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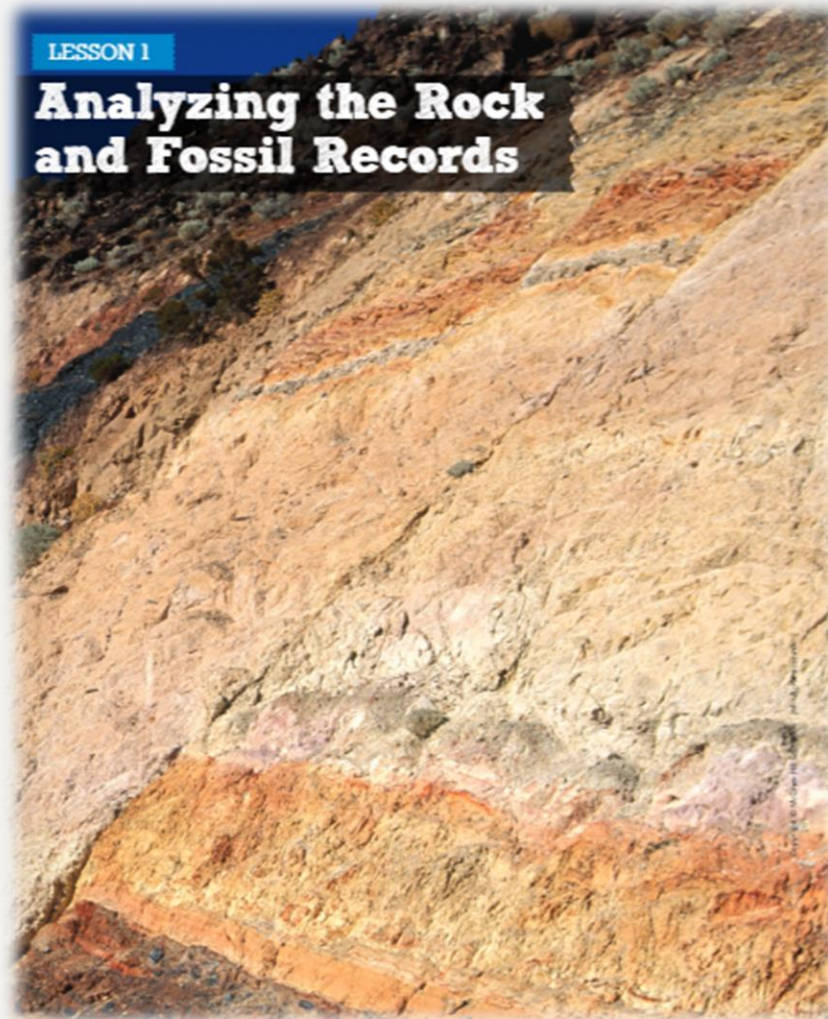
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GEOLOGIC TIME- MODULE 1, LESSON 1

- Analyzing the Rock and Fossil Records



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Objectives

Students will Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

By the end of the lesson

- **Identify the purpose of analyzing rock and fossil records in geology.**
- **Explain how rock layers and fossils provide insights into Earth's history.**



VOCABULARY FOR TODAY

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Uniformitarianism

التماثلية

a principle stating that geologic processes that occur today are similar to those that occurred in the past.

absolute age

العمر المطلق

the numerical age, in years, of a rock or object.

Relative age

العمر النسبي

the age of rocks and geologic features compared with other nearby rocks and features.



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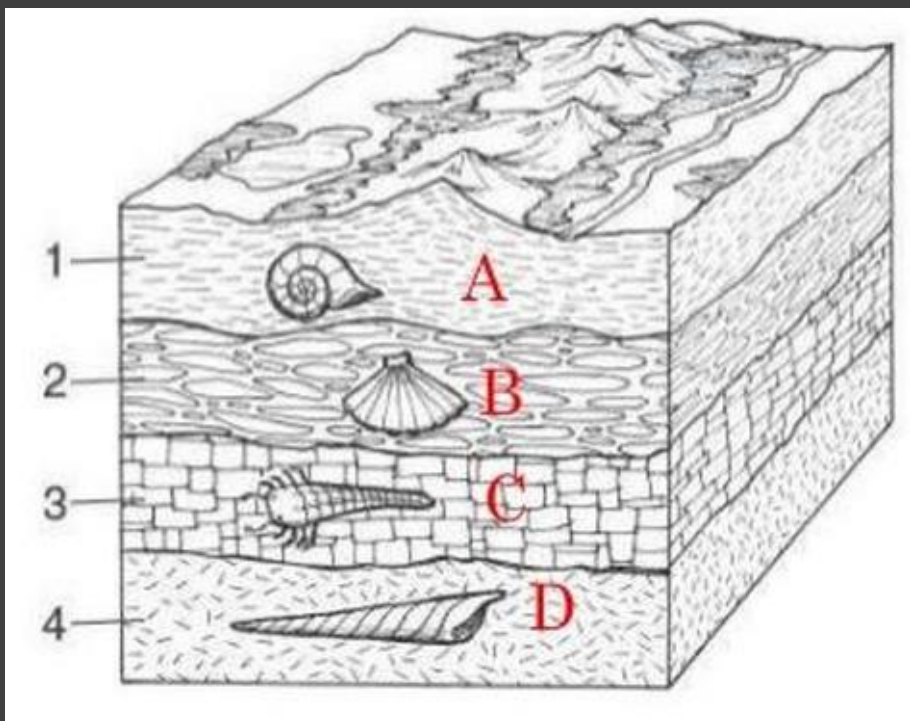
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[ASSESS PRIOR KNOWLEDGE]

Where would you expect to find the oldest fossils in a sequence of rock layers?





INVESTIGATION [CRITICAL THINKING]



1. Do you think the processes that form and shape the small stream bed are similar to those that form and shape the Grand Canyon? Why or why not?

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INVESTIGATION (CRITICAL THINKING) **PAGE 10**

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2. How long do you think it would take to create a canyon as deep as the Grand Canyon? Explain your reasoning.



ANSWERS

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1. Do you think the processes that form and shape the small stream bed are similar to those that form and shape the Grand Canyon? Why or why not?

Yes. The water erosion that is wearing away the banks of the stream is the same as the erosion that is carving the Grand Canyon.

2. How long do you think it would take to create a canyon as deep as the Grand Canyon? Explain your reasoning.

Millions of years. Much longer than the lifetimes of humans or the entire history of humanity.



PRINCIPLES OF RELATIVE DATING

James Hutton rejected this idea. He was one of the first scientists to think of Earth as very old, Hutton proposed that Earth is much older than a few thousand years.

-Relative age is the age of rocks and geologic features compared to other rocks and features nearby.

-Relative dating is the Science of determining the **relative** order of past events.



