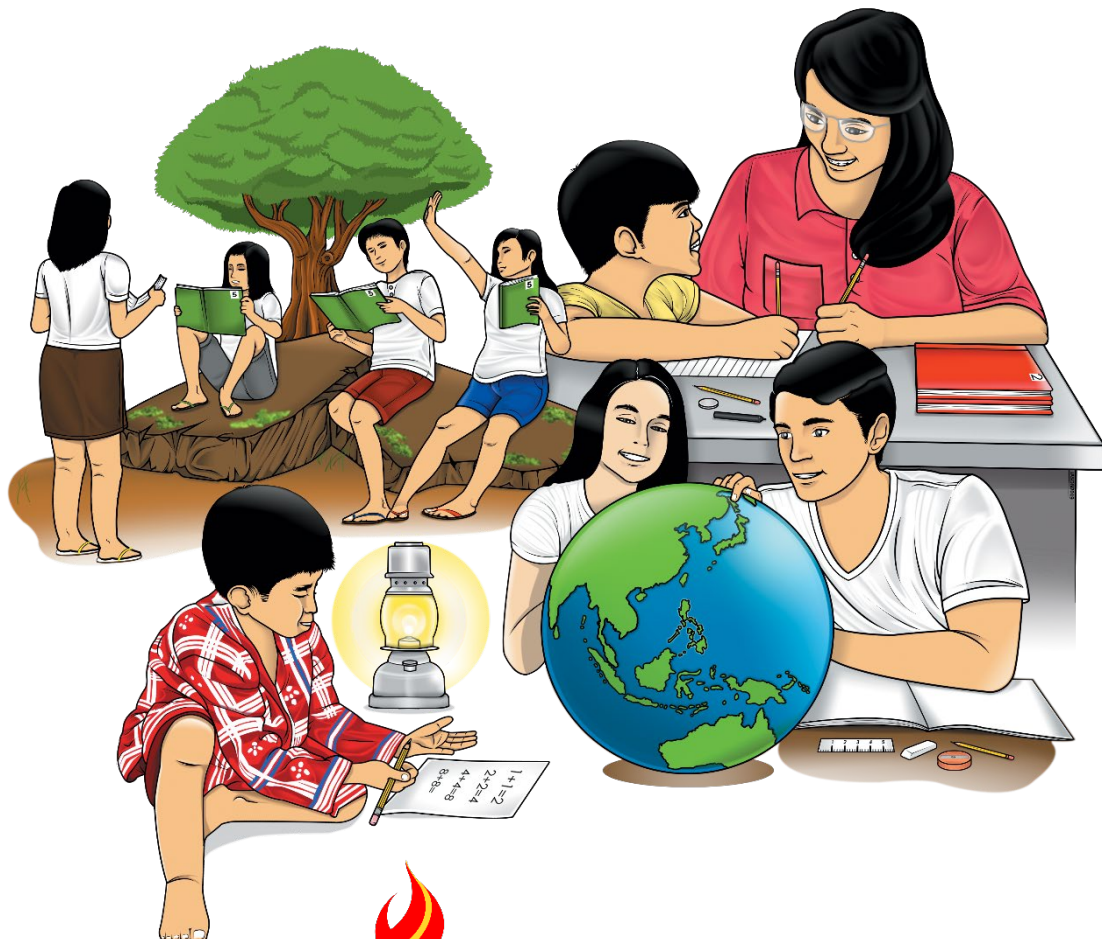


Senior High School

# Earth and Life Science

## Quarter 1 – Module 12:

### Relative and Absolute Dating



**Earth and Life Science**  
**Alternative Delivery Mode**  
**Quarter 1 – Module 10: Movements of Plates and Formation of Folds and Faults**  
**First Edition, 2021**

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Published by the Department of Education  
Secretary: Leonor Magtolis Briones  
Undersecretary: Diosdado M. San Antonio

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Senior High School

# **Earth and Life Science**

## **Quarter 1 – Module 12:**

### **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 you're 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***

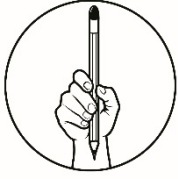
This module was designed and written with you in mind. It is here to help you master the different methods in determining the age of stratified rocks. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. 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.

The module covers:

- Lesson 1 – Relative and Absolute Dating

After going through this module, you are expected to:

1. differentiate relative from absolute dating through pictures presented; and
2. compare relative and absolute dating using comparison chart.



