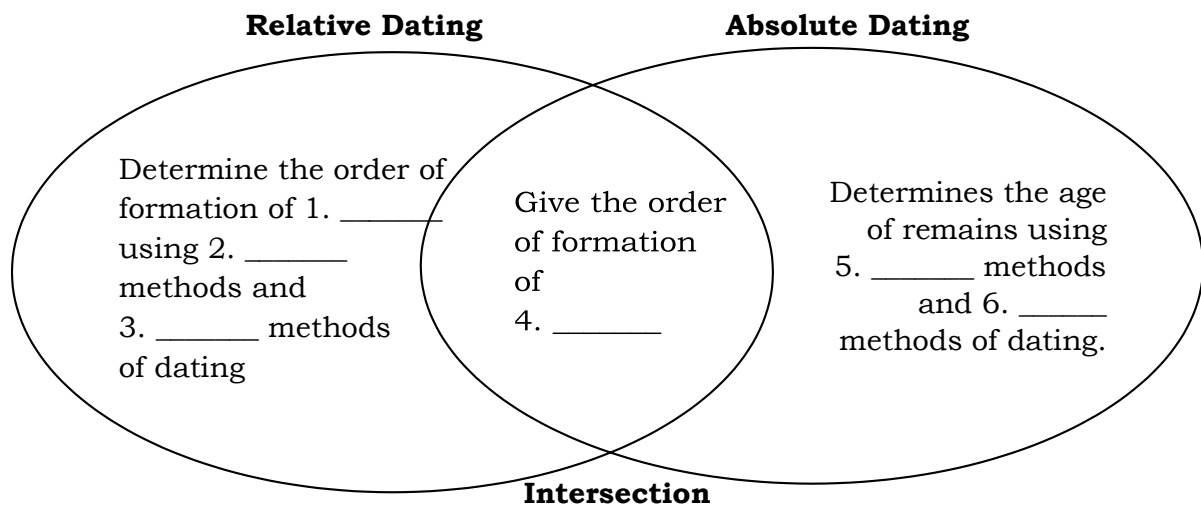
**B.** qualitative

**C.** quantitative

**D.** remains

**E.** radiometric

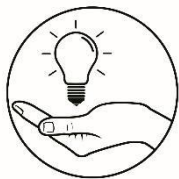
**F.** stratigraphic



**Activity 2:** Tell Me! Relative Dating? Or Absolute Dating?

Read the statement carefully and tell what type of dating is being described. Write **RD** if relative, and **AD** if absolute. Write your answer on your answer sheet.

1. It tells if an object/event is younger or older than another object/event from history.
2. It is qualitative.
3. Most absolute dates for rocks are obtained with radiometric methods.
4. It is quantitative.
5. This technique helps determine the exact age of the remains.



***What I Have Learned***

**Activity:** Let us Explore!

Use the laws of superposition, inclusions, and cross-cutting relationships to determine the relative ages of the following cross-sections. Determine the oldest bed first up to youngest. Copy the column and write the letter in your answer sheet.