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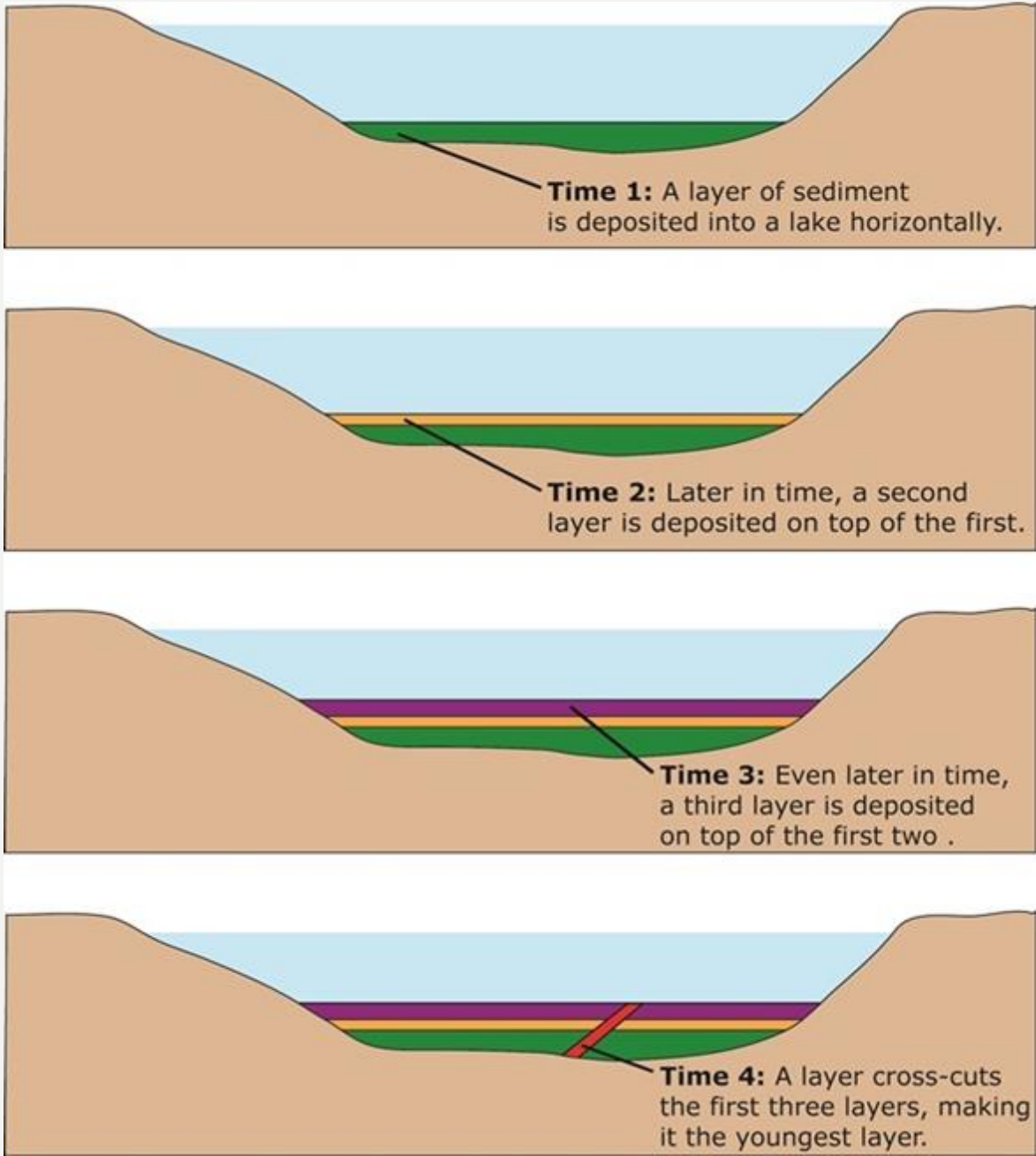
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INVESTIGATION

Relatively Speaking

Analyze the image below.



1. Do you think all of the rock layers in the picture formed at the same

1. Do you think all of the rock layers in the picture formed at the same

No. sedimentary rock forms slowly over time.

The sediments must be compressed and lithified before they turn into rock layers. The colors of the layers also indicate differences between the rocks.

2. If you think the rocks formed at different times, which layers are the oldest and which are the youngest? Explain.

The rock layers at the bottom of the formation are the oldest. The rock layers get younger as you go up. Each layer had to form on top of the last one deposited, making each layer younger than the one before.



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Poster Activity: “My Fossil Record of Growth”

Instructions for Students

1. Each student (or pairs) creates a poster showing their own “personal rock layers”.
2. Draw 4–5 horizontal layers (like rock strata).
3. In each layer, write or draw something that represents:
 1. **Layer 1 (Bottom / Oldest):** A challenge you faced in the past.
 2. **Layer 2:** A skill or strength you developed.
 3. **Layer 3:** An important learning moment or success.
 4. **Layer 4 (Top / Newest):** A current goal or area you are still working on.
5. **Fossils / Symbols:** Add small drawings or symbols that represent “memories” or “evidence” of your growth (e.g., a book for learning, a heart for kindness, a star for achievement).





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Relative age dating

Word Clouds



Inclusions

Absolute age

uniformitarianism

Superposition

Cross-cutting

Original horizontality

Lateral continuity



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[ASSESS PRIOR KNOWLEDGE]

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THREE-DIMENSIONAL THINKING

Scientists use the principle of uniformitarianism to **interpret** Earth's history. Suppose you discover a rock from an ancient beach. Now imagine you are standing on that ancient beach. What do you think you would see? **Explain** how your answer relates to the principle of uniformitarianism.

If you stand on a shore of an ocean and watch the waves come in, you are observing a process that has not changed since the oceans formed. Using the principle of uniformitarianism, you can infer that you would see waves eroding the shore of the beach just as they do today.





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PRINCIPLES OF RELATIVE-AGE DATING

What is Relative-age Dating?

Relative age is the age of rocks and geologic features compared to other rocks and features nearby.



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LET'S REMEMBER!



1. Do you think all of the rock layers in the picture formed at the same time? Why or why not?

2. If you think the rocks formed at different times, which layers are the oldest and which are the youngest? Explain.



ANSWER KEY



1.

No. sedimentary rock forms slowly over time. The sediments must be compressed and lithified before they turn into rock layers. The colors of the layers also indicate differences between the rocks.
2.

The rock layers at the bottom of the formation are the oldest. The rock layers get younger as you go up.

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3. Do you think the small pieces of rock in the picture formed at the same time as the rock containing the pieces? Why or why not?

4. If you think the rock formed at different times, which is oldest—the rock containing the pieces, or the pieces of rock? Explain.





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5. Notice the large fault cutting across the rock layers. Do you think the fault and the rock layers are the same age? Why or why not?

6. If you think the fault and the rock formed at different times, which is oldest—the fault or the rocks? Explain.



Now, study this image.



3. Do you think the small pieces of rock in the picture formed at the same time as the rock containing the pieces? Why or why not?

The small pieces of rock must have formed before they were incorporated into the rock shown here.

4. If you think the rock formed at different times, which is oldest—the rock containing the pieces, or the pieces of rock? Explain.

The small pieces of rock are older than the rock containing the pieces. The pieces of older rock became part of the new, younger rock sometime in the past.

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Now, try to interpret this image.



5. Notice the large fault cutting across the rock layers. Do you think the fault and the rock layers are the same age? Why or why not?

The rock layers formed slowly over time. The fault cuts across all of the layers. This could not have occurred while the rock layers were forming.

6. If you think the fault and the rock formed at different times, which is oldest—the fault or the rocks? Explain.

The rocks are older than the fault. The rock layers had to form first. Sometime after that, a fault broke through the rock layers.



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PRINCIPLES OF RELATIVE-AGE DATING

Geologists have developed a set of principle to organize rock layers according to their relative ages. Using the principles of relative-age dating, geologists can determine if rocks or features are younger or older than the rocks or features around them

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Objective/s

L1: Analyzing The Rock and Fossil Records

- Analyze the rock and fossil records in the diagrams and answer the questions related.
- Apply the principles of relative age dating to determine the sequence of geological events in rock formations.