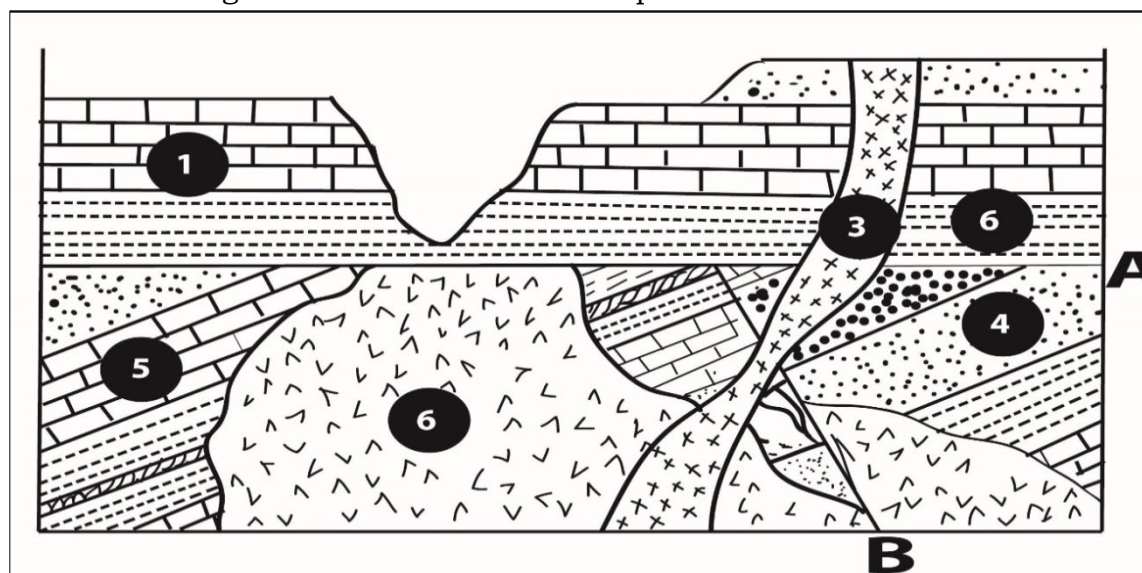
## ***What I Know***

**Directions.** Read the following questions and choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. Which of these is the best indication of the relative age of a rock layer?
  - A. the thickness of the layer
  - B. the chemical make-up of the layer
  - C. the distance of the layer on the surface
  - D. the position of the layer compared to other layers
2. Which of the following processes will give the relative age of a rock?
  - A. examining the environment in which the rock is found
  - B. examining the rock's relative position in a rock outcrop
  - C. comparing the amount of decayed and undecayed radioactive isotopes
  - D. comparing the size of crystals in the upper and lower parts of the rock
3. Where can you find the oldest rock in an undisturbed rock file?
  - A. on the topmost
  - B. at the bottom
  - C. upper part
  - D. lower part
4. The principle of horizontality is based on the observation that sediment usually accumulates in layers. How will you describe the rock layering based on this principle?
  - A. Rocks are pile horizontally with the oldest at the bottom and youngest on the topmost.
  - B. Rocks are pile horizontally with the oldest on the topmost and youngest at the bottom.
  - C. Rocks are in inclined layers, the steeper the tiltation the older the rock is.
  - D. Rocks are piled in any form, the darker the rock the older it is.
5. Which of the following makes use of the position of rocks to determine its age?
  - A. Absolute Dating
  - B. Radioactive Dating
  - C. Radiometric Dating
  - D. Relative Dating
6. Which type of dating method can be used on rock layers by applying the Law of Superposition?
  - A. Absolute Dating
  - B. Radioactive Dating
  - C. Radiometric Dating
  - D. Relative Dating

7. Which was the first method used to determine ages of rock and fossils?
- Relative Dating
  - Absolute Dating
  - Radioactive Dating
  - Radiometric Dating
8. What is the difference between an absolute date and a relative date?
- An absolute date refers to a year or a range of years while a relative date indicates a chronological order.
  - A relative date is derived from radiometric dating techniques while an absolute date comes from guesswork.
  - A relative date refers to a year or a range of years while an absolute date indicates a chronological order.
  - An absolute date involves testing of sedimentary rocks while relative date involves testing of igneous rocks.

Refer to the diagram below and answer the questions that follow.



9. Which layer of the rocks follows the principle of superposition?
- Layer 1
  - Layer 3
  - Layer 4
  - Layer 6
10. Which layer of the rocks shows the cross-cutting relationship?
- Layer 1
  - Layer 3
  - Layer 4
  - Layer 6

11. What method of Rock Dating is used in giving rocks an actual date?
  - A. Absolute Dating
  - B. Geological Dating
  - C. Historical Dating
  - D. Relative Dating
  
12. Which of the following is NOT true about Relative Dating?
  - A. quantitative method of dating
  - B. principles to recognize the relative ages of rocks
  - C. used stratigraphy method (oldest found at the bottom and youngest at the top)
  - D. used to arrange geological events and the rocks they leave behind in sequence
  
13. Which of the following is a principle of Relative Dating?
  - A. Principle of Half-life
  - B. Principle of Layering
  - C. Principle of Superposition
  - D. Principle of Floral Succession
  
