READ these pages below independently, then try to answer the questions below it:

Section 2

The Relative Age of Rocks

Reading Preview

Key Concepts

- What is the law of superposition?
- How do geologists determine the relative age of rocks?
- How are index fossils useful to geologists?

Key Terms

- relative age • absolute age
- law of superposition
- extrusion • intrusion • fault
- unconformity • index fossil

Target Reading Skill

Asking Questions Before you read, preview the red headings. In a graphic organizer like the one below, ask a *what* or *how* question for each heading. As you read, write answers to your questions.

Relative Age

Question	Answer
What does the position of rock layers reveal?	The position of rock layers shows . . .

Lab zone **Discover Activity**

Which Layer Is the Oldest?

1. Make a stack of different-colored layers of clay. Each layer should be about the size and thickness of a pancake. If these flat layers are sediments, which layer of sediment was deposited first? (*Hint:* This is the oldest layer.)
2. Now form the stack into a dome by pressing it over a small rounded object, such as a small bowl. With a cheese-slicer or plastic knife, carefully cut off the top of the dome. Look at the layers that you have exposed. Which layer is the oldest?

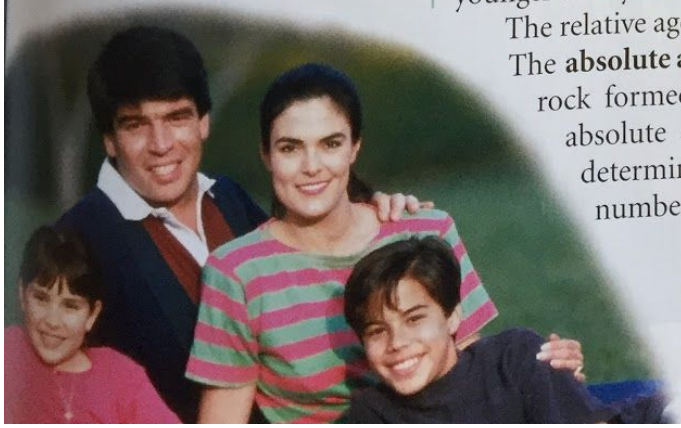
Think It Over

Inferring If you press the stack into a small bowl and trim away the clay that sticks above the edge, where will you find the oldest layer?

As sedimentary rock forms, the remains of organisms in the sediment may become fossils. Millions of years later, if you split open the rock, you might see the petrified bones of an extinct reptile or insect.

Your first question about a new fossil might be, "What is it?" Your next question would probably be, "How old is it?" Geologists have two ways to express the age of a rock and any fossil it contains. The **relative age** of a rock is its age compared to the ages of other rocks. You have probably used the idea of relative age when comparing your age with someone else's age. For example, if you say that you are older than your brother but younger than your sister, you are describing your relative age.

The relative age of a rock does not provide its absolute age. The **absolute age** of a rock is the number of years since the rock formed. It may be impossible to know a rock's absolute age exactly. But sometimes geologists can determine a rock's absolute age to within a certain number of years.



◀ The age of each family member could be given as relative age or absolute age.