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Success Criteria

L1: Analyzing The Rock and Fossil Records

You will be successful in today's lesson when you can:

Knowledge: Identify different types of rocks and fossils.

Comprehension: Explain how fossil records provide evidence for different periods in Earth's history.

Application: Apply knowledge of rock and fossil records to interpret Earth's geological timeline.

Analysis: Differentiate between fossil records of varying ages and relate them to specific geological time periods.

Evaluation: Assess the reliability of fossil evidence in constructing Earth's history.

Creation: Develop a timeline or diagram showing the connection between rock layers, fossil records, and the geological time scale.

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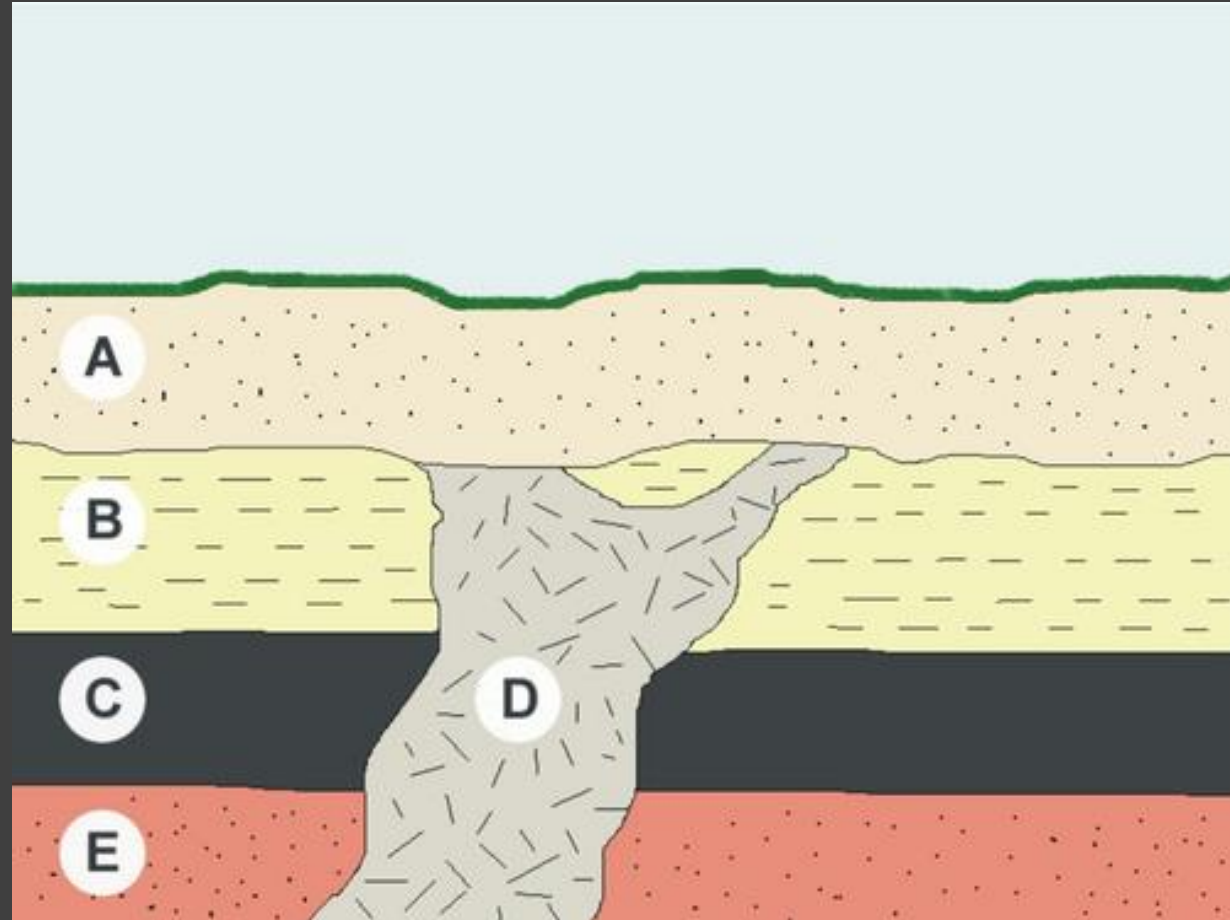
Superposition	the principle that in undisturbed rock layers, the oldest rocks are on the bottom.
original horizontality	principle that most rock-forming materials are deposited in horizontal layers.
lateral continuity	principle that sediments are deposited in large, continuous sheets in all lateral directions.
Inclusions	A piece of an older rock that becomes a part of a new rock.
cross-cutting relationships	the principle that if one geologic feature cuts across another feature, the feature that it cuts across is older.



THINK. PAIR. SHARE.

STARTER

Which layer refer to the **newest** layer ??



Assess Prior Knowledge

What are fossils?

- ☒ A. Preserved remains or traces of living things
- ☐ B. Animals that recently died
- ☐ C. One celled animals
- ☐ D. Animals that died 400 years ago
- ☐ E. Only dead people



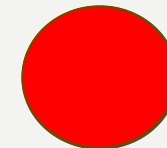
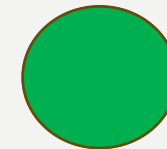
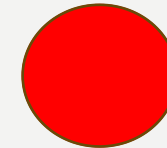
Engage

Starter True or False strategy



Prior Knowledge Check

1. Fossils found in the deepest rock layers are usually the youngest.
2. If a fossil of a fish is found in a desert rock layer, it suggests that the area was once covered by water.
3. Younger rock layers are always found below older layers, regardless of disturbances.



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PRINCIPLES OF RELATIVE-AGE DATING



The Principles of Relative-Age Dating As you just discovered in the *Relatively Speaking* investigation, there are five principles that geologists use to assign relative ages to rocks and features.

- **Superposition** is the principle that in undisturbed rock layers, the oldest rocks are on the bottom.
- According to the principle of **original horizontality**, most rock-forming materials are deposited in horizontal layers.
- **Lateral continuity** is the principle that sediments are deposited in large, continuous sheets in all lateral directions.
- According to the principle of **inclusions**, if one rock contains pieces of another rock, the rock containing the pieces is younger than the pieces.
- According to the principle of **cross-cutting relationships**, if one geologic feature cuts across another feature, the feature that it cuts across is older.

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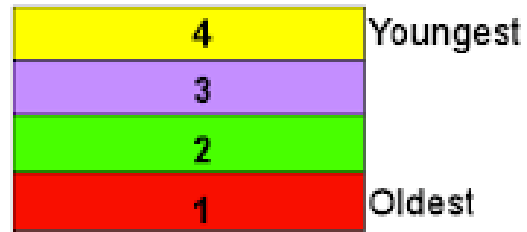
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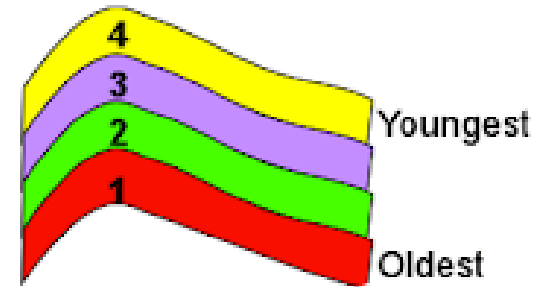
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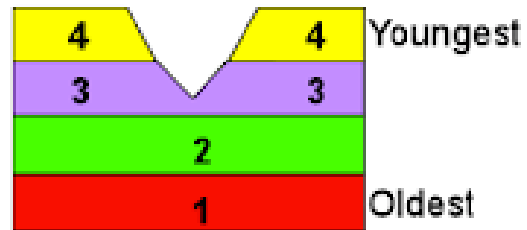
Law of Superposition