14. Which of the following is NOT true about Absolute Dating?
  - A. quantitative method of dating
  - B. principles to recognize the relative ages of rocks
  - C. used to give rocks an actual date or date range, in number of years
  - D. use radiometric method by radioactive decay: concept of isotopes and concepts of half- life
  
15. What method of Rock Dating is using stratigraphy method?
  - A. Absolute Dating
  - B. Geological Dating
  - C. Historical Dating
  - D. Relative Dating



## Lesson

# 1

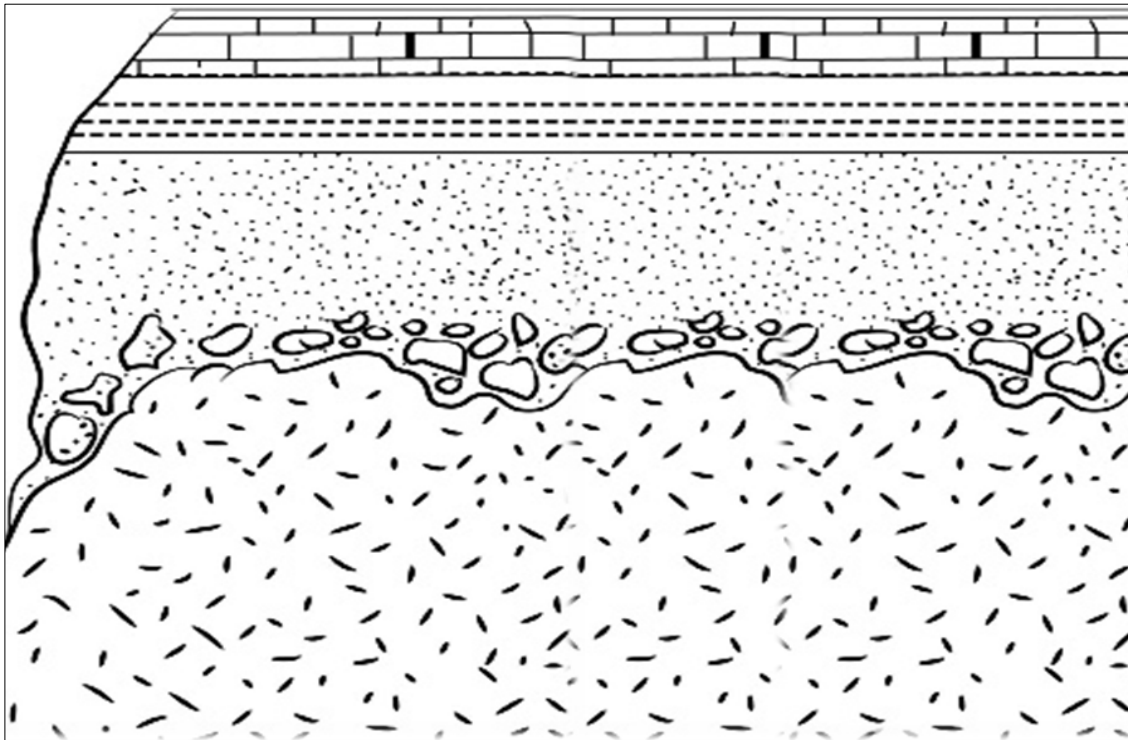
# Relative and Absolute Dating

How old is it? This might be the first question that will enter your mind when you see an old rock or artifact. Certainly, that is one of the first thing that a geologist wants to know.

Geologists find ways on how to determine the age and traces of history from the large number of artifacts and monuments bestowed upon us by older civilization.

There are methods and techniques used by geologists to help them determine the age of the materials that evolved in the past. In this lesson, the relative and absolute dating processes will be discussed.

**Figure 1.** Rock Layers





## What's In

### Activity 1: Solving the Earth's Puzzle!

**Directions.** Find and encircle relevant words from the puzzle. Then, do the given tasks.

List of Words:

1. Rock
2. Relative
3. Absolute
4. Earth
5. Age

A	F	F	E	N	D	F	I	N	D	C
D	R	O	C	K	S	A	J	H	T	O
M	F	S	R	E	L	A	T	I	V	E
A	H	S	A	R	A	G	L	S	U	A
B	H	I	O	T	I	E	A	T	S	R
C	G	L	R	Z	Y	S	Y	O	A	T
A	B	S	O	L	U	T	E	R	N	H
D	A	B	S	P	I	O	R	Y	O	R
E	F	S	U	L	I	T	S	O	C	O

Tasks:

1. Using a dictionary or any reference, find the meaning of identified words.  
\_\_\_\_\_
2. Write sentences out of the identified words from the puzzle.  
\_\_\_\_\_
3. Differentiate absolute age from relative age.  
\_\_\_\_\_



### **Notes to the Teacher**

This module will help you understand the concepts about how to determine age of rocks. All parts are comprised of activities. Be guided with the instructions on how you will answer. Discuss through any mode the simple principles so the students can proceed to the next activity.