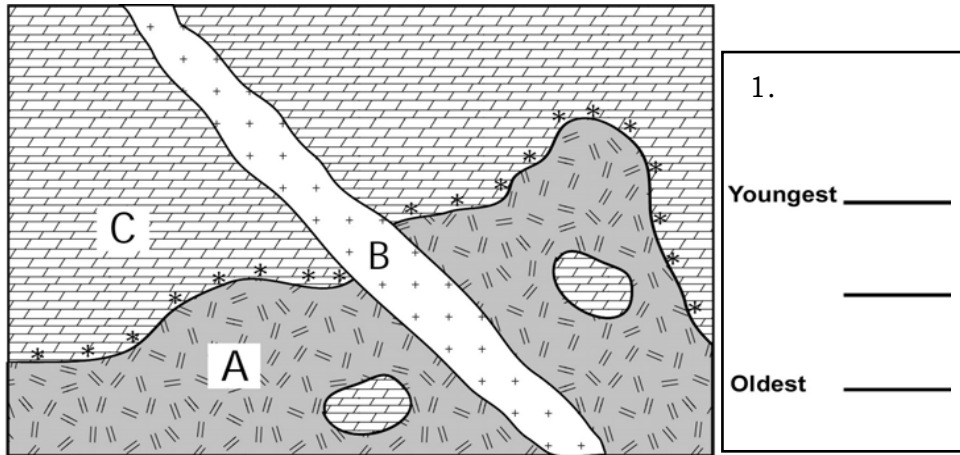


Figure 4. Subdivision of Geologic time (Layers of rock)

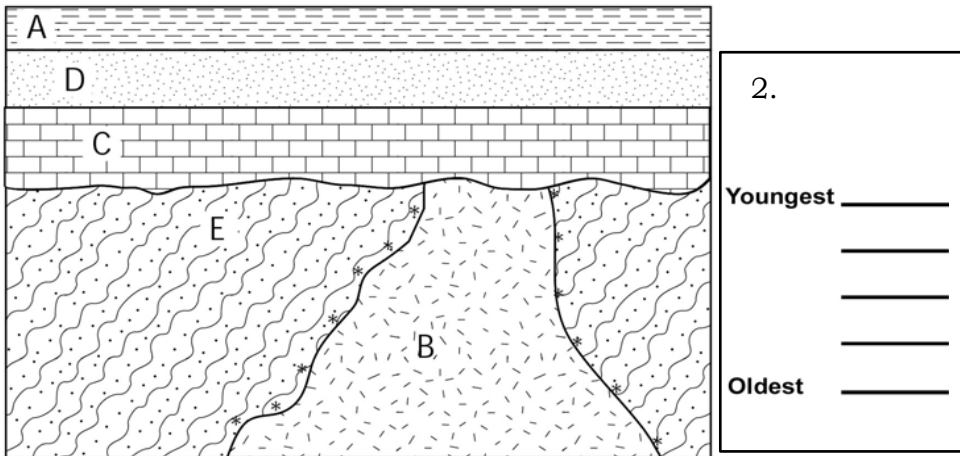


Figure 5. Subdivision of Geologic time (Layers of rock)

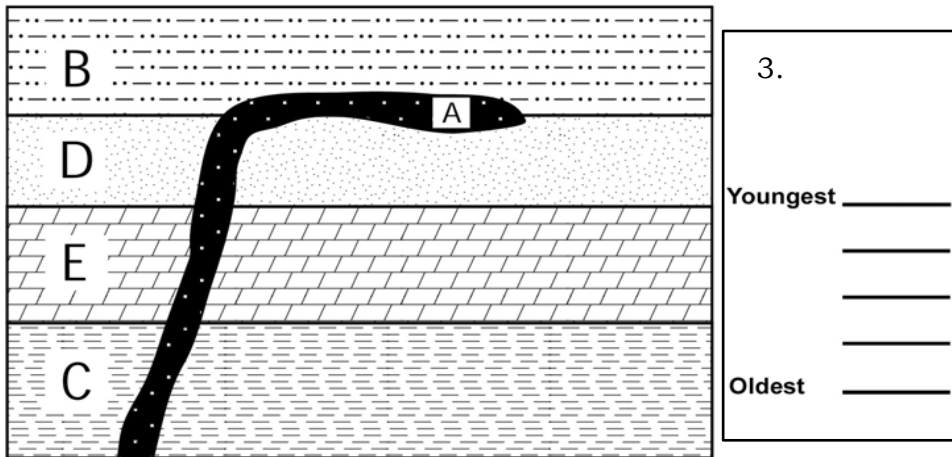


Figure 6. Subdivision of Geologic time (Layers of rock)