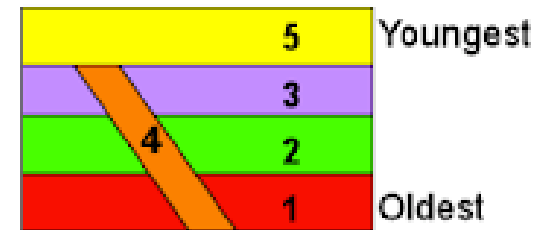
*Law of Original Horizontality
(originally like figure to the right)*



Law of Lateral Continuity



Cross-Cutting Relationship



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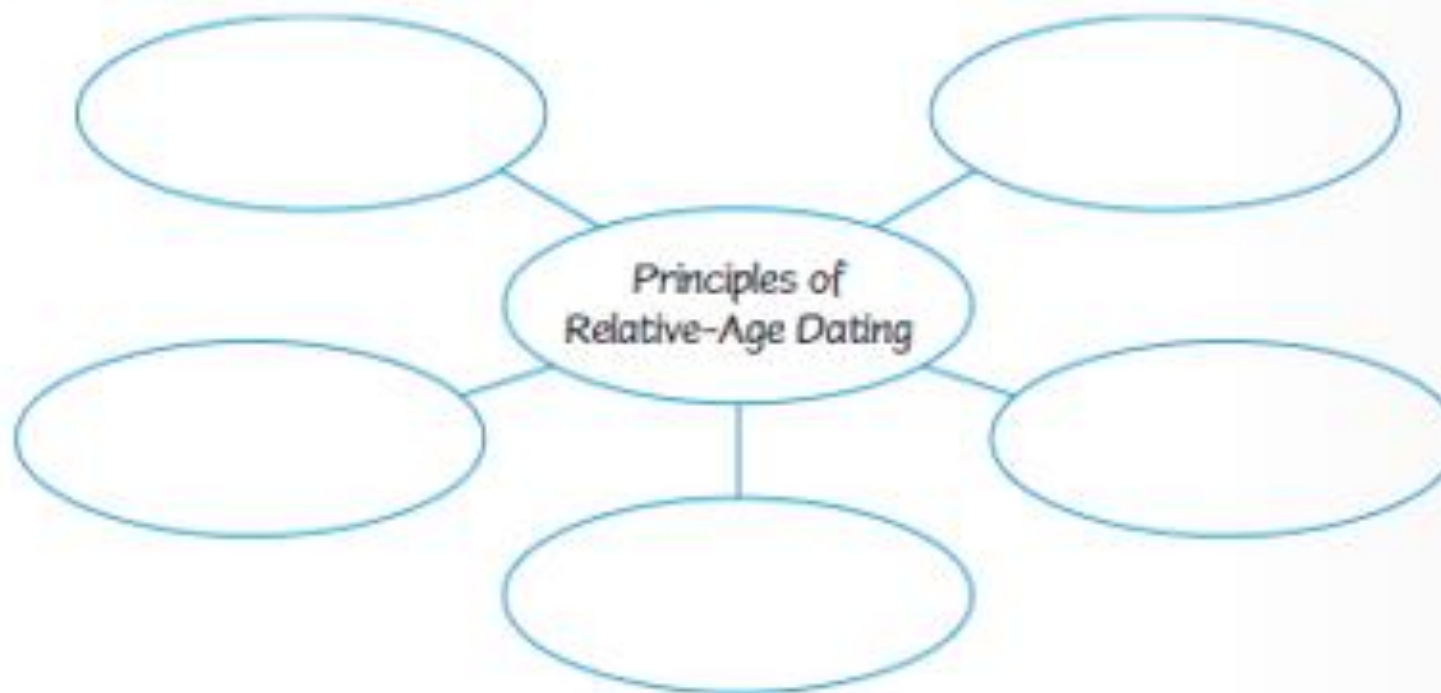
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 **GO ONLINE** Finally, watch the animation *Relative-Age Dating*.
Then answer the questions that follow.

7. What are the principles of relative-age dating?





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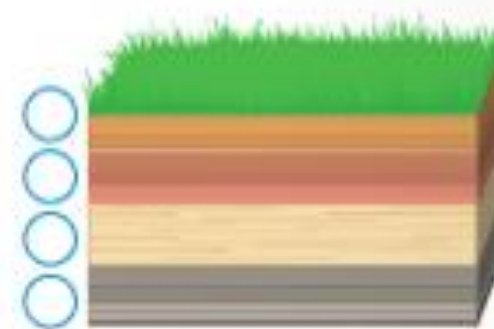
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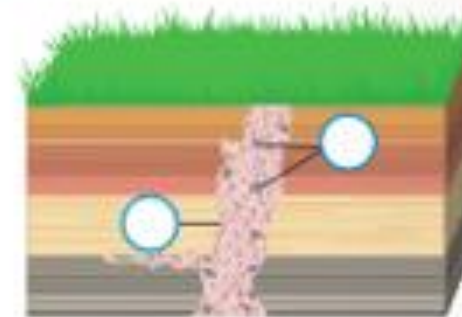
8. Which principle did you apply in Step 2 of the investigation?

Using this principle, assign the rock layers in the diagram to the right their relative ages from oldest (1) to youngest (4).



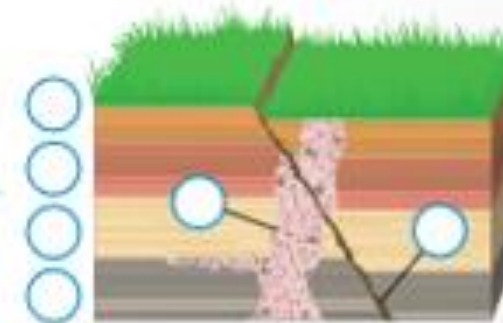
9. Which principle did you apply in Step 4 of the investigation?

Using this principle, label the older feature 1, and the younger feature 2 on the diagram to the right.



10. Which principle did you use in Step 6 of the investigation?

Using this principle, label the rock layers and features from oldest (1) to youngest (6).