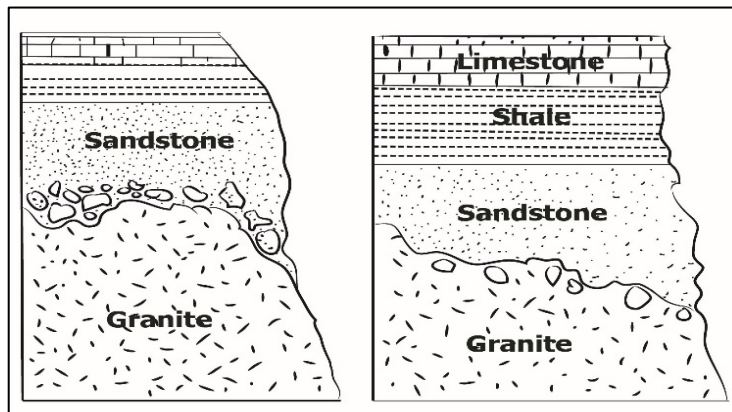


## What's New

We have learned that geologic time is measured in two ways: relative and absolute age. Relative date or age measurement refers only to the order in which events occurred. On the other hand, absolute age is age in years. It tells the order in which events occurred and the exact amount of time that has passed since they occurred.

### Activity 2: What's in the Stack of Rock?

**Directions.** Look at the diagram of a rock layer. Focus on the sediment layer.



**Figure 2.** Sedimentation

Guide Questions:

1. How will you describe the rocks in the illustrations?  
\_\_\_\_\_
2. What is/are the use/s of this layering to the geologists?  
\_\_\_\_\_
3. At which pile of rock can you find the oldest? youngest?  
Justify your answer.  
\_\_\_\_\_
4. Can you determine the relative age of the rock based on the layering?  
How about absolute age?  
\_\_\_\_\_
5. What does the thickness of each layer indicate?  
\_\_\_\_\_



## What is It

### Relative Age

Prior to absolute age measurements, geologists used field observations to determine the relative ages. They used simple principle in order to get the relative ages. The following are the principles used by the geologists:

The **principle of original horizontality** is based on the observation that sediment usually accumulates in horizontal layers. Tectonic forces tilted or folded rocks into an angle after it was formed.

The **principle of superposition** states that sedimentary rocks become younger from bottom to top. This is because younger layers of the sedimentary always accumulates at the top of the layers. In figure 4, rocks number 5 are oldest and rocks in 1 are the youngest.

The **principle of crosscutting** relationships is based on the fact that rocks must exist before anything else happened like intrusions or dike-cutting across rocks. In figure 5, the cut rock layers are older than the rock that cuts across them.

The **principle of faunal succession** states that species succeeded one another through time in a definite and recognizable order and that the relative ages of sedimentary rocks can be therefore recognized from their fossils. The absence or the presence may be used to give a relative age of the sedimentary where they are found.

The **principle of lateral continuity** explained that layers of sediment are continuous. Layers with same rocks but separated by a valley or erosion are initially continuous.