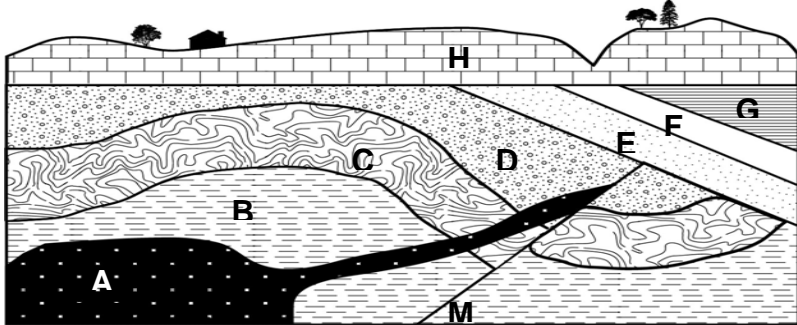


Figure 7. Subdivision of Geologic time (Layers of rock)

4.

Youngest \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Oldest \_\_\_\_\_

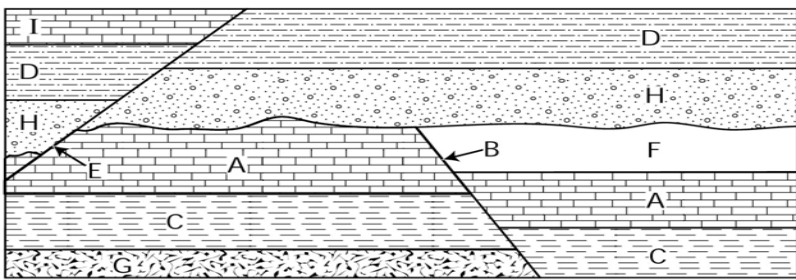


Figure 8. Subdivision of Geologic time (Layers of rock)

5.

Youngest \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Oldest \_\_\_\_\_

Outline the sequence of events in the cross sections below by numbering each rock unit or event in the order in which it occurred or was deposited.

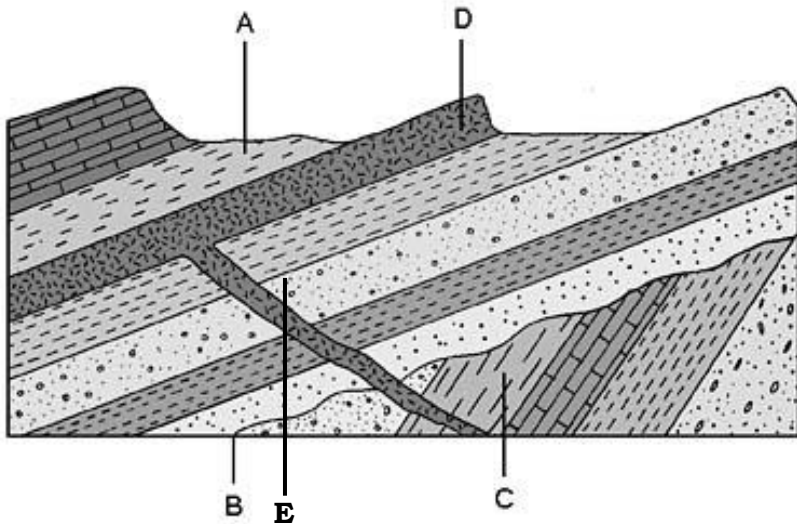


Figure 9. Subdivision of Geologic time (Layers of rock)

6.