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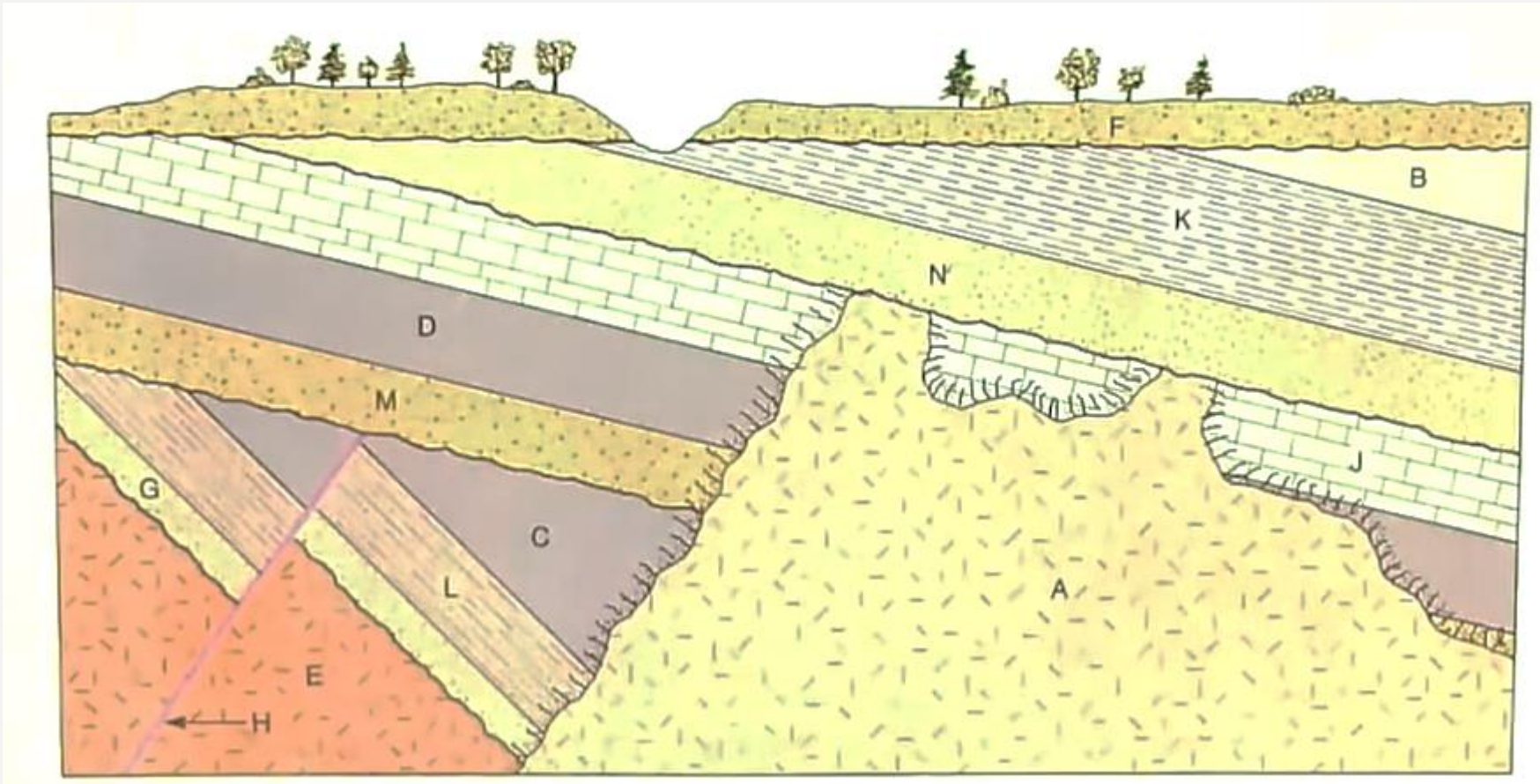
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Let's Find The correct order of layers

Think – pair - share





Fossil types and the rocks they are in give scientists' clues about **ancient** environments.

What can the fossil record tell us about Earth's history?

You just discovered how the principles of relative-age dating allow geologists to determine if rocks or features are younger or older than the rocks or features around them. But did you know that the rocks themselves can hold clues about their ages?

LIFE SCIENCE Connection Some of the most obvious clues found in rocks are **fossils**—the remains or traces of ancient living things. How can geologists use fossils to infer the ages of rocks and events in Earth's history? Let's dig in.



Learning from Fossil Records



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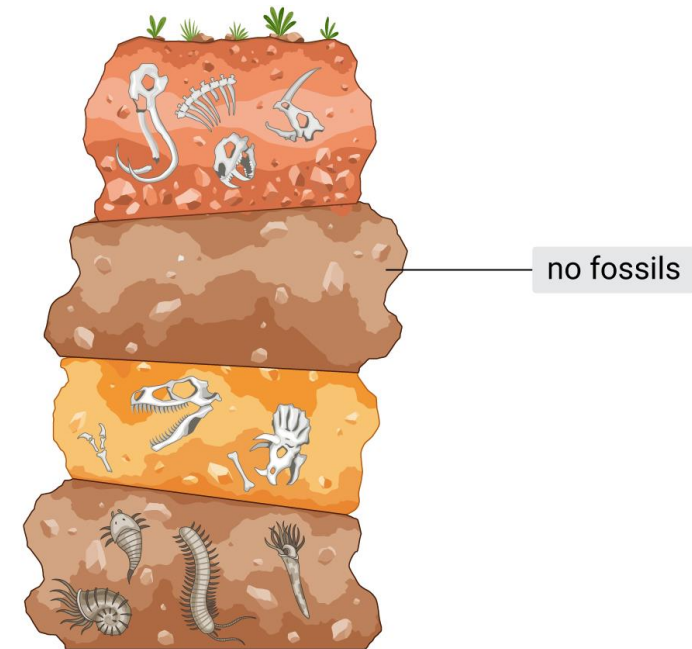
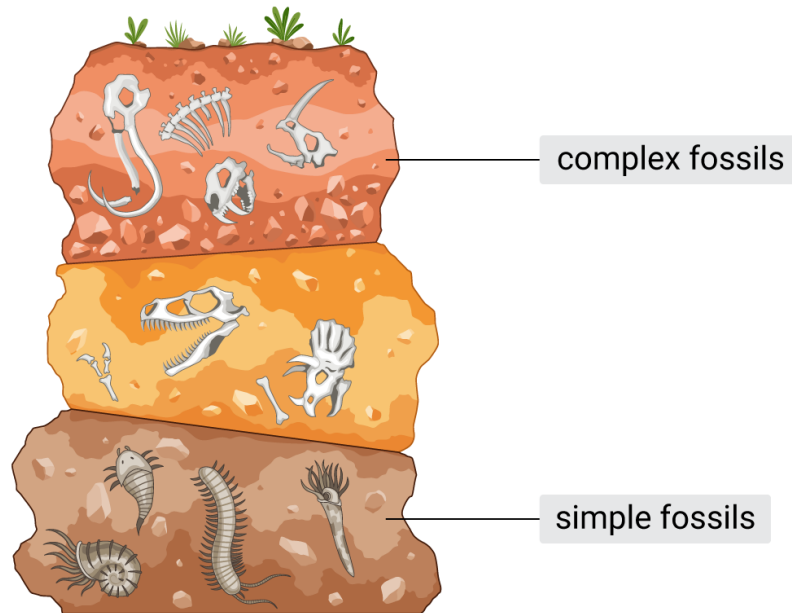
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The fossils found in **older** rock layers are simple.
The fossils found in **newer** rocks are more complex.



Mass extinctions occur when many plant and animal species die out within a relatively short period of time.