Discovery CHANNEL SCHOOL

A Trip Through Geologic Time

Video Preview
▶ Video Field Trip
Video Assessment

The Position of Rock Layers

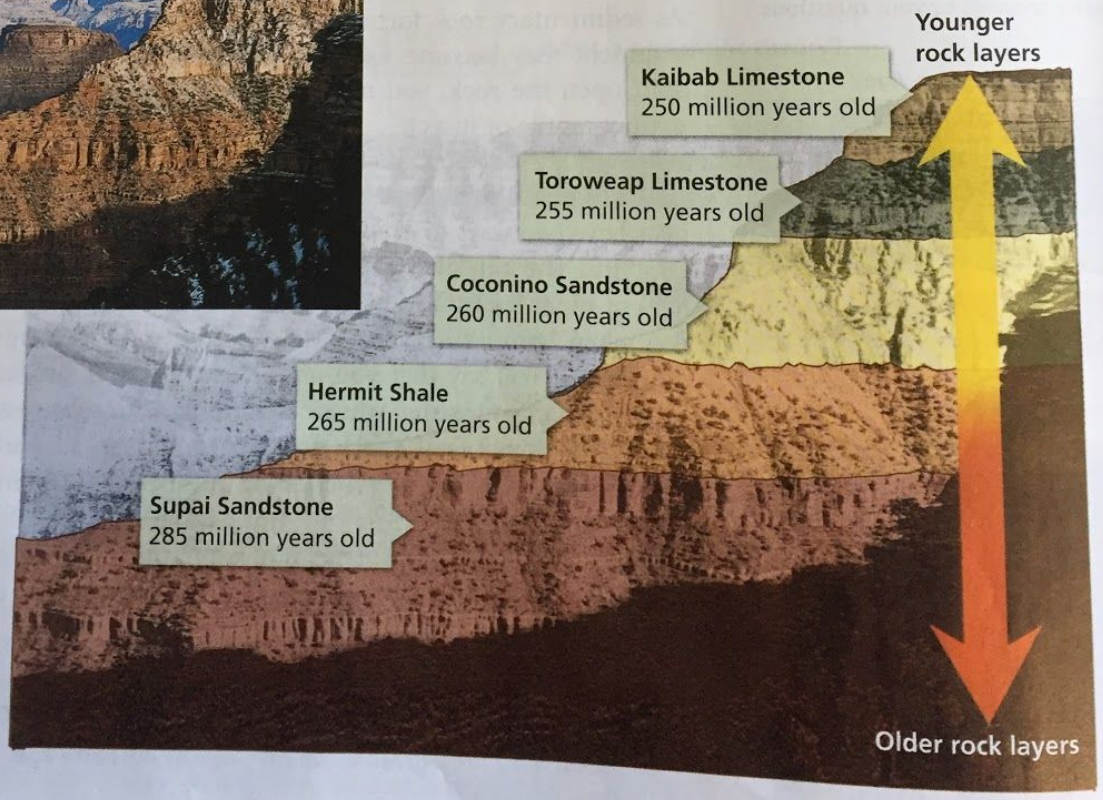
Have you ever seen rock layers of different colors on a cliff beside a road? What are these layers, and how did they form? The sediment that forms sedimentary rocks is deposited in flat layers one on top of the other. Over time, the sediment hardens and changes into sedimentary rock. These rock layers provide a record of Earth's geologic history.

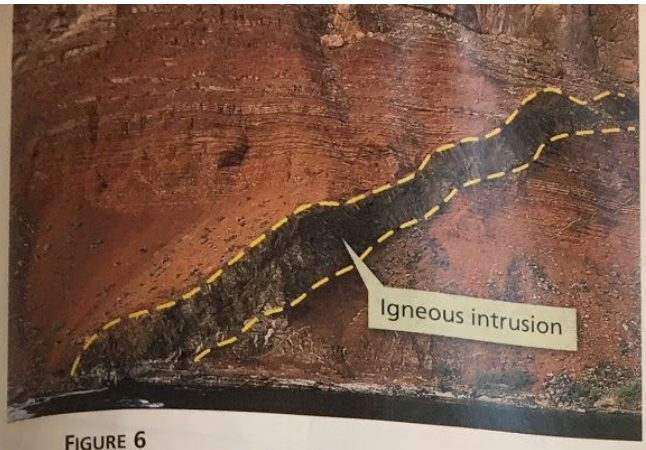
It can be difficult to determine the absolute age of a rock. So geologists use a method to find a rock's relative age. Geologists use the **law of superposition** to determine the relative ages of sedimentary rock layers. **According to the law of superposition, in horizontal sedimentary rock layers the oldest layer is at the bottom. Each higher layer is younger than the layers below it.**

The walls of the Grand Canyon in Arizona illustrate the law of superposition. You can see some of the rock layers found in the Grand Canyon in Figure 5. The deeper down you go in the Grand Canyon, the older the rocks.

Reading Checkpoint **Why do sedimentary rocks have layers?**

FIGURE 5
The Grand Canyon
More than a dozen rock layers make up the walls of the Grand Canyon. You can see five layers clearly in the photograph. **Applying Concepts** *In which labeled layers would you find the oldest fossils? Explain.*





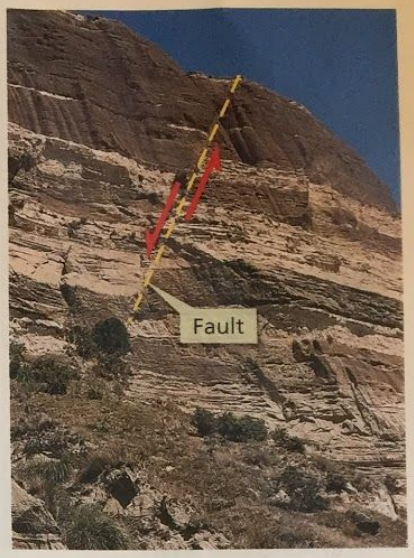


FIGURE 6
Intrusions and Faults
Intrusions and faults give clues to the relative ages of rocks. An intrusion (left) cuts through rock layers. Rock layers are broken and shifted along a fault (right).