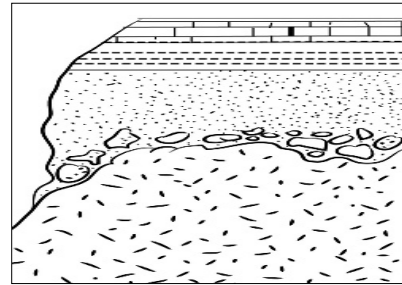


Figure 3. Horizontal layers

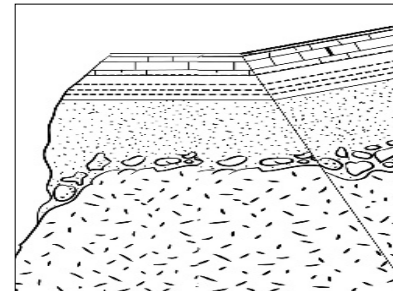


Figure 4. Tiltation after deposition into horizontal layers

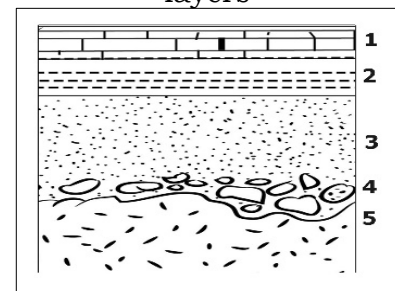


Figure 5. The principle of superposition

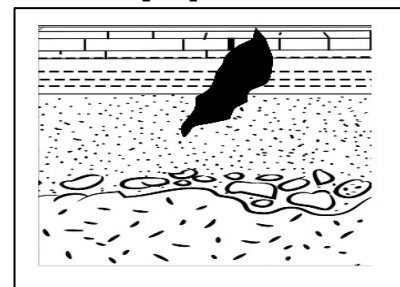
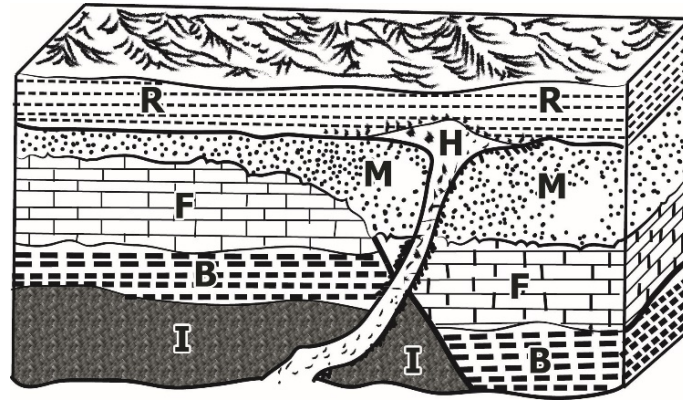


Figure 6. Horizontal layers with dikes

### Activity 3: A. Who's the Oldest?

**Directions.** Use the letters in the diagram below to determine the age of rocks applying the method of relative dating. List the rock layers from youngest to the oldest relative to age.



**Figure 7.** Rocks layers and dikes

Guide Questions:

1. In the law of superposition, which layer is the oldest?

---

2. What is the relative age of igneous rock in layer H? (younger or older)

---

3. What is the youngest rock layer?

---

4. What law/principle is represented by layer H as it passes through layer M, F, B, and I?

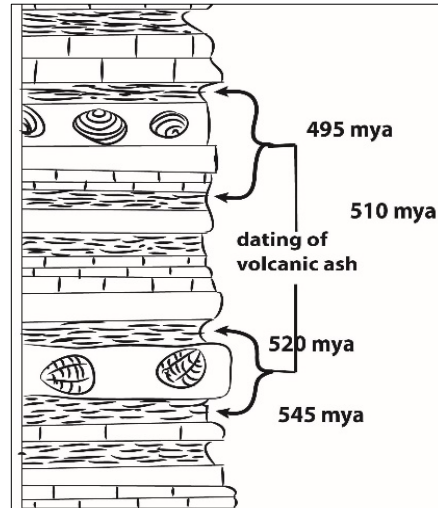
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5. Which rock layer is older, layer B or layer F?

---

## B. How many years?

**Directions.** Refer and analyze the diagram below to answer the provided questions.



**Figure 8.** Rock Layers and Fossils

1. How old was the youngest rock layer?  
\_\_\_\_\_
2. How about the oldest rock layer?  
\_\_\_\_\_
3. What method is used in determining the age of rocks and fossils based on the diagram?  
\_\_\_\_\_

### Absolute Age

Since change is the only thing that is permanent, the measurement of absolute age or exact date became a challenging task to the scientists. But they found a natural process that occurs at constant rate and accumulates its record of the radioactive decay of elements in rocks.

Radioactive elements decay because they are composed of unstable isotopes that decompose spontaneously. Each atom has a certain probability of decaying at any time. It has half-life or time for it to decompose into half.

Radioactivity is not affected by geologic process and easily measured in the laboratory. Aside from those, daughter isotopes accumulate in rocks. The longer the rock exists, the more daughter isotopes accumulate. The process of determining the absolute ages of rocks and minerals by measuring the relative amounts of parent and daughter isotopes is called radioactive dating.

**e.g. a form of uranium changes (decays) to lead**

In the above example, the parent element is uranium (U) and the daughter element is lead (Pb).

Again, the process of radioactive decay can be used for dating rocks because: *Radioactive decay proceeds at a constant, regardless of changes in conditions such as temperature, pressure, or the chemical environment.*

Here are the commonly used radioactive isotopes in radioactive dating.

Table 1.1 Some Used Isotopes for Radiometric Dating

<b>Parent Isotope</b>	<b>Daughter Isotope</b>	<b>Half-life (Years)</b>	<b>Effective Dating Range (Years)</b>	<b>Materials that Can be Dated Using this Isotope</b>
Carbon-14	Nitrogen-14	5730	100-50000	Wood, shells, or anything that was once alive, Trapped Carbon dioxide
Potassium-40	Argon-40 Calcium-40	1.3 billion	40,000-4.6 billion	Muscovite Biotite Volcanic rock
Uranium 238	Lead 206	4.5 billion	10 million-4.6 billion	Zircon
Uranium 235	Lead 207	710 million	10 million-4.6 billion	Uranite

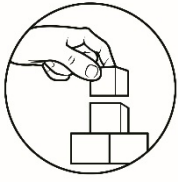
## Half-Life

It is almost impossible to say when the last of the parent atoms will decay, but the time taken for half the atoms to decay is comparatively easy to predict. The half-life of a radioactive decay process is the time taken for half the original parent atoms to decay.