Assessment for learning



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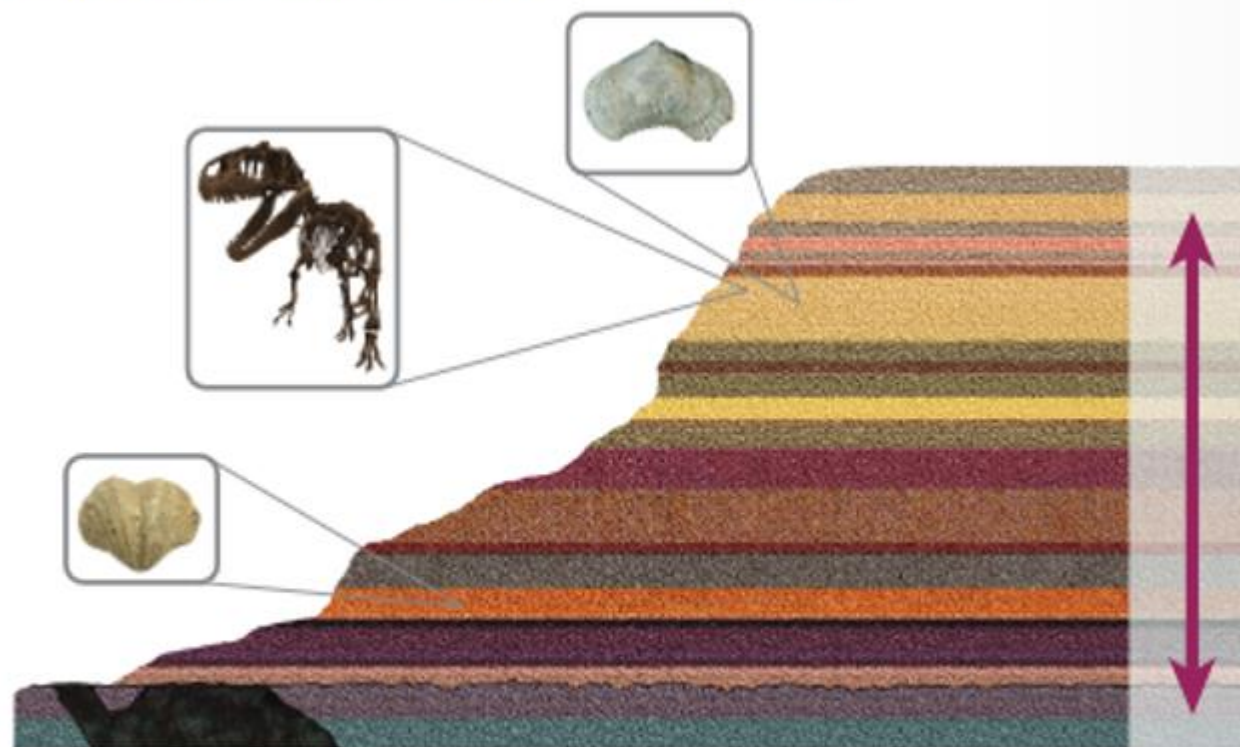
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Clues to Earth's Past

Analyze the image below. Then answer the questions that follow.



Note: Fossils are not to scale.

- Using the principle of superposition, determine which rock layers are the oldest, and which rock layers are the youngest. Label the space above and below the arrow heads *Oldest* and *Youngest* accordingly.

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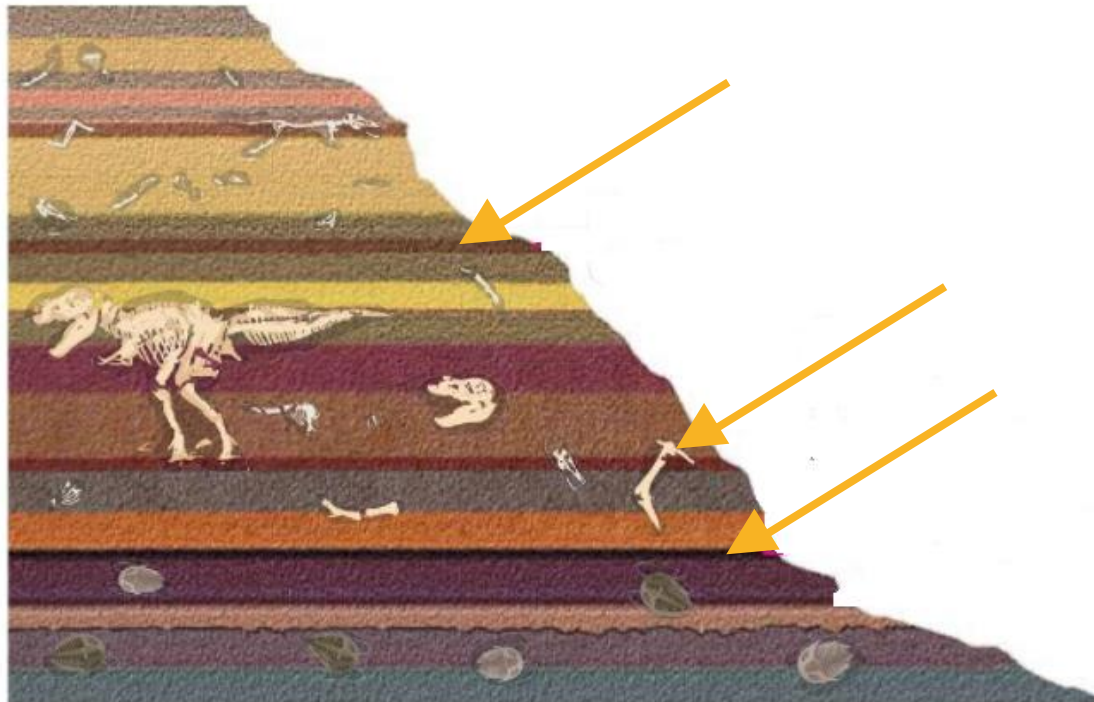
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3. Make a claim about how the complexity of fossils in the fossil record can provide clues to the relative ages of rock units.

Complex fossils are found in

Simple fossils are found in

Now, study the image below. Notice the fossil trilobites in the rock layers at the bottom of the sequence. As you move upward in the sequence you'll see fossils of mammals and dinosaurs.



Note: Fossils are not to scale.



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Label : Oldest/ youngest &
appearance /disappearance
of organisms



LABEL : OLDEST/ YOUNGEST & APPEARANCE /DISAPPEARANCE OF ORGANISMS

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Alef

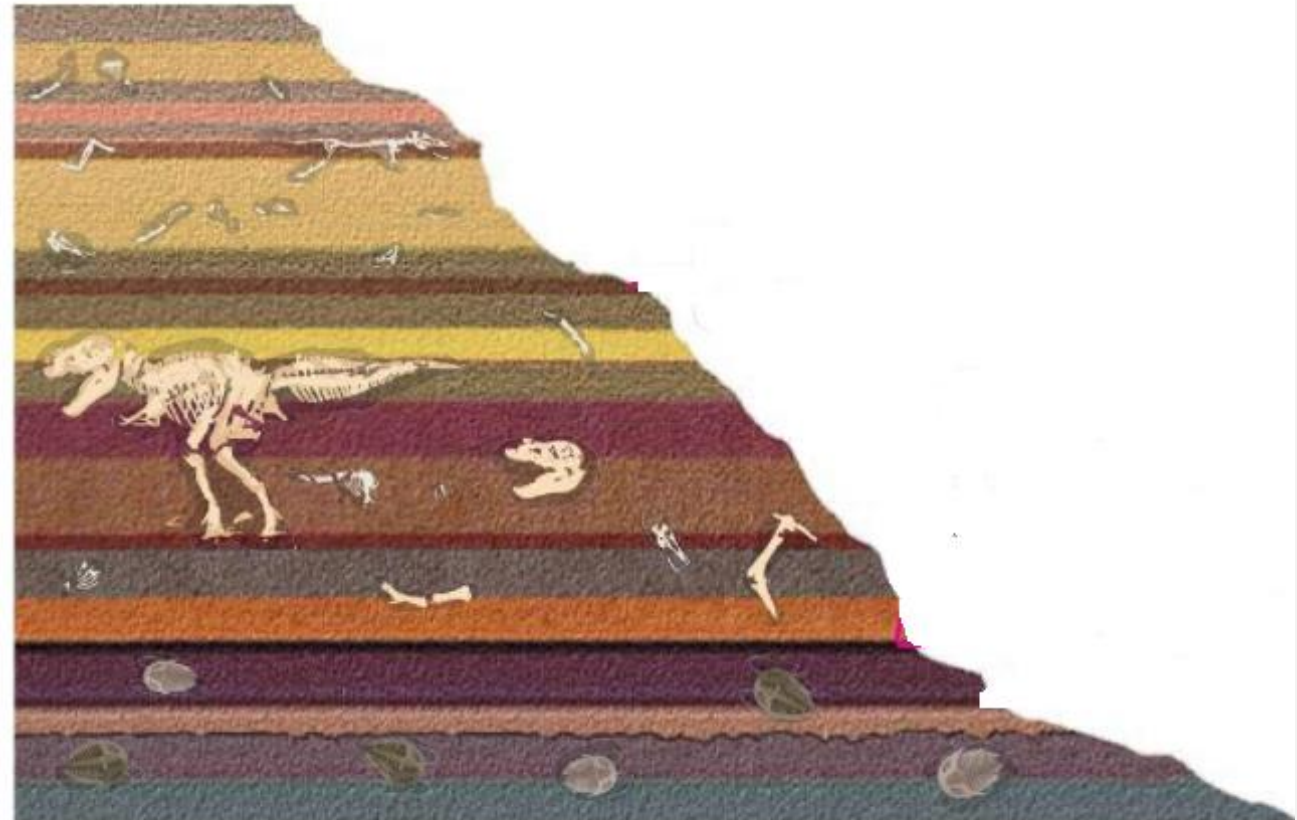
Workbook /
Notebook activity
(writing)