Youngest \_\_\_\_\_

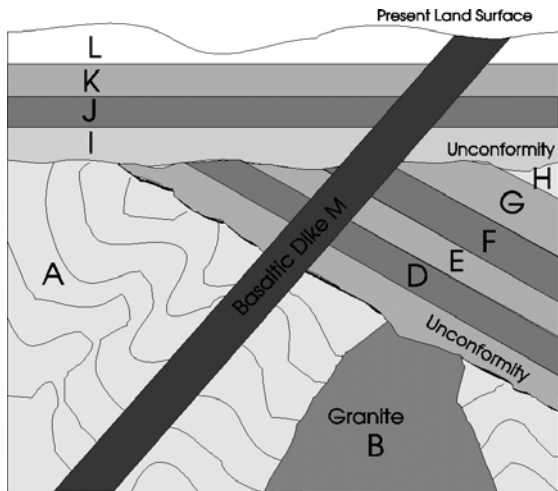
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

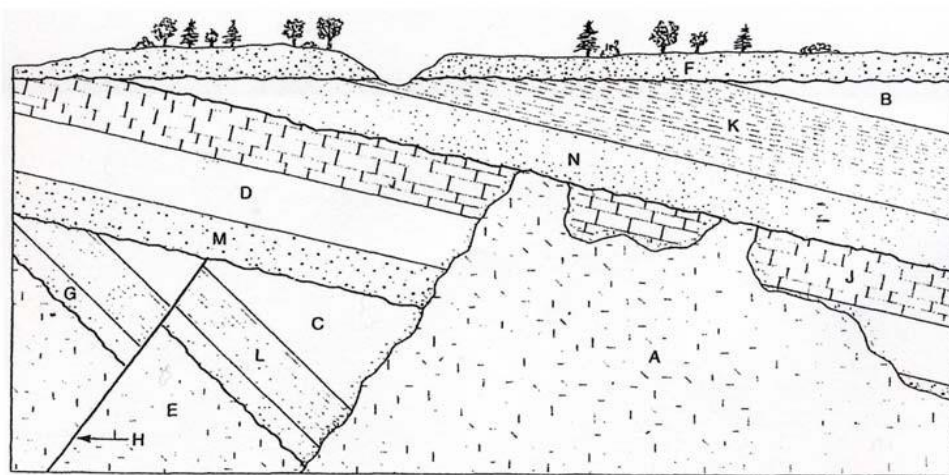
Oldest \_\_\_\_\_



Refer to the cross-section on the left. For each of the following pairs of rock layers, identify the relative dating law that would be used to determine which bed was older and which was younger. Write the letter of the older bed and through the two combined letters state if it is superposition or cross-cutting.

**Figure 10.** Subdivision of Geologic time (Layers of rock)

- 1) A & B \_\_\_\_\_    3) C & D \_\_\_\_\_
- 2) D & E \_\_\_\_\_    4) J & K \_\_\_\_\_



**Figure 11.** Subdivision of Geologic time (Layers of rock)

7.

Youngest \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

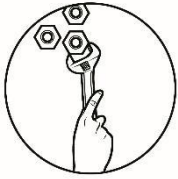
\_\_\_\_\_

Oldest \_\_\_\_\_

Refer to the cross-section above. For each of the following pairs of rock layers identify the relative dating law that you used to determine which bed was older and which was younger. Write the letter of the younger bed and through the two combined letters state if it is superposition or cross-cutting.

- 9.1) M & A \_\_\_\_\_
- 9.2) J & N \_\_\_\_\_
- 9.3) H & C \_\_\_\_\_
- 9.4) D & M \_\_\_\_\_





## What I Can Do

### Activity 1: Guide Questions

Answer the following in a complete statement. Write your answer on your answer sheet

1. What are the four methods of relative dating?
2. Give the four methods of absolute dating.
3. This type of dating determines the exact age of the remains and is more expensive.
4. The technique used in dating sedimentary rocks and is qualitative in nature.
5. Why are layers of rocks related to one another?

### Activity 2: Geologic Time Scale

Time span of 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 the geologic events and the evolution of life forms.

1. On a separate sheet of paper, draw and complete a Brace Map showing the Geologic Time Scale Eras and Periods as shown on the Geologic Time Scale Reference Chart below.