The length of half-life is a unique feature of each decay process. The half-life of the uranium is 713 million years. This means that if an igneous rock contained 1000 atoms of U-235 when it solidified:

After 713 million years, it would contain 500 atoms of U-235 and 500 atoms of the daughter element for the decay process, Pb-207.

The proportion of parent atoms/daughter atoms present in an igneous rock gives the age of the rock — or the number of million years since the rock solidified

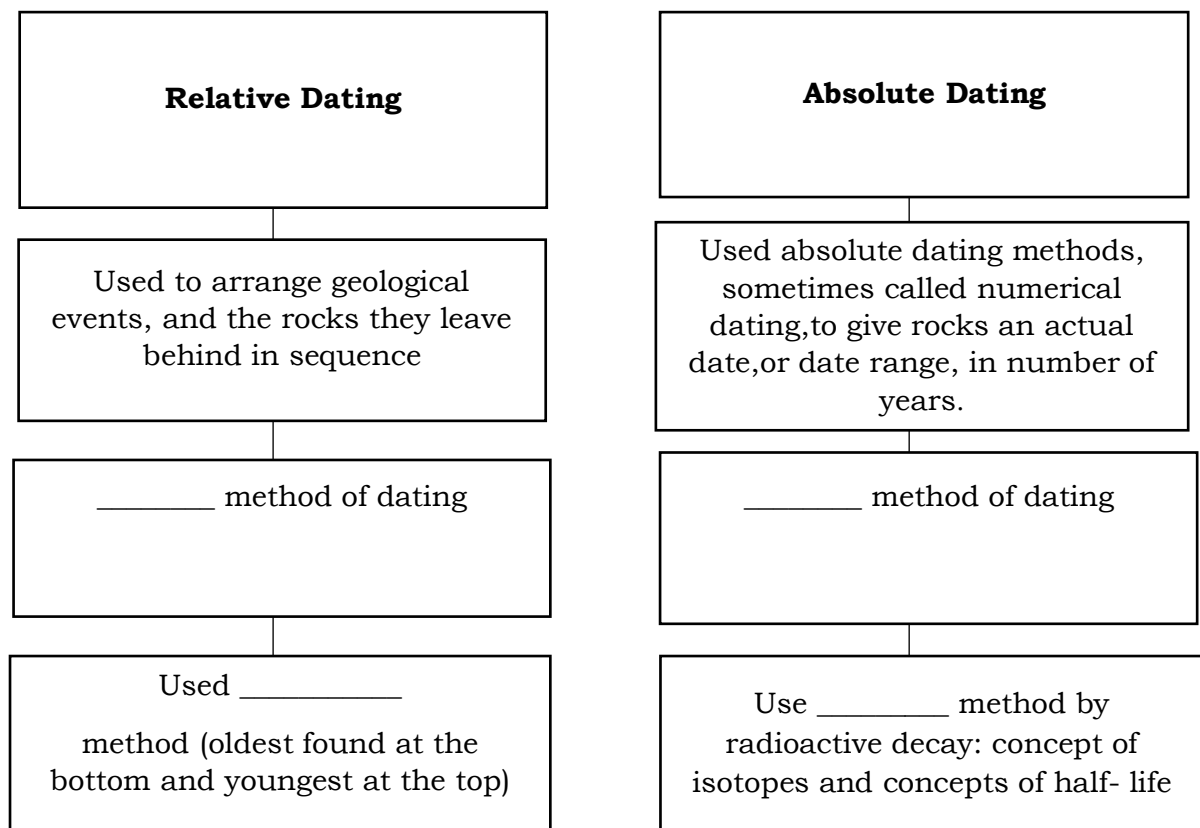


## What's More

### Activity 4: Relative vs. Absolute

Age of rocks can be determined through using two methods. These methods are absolute and relative dating.

**Directions.** Complete the concept map to show the differences between the two methods of dating.





## Activity 5: Read and Fill!

**Directions.** Place the missing letters that best complete the term being described by each statement.

__b__l__u__e D__i__g	1. It is used to determine the age of a material by using numeric values.
C__o__s C__t__i__g	2. It states that the geologic feature which cuts another is younger of the two features.
R__l__a__i__e __a__i__g	3. It is used to determine the relative age of rock layers.
__u__p__r__o__i__i__n	4. This law states that the younger layer is at the top and older layer of rocks are at the bottom.
Se__i__m__e__n__t__a__ry __o__s	5. These are rocks that usually form deposits that pile up and hardened.

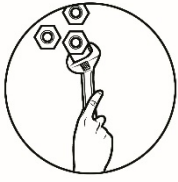


## *What I Have Learned*

- In determining the age of rocks in relative dating, it follows the different principles such as: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
- \_\_\_\_\_ dating is used to arrange geological events, and the rocks they leave behind in sequence.
- \_\_\_\_\_ dating is used to give rocks an actual date, or date range, in number of years.
- Relative dating uses stratigraphy method while absolute dating uses \_\_\_\_\_ method by radioactive decay.
- The \_\_\_\_\_ of a radioactive decay process is the time taken for half the original parent atoms to decay.