Critical
Thinking/making
connection

Self-Assessment

Plenary-exit ticket

Enrichment



Note: Fossils are not to scale.

COMPLETE ALEF LESSONS





2. Analyzing the Rock and Fossil Records: Earth's Rock Records

🔓 Unlocked 29/30





3. Analyzing the Rock and Fossil Records: Earth's Fossil Records

🔒 Locked



4. Analyzing the Rock and Fossil Records - Investigate

🔒 Locked

Early finishers to write the Principles of Relative-age Dating in their notebook with drawing .



CRITICAL THINKING QUESTION

What clues do you think fossils provide about Earth's past?

clues about the kinds of organisms
and climates that occurred on Earth





Introduction

Student well being

Class rules and
digital citizenship

Do now activity

Outcomes &
Success Criteria

Key Vocabulary

Starter

Main Activity:
Reading/listening/
Alef**Workbook** /
Notebook activity
(writing)Critical
Thinking/making
connection

Self-Assessment

Plenary-exit ticket

Enrichment

The Fossil Record While studying the fossils in rock layers, as you just did in the *Clues to Earth's Past* investigation, early geologists recognized three things. First, fossils found in the oldest layers of rock are of relatively simple organisms. Fossils of more complex organisms appear in younger layers of rock. Second, there were a few times when many types of fossils that appear in one rock layer did not appear in the younger rock layers right above it. These sudden disappearances in the fossil record of many types of organisms mark **mass extinctions**—times when many species on Earth died or became extinct within a relatively short period of time.



And finally, fossils and the rocks they are within can be used to determine what the environment of an area was like long ago. Let's look at an example.

MASS EXTINCTIONS



Activity

CLASS ACTIVITY

TextStudio

Low Level

RELATIVE DATING WORKSHEET

Name: _____

Principles of Geology

- **Law of Superposition:** The youngest layer of rock is on the top. The oldest layer of rock is on the bottom
- **Law of Original Horizontality:** All sedimentary rocks are deposited flat initially. If you find them at an angle, they have been moved
- **Law of Cross-cutting relationships:** Igneous rocks or faults that "cut" into other rocks are the youngest. (the "other rocks" had to be there before they could get cut by anything)

Sand

GRAVEL

Clay

Limestone

1

2

3

1. Which of these layers is the youngest? _____

2. How can you tell? _____

3. What principle of geology does this relate to? _____

4. When did layer "4" occur? _____

5. How can you tell? _____

6. What principle of geology teaches that concept? _____

Middle level

Q 1 Choose correct answer.

1-A leaf imprinted on a rock, causing a too be made.

a-Sedimentary rock b-Fossils

2- Scientists can learn about ancient environments by studying.....in layers of sedimentary rock.

a- organisms b- water

3- Most fossils are found in

a- Sandy layers b- rocky layers

4- If a fern fossil is found in a rock layer lower than a fossil of a smallish, the fern is probably.....

a- older b- younger

5- Fossil evidence provides scientists with information about

A. How an environment has changed over time

B. Rocks and minerals.

C. Where earthquakes occur.

D. How mountains form.

Q6- Answer questions 1 & 2 correctly

1- Look to rock layers the oldest layer fossils are
The youngest layer fossils are

2- Order layers of this rock from 1 to 3 depended on age from oldest to youngest?

High level

RELATIVE DATING WORKSHEET

Name: _____

Principles of Geology

- **Law of Superposition:** The youngest layer of rock is on the top. The oldest layer of rock is on the bottom
- **Law of Original Horizontality:** All sedimentary rocks are deposited flat initially. If you find them at an angle, they have been moved
- **Law of Cross-cutting relationships:** Igneous rocks or faults that "cut" into other rocks are the youngest. (the "other rocks" had to be there before they could get cut by anything)

Sand

GRAVEL

Clay

Limestone

1

2

3

1. Which of these layers is the youngest? _____

2. How can you tell? _____

3. What principle of geology does this relate to? _____

4. When did layer "4" occur? _____

5. How can you tell? _____

6. What principle of geology teaches that concept? _____

7. What happened to these layers of rock (if anything)? _____

8. Which principle of geology did you use to determine what happened? _____

9. What happened first: the igneous pluton D or the earthquake fault line E? _____

10. Which rock layer was put down last (A, B, C, or D)? _____

11. Which way did the rocks on the right move? (upward or downward)? _____

12. Which happened first: the Coal layer, the Barren Sandstone, or the erosion of Deadman's canyon? _____

13. What happened to the top of the curly rocks beneath the Barren Sandstone? _____

14. Why are the rocks on the bottom folded but the top ones are not? What do you think could have caused this? _____

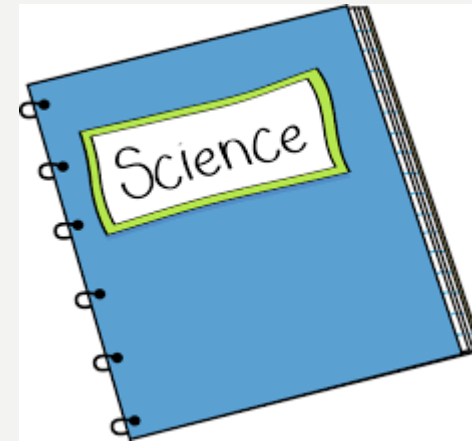
Announcement :

 In your notebook, you must complete the following:

- 1 Write the **title of the lesson, date, and lesson objectives** at the top.
- 2 Write the **definition of Relative Age Dating**.
- 3 List the **5 Principles of Relative Age Dating** and include a short explanation of each.
- 4 **Draw diagrams** to represent the 5 Principles of Relative Age Dating. (refer to textbook pages 17 to 18 +online resources).