Determining Relative Age

There are other clues besides the position of rock layers to the relative ages of rocks. **To determine relative age, geologists also study extrusions and intrusions of igneous rock, faults, and gaps in the geologic record.**

Clues From Igneous Rock Igneous rock forms when magma or lava hardens. Magma is molten material beneath Earth's surface. Magma that flows onto the surface is called lava.

Lava that hardens on the surface is called an **extrusion.** An extrusion is always younger than the extrusion below it.

Beneath the surface, magma may push into bodies of rock. There, the magma cools and hardens into a mass of igneous rock called an **intrusion.** An intrusion is always younger than the rock layers around and beneath it. Figure 6 shows an intrusion. Geologists study where intrusions and extrusions formed in relation to other rock layers. This helps geologists understand the relative ages of the different types of rock.

Clues From Faults More clues come from the study of faults. A **fault** is a break in Earth's crust. Forces inside Earth cause movement of the rock on opposite sides of a fault.

A fault is always younger than the rock it cuts through. To determine the relative age of a fault, geologists find the relative age of the youngest layer cut by the fault.

Movements along faults can make it harder for geologists to determine the relative ages of rock layers. You can see in Figure 6 how the rock layers no longer line up because of movement along the fault.

Lab zone **Try This Activity**

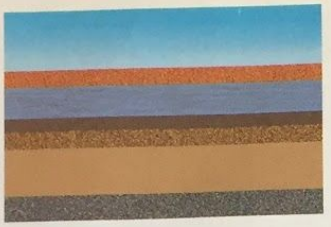
Sampling a Sandwich

Your teacher will give you a sandwich that represents rock layers in Earth's crust.

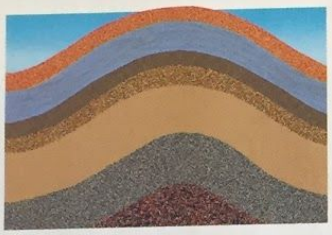
1. Use a round, hollow, uncooked noodle as a coring tool. Push the noodle through the layers of the sandwich.
2. Pull the noodle out of the sandwich. Break the noodle gently to remove your core sample.
3. Draw a picture of what you see in each layer of the core.

Making Models Which layer of your sandwich is the "oldest"? The "youngest"? Why do you think scientists study core samples?

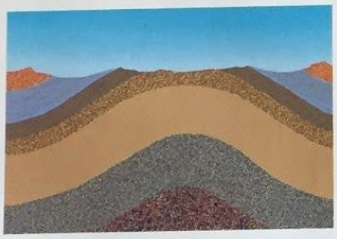
FIGURE 7
Unconformity
An unconformity occurs where erosion wears away layers of sedimentary rock. Other rock layers then form on top.
Sequencing *What two processes must take place before an unconformity can form?*



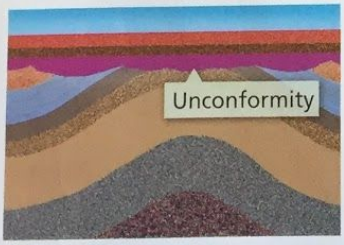
1 Sedimentary rocks form in horizontal layers.



2 Folding tilts the rock layers.



3 The surface is eroded.



4 New sediment is deposited, forming rock layers above the unconformity.

Gaps in the Geologic Record The geologic record of sedimentary rock layers is not always complete. Deposition slowly builds layer upon layer of sedimentary rock. But some of these layers may erode away, exposing an older rock surface. Then deposition begins again, building new rock layers.

The surface where new rock layers meet a much older rock surface beneath them is called an **unconformity**. An unconformity is a gap in the geologic record. An unconformity shows where some rock layers have been lost because of erosion. Figure 7 shows how an unconformity forms.

Reading Checkpoint **What is an unconformity?**

Using Fossils to Date Rocks

To date rock layers, geologists first give a relative age to a layer of rock at one location. Then they can give the same age to matching layers of rock at other locations.

Certain fossils, called index fossils, help geologists match rock layers. To be useful as an **index fossil,** a fossil must be widely distributed and represent a type of organism that existed only briefly. A fossil is considered widely distributed if it occurs in many different areas. Geologists look for index fossils in layers of rock. **Index fossils are useful because they tell the relative ages of the rock layers in which they occur.**

Geologists use particular types of organisms as index fossils—for example, certain types of ammonites. Ammonites (AM uh nyts) were a group of hard-shelled animals. Ammonites evolved in shallow seas more than 500 million years ago and became extinct about 65 million years ago.