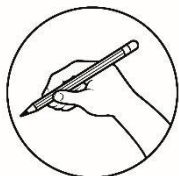
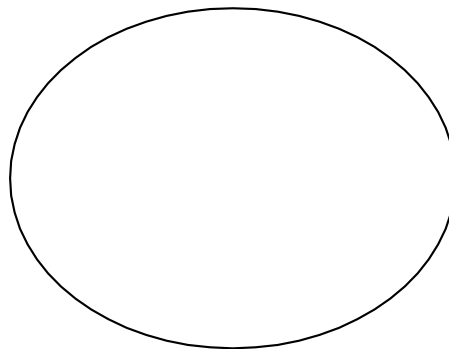
(Sample brace map)

Events	Years
single-celled organisms	3,500 million years ago
Trilobites	500 million years ago
Early land plants	430 million years ago
Reptiles	280 m.y.a.
Fish	395 m.y.a.
Whales	20 m.y.a.
Dinosaurs	225-65 m.y.a.
Mammals	65 m.y.a.
Humans	2.5 m.y.a.
Birds	120 m.y.a.
Pangaea starts to separate	225 m.y.a.

2. Encircle the important events on your brace map next to the correct period:
3. What do you notice about the complexity of the fossils as we move through the Geologic Time Scale from the Precambrian Times to Quaternary Period? What can you conclude from your observation? Answer in a complete sentence on your answer sheet
4. Fill in the data table to show the number of millions of years each Era lasted:  
 \*Note: Percentages are rounded to the nearest .5%. Copy the table and write your answer on your answer sheet.

The Divisions of Geologic Time	Percent	Millions of years
The age of the Earth	100%	4,600 my
Cenozoic Era	1.5%	
Mesozoic Era	4.0%	
Paleozoic Era	6.5%	
Precambrian Time	88.0%	

5. Create a pie chart to show the percentage of time each Era represents in the Geologic Time Scale:

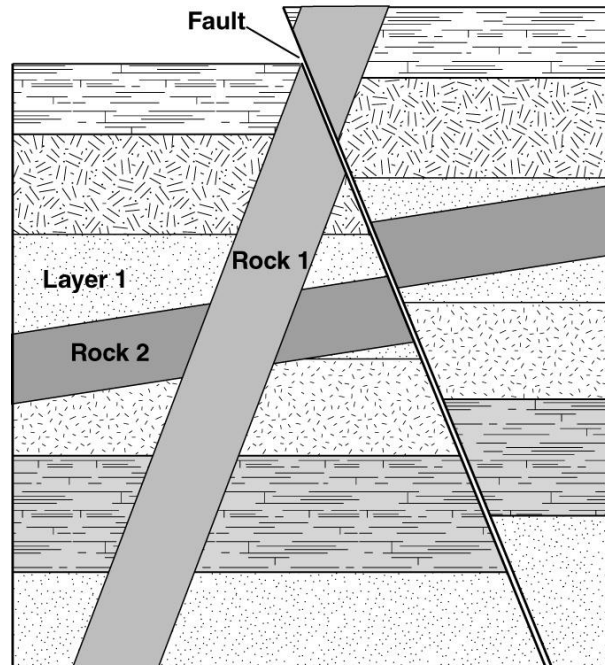


## **Assessment**

Multiple Choice: Read and analyze the following questions. Choose the letter of the best answer. Write the letter of the correct answer on your answer sheet.