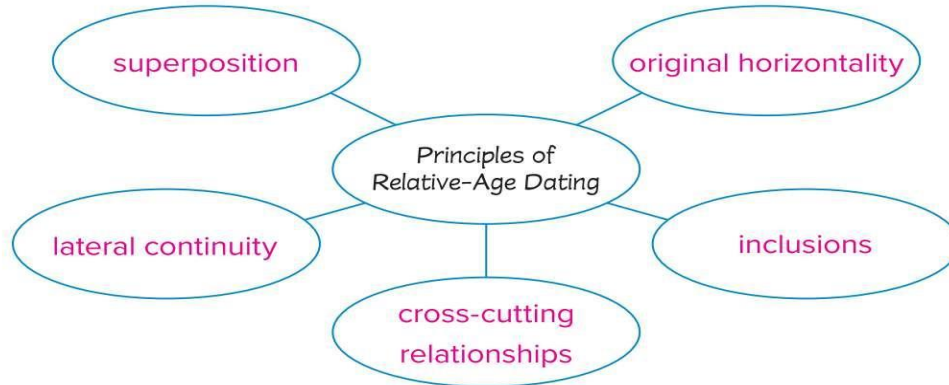
 Please make sure your work is neat and complete.

NOTEBOOK TASK



GO ONLINE Finally, watch the animation *Relative-Age Dating*. Then answer the questions that follow.

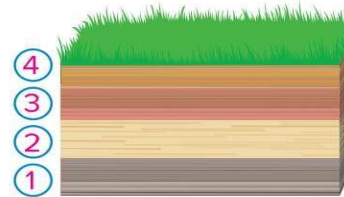
7. What are the principles of relative-age dating?



8. Which principle did you apply in Step 2 of the investigation?

superposition

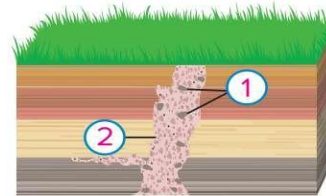
Using this principle, assign the rock layers in the diagram to the right their relative ages from oldest (1) to youngest (4).



9. Which principle did you apply in Step 4 of the investigation?

inclusions

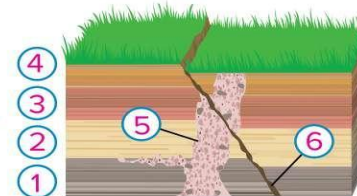
Using this principle, label the older feature 1, and the younger feature 2 on the diagram to the right.



10. Which principle did you use in Step 6 of the investigation?

cross-cutting relationships

Using this principle, label the rock layers and features from oldest (1) to youngest (6).



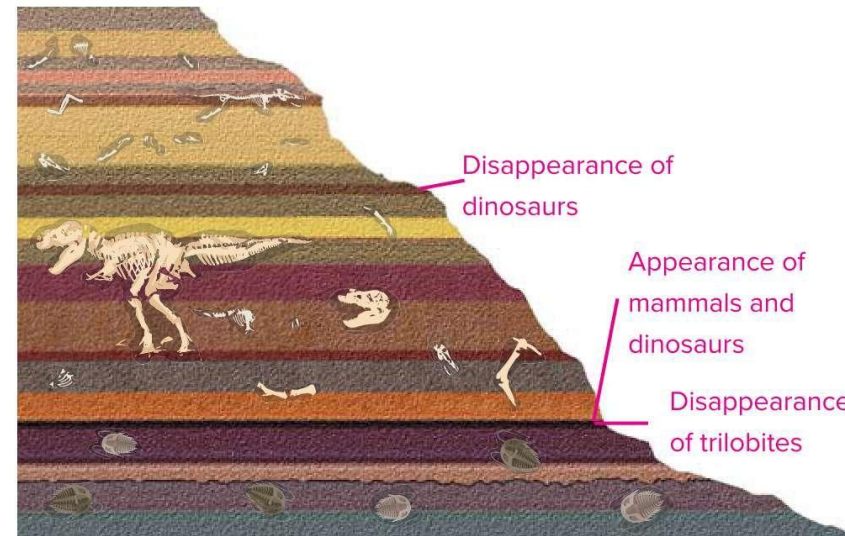
2. Imagine you discovered the fossils in the rock layers on the previous page. What do you notice about the complexity of the fossils in the rocks? Where are the more simple fossils located? Where is the more complex fossil located?

Complex fossils are found in younger rock layers. The more simple fossils are found in both old and young rock layers.

3. Make a claim about how the complexity of fossils in the fossil record can provide clues to the relative ages of rock units.

The fossil record can provide clues based on the complexity of the organisms. Older rock layers only contain simple lifeforms; younger layers contain both simple and complex.

Now, study the image below. Notice the fossil trilobites in the rock layers at the bottom of the sequence. As you move upward in the sequence you'll see fossils of mammals and dinosaurs.



Note: Fossils are not to scale.

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4. When do trilobites disappear from the rock sequence? Label this point *Disappearance of trilobites* in the white space to the right of the image.
5. When do mammals and dinosaurs appear in the rock sequence? Label this point *Appearance of mammals and dinosaurs*.
6. What can you conclude about the layers that contain the trilobites? Are they older or younger than the layers that contain the mammals and dinosaurs?



The rock layers that contain the trilobites are older than the rock layers that contain the mammals and dinosaurs.

7. When do the dinosaurs disappear from the rock sequence? Label this point *Disappearance of dinosaurs* in the white space to the right of the image.

8. What can you conclude about the layers that contain only the mammals? Are they older or younger than the layers that contain the dinosaurs?

The rock layers that contain only mammals are younger than the layers that contain dinosaurs.

9. Make a claim about how the appearance and disappearance of organisms in the fossil record provides relative dates.

Rock layers that contain extinct organisms are older than rock layers that contain fossils of organisms that are still living today.

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 **GO ONLINE** for additional opportunities to explore!

LIFE SCIENCE Connection Want to learn more about fossils? Then perform one of the following activities.

☐ **Investigate** clues about how organisms lived in the **Lab** *What can trace fossils show?*

OR

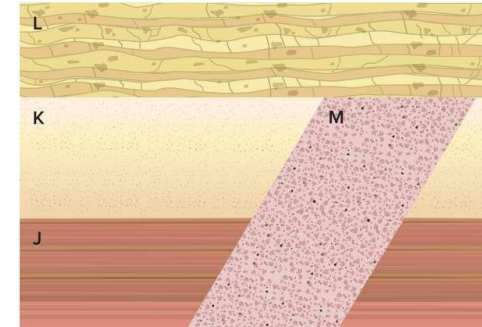
☐ **Explore** ancient organisms by studying fossil remains in the **Lab** *How is a fossil a clue?*

ANSWERS : C & A



Three-Dimensional Thinking

Imagine you are a geologist. You have been asked to analyze and interpret the rock sequence below. Your task is to determine the relative ages of the rocks.



2. Order the features in the illustration from oldest to youngest.

- A JKLM
- B MJKL
- ☒ C JKML
- D MLKJ

3. Which geologic principle must be assumed to determine the relative age of M?

- ☒ A cross-cutting relationships
- B superposition
- C original horizontality
- D inclusions

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H.W – PAGE 26



Real-World Connection

4. **Contrast** What is your absolute age? What is your relative age compared to two of your classmates? How do these ages contrast?

My absolute age is 13. I am younger than Salvador and older than Cora. Absolute age is a numerical age, whereas relative age is not an exact age, but rather the age of an object, feature, or person in comparison to another.

5. **Predict** Suppose you are a geologist tasked with analyzing the fossil record in your region and determining when a major marine extinction event took place. What changes in the fossil record would you look for?

There would likely be a sudden disappearance of marine fossil organisms in the fossil record. New, different life-forms might appear in the rock layers above the mass extinction event.



- Summarize what they learned in their notebook and complete the survey ..



LAB ACTIVITY