Ammonite fossils make good index fossils for two reasons. First, they are widely distributed. Second, many different types of ammonites evolved and then became extinct after a few million years.

Geologists can identify the different types of ammonites through differences in the structure of their shells. Based on these differences, geologists can identify the rock layers in which a particular type of ammonite fossil occurs.

You can use index fossils to match rock layers. Look at Figure 8, which shows rock layers from four different locations. Notice that two of the fossils are found in only one of these rock layers. These are the index fossils.

Reading Checkpoint **What characteristics must a fossil have to be useful as an index fossil?**

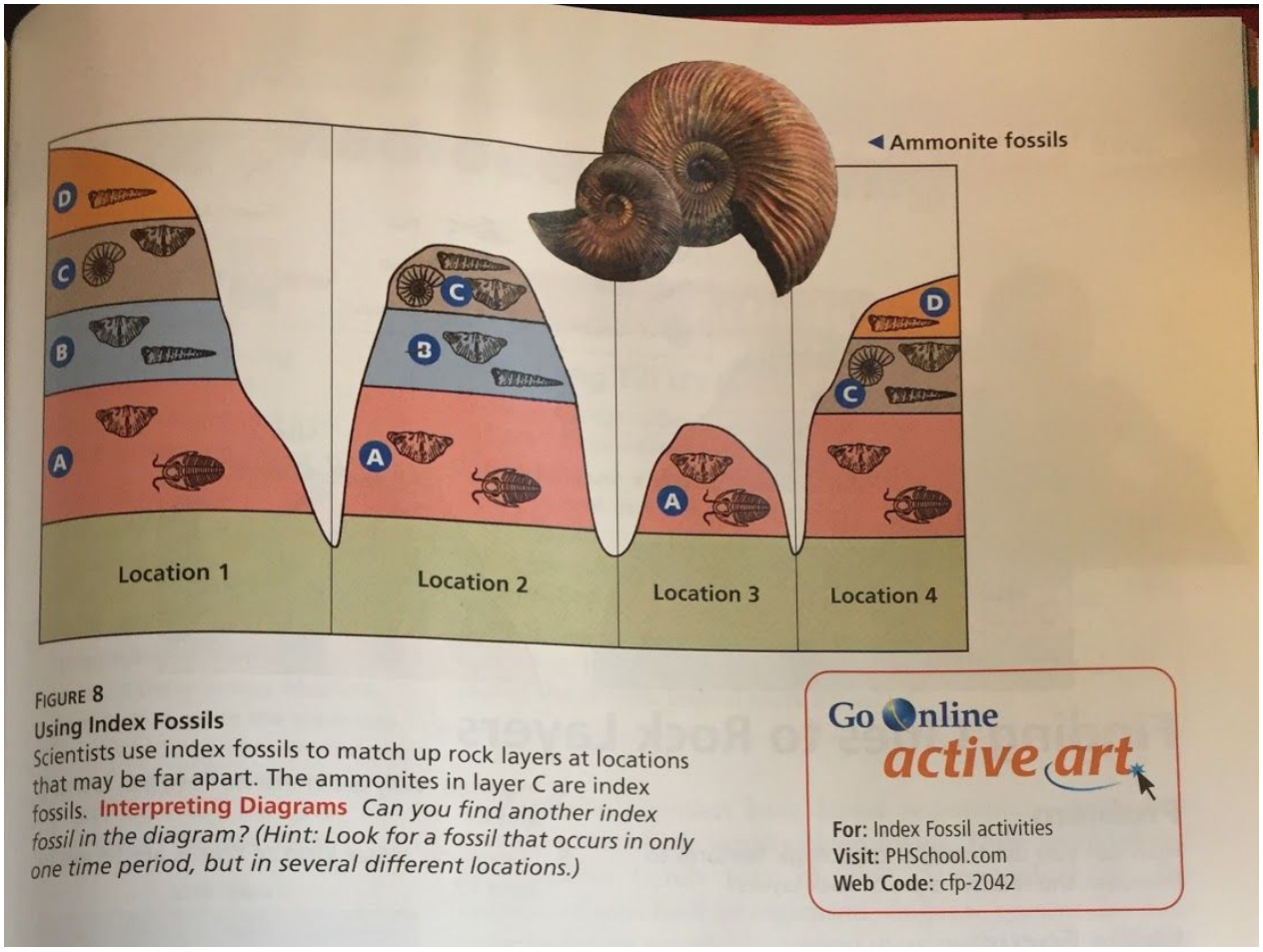


FIGURE 8
Using Index Fossils
Scientists use index fossils to match up rock layers at locations that may be far apart. The ammonites in layer C are index fossils. **Interpreting Diagrams** *Can you find another index fossil in the diagram? (Hint: Look for a fossil that occurs in only one time period, but in several different locations.)*