1. Which geological dating technique determines the actual age of a fossil?
  - a. absolute
  - b. radioactive isotopes
  - c. relative
  - d. stratigraphy
2. Which geological dating technique arranges them in the geological order of their formation?
  - a. absolute
  - b. radioactive decay
  - c. radioactive isotopes Relative
  - d. relative

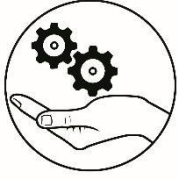
3. Which of the following is the original isotope?
  - a. daughter
  - b. half-life
  - c. parent
  - d. radioactive
  
4. What happens when the isotopes decay?
  - a. parent isotopes become half
  - b. parent isotopes become a team
  - c. parent isotopes become a parent
  - d. parent isotopes become a daughter
  
5. What is the importance of dating?
  - a. determine the age of fossils
  - b. determine the amount of fossils
  - c. determine the sample of fossils
  - d. determine the particles in fossil
  
6. Which of following is an example of the way a geologist would use relative dating?
  - a. determining the minerals that make up rocks
  - b. placing rock layers in order of oldest to youngest
  - c. classifying rocks as igneous, sedimentary, or metamorphic
  - d. using radioactive isotopes to determine the exact age of rock samples
  
7. The following diagram shows rock layers that are cut by a fault and two bodies of rock (rock 1 and rock 2).



What are the relative ages of the features in order of oldest to youngest?

- a. fault, rock 1, rock 2, layer 1
- b. layer 1, rock 2, rock 1, fault
- c. rock 2, layer 1, rock 1, fault
- d. fault, rock 2, layer 1, rock 1

8. Fossils are the preserved remains or traces of plants and animals that have lived on Earth throughout Earth's history. How does the fossil record of animals compare to animals that exist today?
- Animals in the fossil record are the same as animals that exist today.
  - Animals in the fossil record are ancestors of animals that exist today.
  - Animals in the fossil record have no similarities to animals that exist today.
  - Animals in the fossil record are more complex than animals that exist today.
9. A geologist is studying three layers of sedimentary rock in an area. The layers have not shifted from their original positions. The geologist records the relative ages of the rocks. The bottom layer is listed as the oldest. The top layer is listed as the youngest. What did the geologist use to determine the relative ages of the rocks?
- mineral content
  - radioactive decay
  - the law of superposition
  - the principle of unconformity
10. What is a geologic column?
- a rock structure that is shaped like a column
  - a body of rock that cuts through sedimentary rock layers
  - a group of rock layers that are taken out of the ground to study
  - a group of rock layers that are placed in order of their relative ages



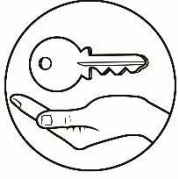
## ***Additional Activities***

### **Reflection**

Complete the paragraph below. Write your answer on a separate sheet of paper.

I've learned that absolute dating, also called \_\_\_\_\_ that arranges the historical remains in order of their ages. Whereas relative dating arranges them in the \_\_\_\_\_ of their formation.

Most absolute dates for \_\_\_\_\_ are obtained with radiometric methods.



## Answer Key

<p><b>Assessment</b></p> <p>1. A 2. D 3. C 4. D 5. A 6. B 7. B 8. B 9. C 10. D</p>	<p><b>What's More</b></p> <p>Activity 1</p> <p>✓ age ✓ remains ✓ radiometric ✓ stratigraphic ✓ qualitative ✓ quantitative</p> <p>Activity 2</p> <p>1. RD 2. RD 3. AD 4. AD 5. RD</p>	<p><b>What I Know</b></p> <p>1. B 2. C 3. B 4. C 5. B 6. B 7. B 8. C 9. D 10. D 11. A 12. B 13. D 14. B 15. B</p>
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# ***References***

## **Online Resources**

<https://www.slideshare.net/flynnbolick/ch13-geologictime>  
<https://slideplayer.com/slide/4449926/> <https://slideplayer.com/slide/8594574/>  
<https://slideplayer.com/slide/8560744/>  
<https://slideplayer.com/slide/10707650/>  
<https://slideplayer.com/slide/10707650/>  
[https://en.wikibooks.org/wiki/High\\_School\\_Earth\\_Science/Geologic\\_Time\\_](https://en.wikibooks.org/wiki/High_School_Earth_Science/Geologic_Time_)  
<https://www2.humboldt.edu/natmus/lifeThroughTime/Timeline/TimeScale>

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