### WORD POOL

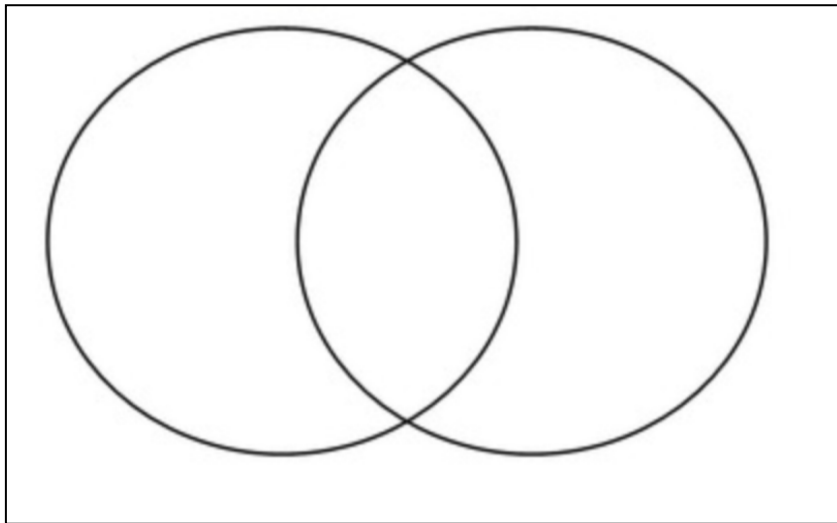
Relative	Absolute	Superposition	Original Horizontality
Radiometric	Crosscutting	Stratigraphy	Lateral Continuity
Doubling	Half-life	Isotopes	Faunal Succession



## *What I Can Do*

### **Activity 4: Venn Diagram**

**Directions.** Fill in the Venn diagram to show the similarities and differences between absolute dating and relative dating. Use the words inside the word pool to complete the diagram.



Word Pool

use of numeric value	qualitative method
quantitative method	use the position of rocks
radiometric method	stratigraphic method
used to tell the age of rocks	use sedimentary rocks
give an idea of the order of geologic events	does not give the true age of rocks

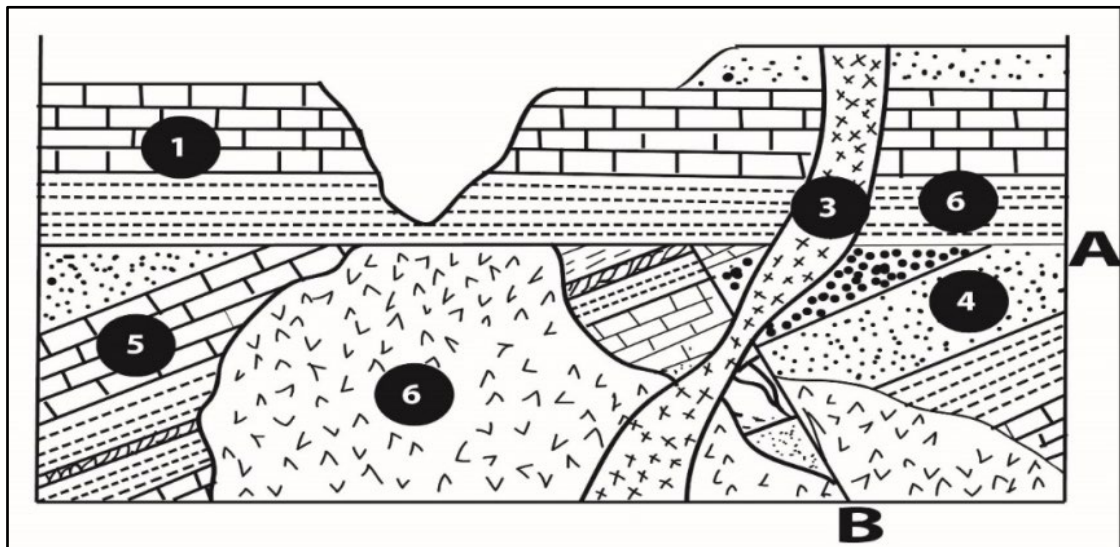


## Assessment

**Directions.** Read the following questions and choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. Which type of dating method can be used on rock layers by applying the Law of Superposition?
  - A. Absolute Dating
  - B. Relative Dating
  - C. Radioactive Dating
  - D. Radiometric Dating
  
2. Which was the first method used to determine ages of rock and fossils?
  - A. Absolute Dating
  - B. Relative Dating
  - C. Radioactive Dating
  - D. Radiometric Dating
  
3. What is the difference between an absolute date and a relative date?
  - A. An absolute date refers to a year or a range of years while a relative date indicates a chronological order.
  - B. A relative date is derived from radiometric dating techniques while an absolute date comes from guesswork.
  - C. A relative date refers to a year or a range of years while an absolute date indicates a chronological order.
  - D. An absolute date involves testing of sedimentary rocks while relative date involves testing of igneous rocks.
  