Go Online
active art
For: Index Fossil activities
Visit: PHSchool.com
Web Code: cfp-2042

1) Describe what the relative age of a rock is:

2) Describe your own age relative to Mrs. Ruminski:

3) Describe what absolute age of a rock is:

4) What is your own absolute age?

5) What does the Law of Superposition say?

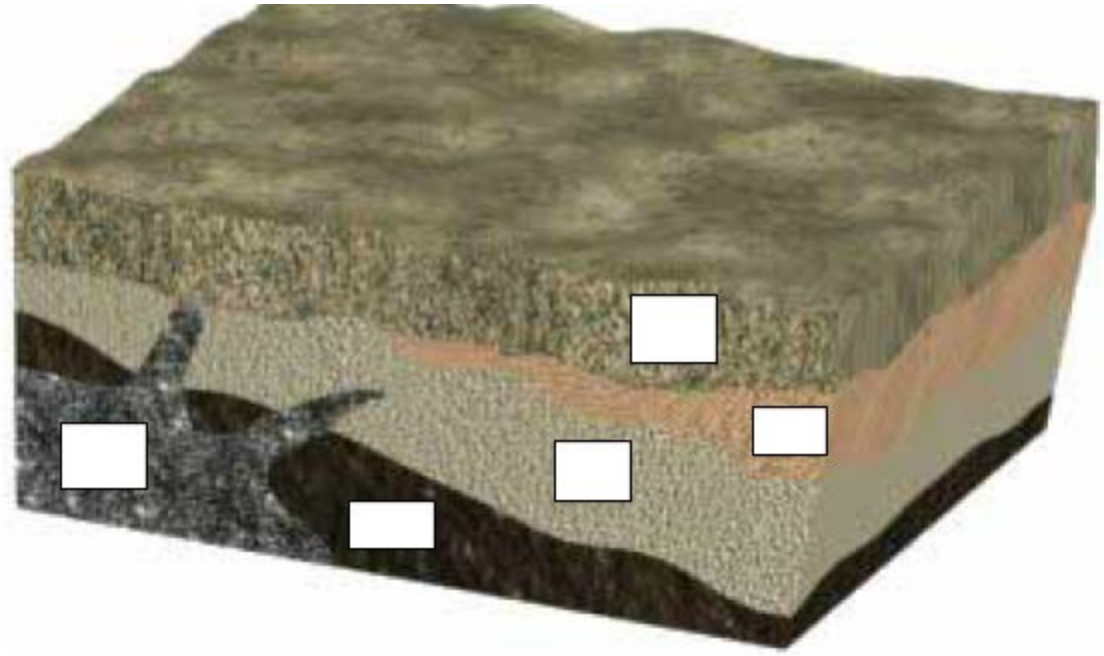
6) Using the Law of Superposition, Label the oldest layer and the youngest layer in the picture below:

7) Using the materials at your table, create rock layers to show you understand relative age and the Law of Superposition.

8) Take a picture of what you make and paste it below:

9) Label the relative ages (Oldest and Youngest) of your rock layers according to the Law of Superposition.

10) Watch the animation in link #27A on Mrs. R's Geology webpage
11) Label:
    - The INTRUSION
    - Number the layers in the order they were formed in the little boxes



12) Using the materials at your table, create rock layers with an intrusion to show you understand the order of cross-cutting relationships.

13) Take a picture of what you make and paste it below:

14) Label the Intrusion.
15) Label with NUMBERS the order in which the layers and intrusion formed (1, 2, 3…)

16) Watch the animation link #27B on Mrs. R's Geology website.
17) Label:

- Which of these is BEFORE and which is AFTER?

18) Using the materials at your table, create rock layers with a fault to show you understand the order of cross-cutting relationships.

19) Take a picture of what you make and paste it below:

20) Label the fault.
21) Label with NUMBERS the order in which the layers and fault formed (1, 2, 3…)

22) What are the 2 rules for a fossil to be an index fossil?

1)

2)

23) What do index fossils help us do?