4. What method of rock dating is used in giving rocks an actual date?
  - A. Absolute Dating
  - B. Geological Dating
  - C. Historical Dating
  - D. Relative Dating
  
5. Which of the following is NOT true about Relative Dating?
  - A. quantitative method of dating
  - B. principles to recognize the relative ages of rocks
  - C. used to arrange geological events and the rocks they leave behind in sequence
  - D. used stratigraphy method (oldest found at the bottom and youngest at the top)

Refer to the diagram below and answer the questions that follow.



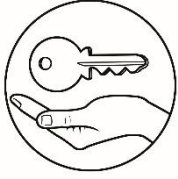
6. Which layer of the rocks follows the principle of superposition?
  - A. Layer 1
  - B. Layer 3
  - C. Layer 4
  - D. Layer 6
  
7. Which layer of the rocks shows the cross-cutting relationship?
  - A. Layer 1
  - B. Layer 3
  - C. Layer 4
  - D. Layer 6
  
8. Which of the following is NOT principle of Relative Dating?
  - A. Superposition
  - B. Floral Succession
  - C. Original Horizontality
  - D. Cross-cutting Relationship
  
9. Which of the following is NOT true about Absolute Dating?
  - A. It is a quantitative method of dating.
  - B. It uses simple principles to recognize the relative ages of rocks.
  - C. It is used to give rocks an actual date, or date range, in number of years.
  - D. It uses radiometric method by radioactive decay: concept of Isotopes and concepts of half- life.
  
10. What method of rock dating is using stratigraphy method?
  - A. Absolute Dating
  - B. Geological Dating
  - C. Historical Dating
  - D. Relative Dating

11. Which of these is the best indication of the relative age of a rock layer?
- A. the thickness of the layer
  - B. the chemical make-up of the layer
  - C. the distance of the layer on the surface
  - D. the position of the layer compared to other layers
12. Which of the following processes will give an absolute age of a rock?
- A. examining the rock's relative position in a rock outcrop
  - B. examining the environment in which the rock is found.
  - C. comparing the size of crystals in the upper and lower parts of the rock
  - D. comparing the amount of decayed and undecayed radioactive isotopes
13. Where can you find the youngest fossil in an undisturbed file?
- A. on the topmost
  - B. at the bottom
  - C. upper part
  - D. lower part
14. Which of the following statements best describe principle of horizontality?
- A. sediment usually accumulates in horizontal layers.
  - B. sediment usually accumulates in tilted layers.
  - C. sediment usually accumulates in alternating rocks.
  - D. sediment usually accumulates in rounded pile.
15. Which of the following makes use of the position of rocks to determine its age?
- A. Relative Dating
  - B. Absolute Dating
  - C. Historical Dating
  - D. Geological Dating



## ***Additional Activities***

If you will be asked to determine the age of a rock, which method will you use? Justify you answer.



# Answer Key

<p style="text-align: center;"><b>Assessment</b></p> <p>1. B 2. B 3. A 4. A 5. A 6. D 7. B 8. B 9. B 10. D 11. D 12. D 13. B 14. A 15. D</p>	<p style="text-align: center;"><b>What's in Activity 1</b></p> <p>Rocks, Relative, Absolute Fossils, History, Earth, Ages Sentences may vary.</p>	<p style="text-align: center;"><b>What I Know</b></p> <p>1. D 2. B 3. B 4. A 5. D 6. D 7. D 8. A 9. D 10. B 11. B 12. A 13. C 14. B 15. D</p>
<p style="text-align: center;"><b>What's New Activity 2</b></p> <p>1. Horizontal layers 2. Give relative age of rock/fossils 3. Bottom/Topmost Reason: Original Horizontality 4. Yes, No 5. Thick, large deposition happened Thin, erosional activity worn the sediments</p>	<p style="text-align: center;"><b>What is It Activity 3.a</b></p> <p>1. Layer I 2. Younger 3. Layer R 4. Cross cutting relationship 5. Layer B</p> <p style="text-align: center;"><b>Activity 3.b</b></p> <p>A. 495 mya B. 545mya C. Absolute dating</p>	<p style="text-align: center;"><b>What's More Activity 4</b></p> <p>1. Qualitative / Quantitative 2. Stratigraphy / Radiometric dating</p> <p style="text-align: center;"><b>Activity 5</b></p> <p>1. Absolute dating 2. Cross-cutting 3. Relative dating 4. Superposition 5. Sedimentary rocks</p>

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