

Unit 7 Earth Science: Part II

Chapter 25 The Earth's History

Chapter 26 The Earth's Oceans

Chapter 27 Exploring Space

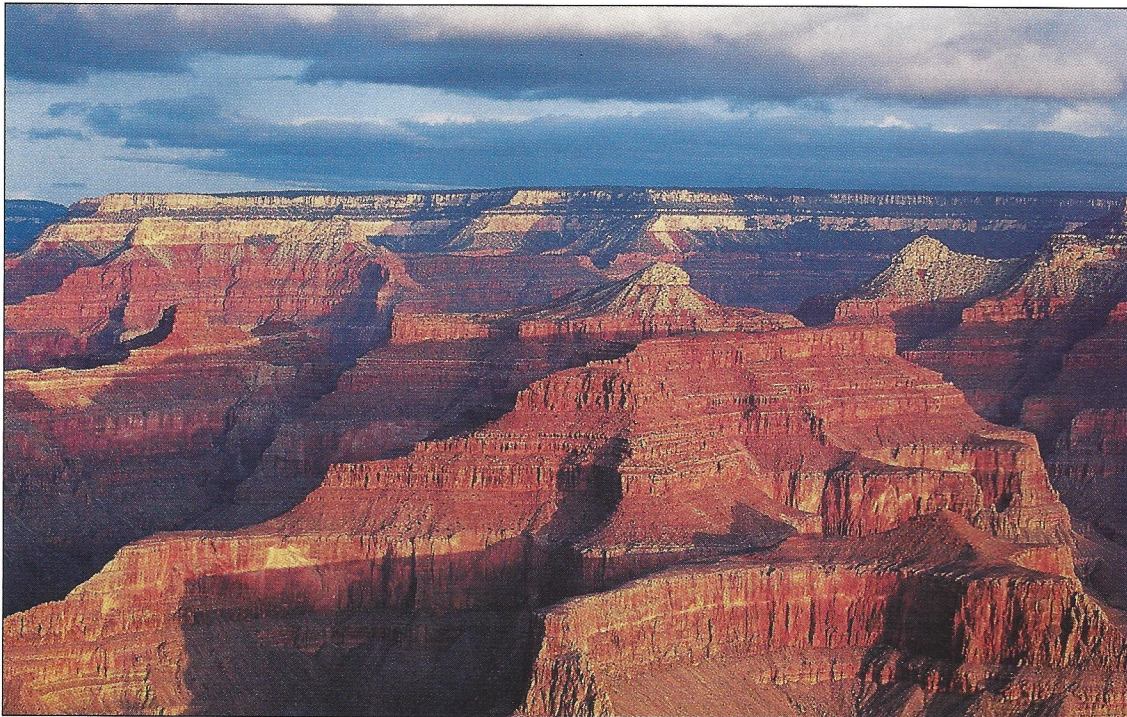


This valley used to be shallow and narrow. However, a glacier carved it wider and deeper. When the glacier melted, it left the beautiful valley you see. These changes took a very long time.

The Earth has changed often over its long history. Earth scientists study these changes. The chart shows some events that can change the Earth and how long they usually take. Use the chart to answer these questions.

1. Which events take place over a short period of time?
2. Which events take place over long periods of time?
3. Compared to the age of the Earth, do you think a hundred years is a long time? Explain.

Event	Time It Takes
Lightning striking	A few seconds
Earthquake	A few minutes
Thunderstorm	An hour
Volcanic eruption	Several days
Formation of a layer of soil	10,000 years
Carving of valley by glacier	500,000 years
Formation of a mountain	50 million years



The Grand Canyon is a cut in the Earth's surface 1 mile (1.6 kilometers) deep. It is a beautiful sight. It is also a useful tool for scientists. The Grand Canyon provides many clues to the Earth's past. What kinds of clues do you think it provides?

Learning Objectives

- Explain how uplifting and folding affects rock layers.
- Describe how geologists use radioactive dating to tell the age of rocks.
- Explain what fossils can show us about the Earth's history.
- Identify the four geological eras.
- List the main geological events and important forms of life during each geological era.
- LAB ACTIVITY: Identify a geological era by its fossils.
- SCIENCE IN YOUR LIFE: Relate field work by students to the study of fossils.

Words to Know

uplifting and folding	a geological process that bends layers of the Earth's crust and sometimes turns them upside down
radioactive dating	a way to find the age of rocks by measuring the decay, or breaking down, of radioactive elements in them
geological era	a huge period of time in the Earth's history
Precambrian era	the geological era that started 4.5 billion years ago and lasted nearly 4 billion years
Paleozoic era	the geological era that started 570 million years ago and lasted 346 million years
Mesozoic era	the geological era that started 225 million years ago and lasted 160 million years
Cenozoic era	the geological era of today that began 65 million years ago

Words to Know

uplifting and folding a geological process that bends layers of the Earth's crust and sometimes turns them upside down

radioactive dating a way to find the age of rocks by measuring the decay, or breaking down, of radioactive elements in them

Remember

Fossils are the remains of organisms that lived long ago.

Remember

Radioactive means "giving off radiation, or harmful rays."

Dating Rocks

The walls of the Grand Canyon have layers made up of many kinds of rock. Each layer is from a different period in the Earth's history. In a way, the striped walls of the Grand Canyon give a history of the area. Its rocks and fossils tell the story of our planet. Scientists date these rocks to learn about the Earth and its organisms.

Layers of rock are arranged by age. The lowest layer is usually the oldest. The top layer is usually the youngest. However, shifting of the Earth's crust can cause **uplifting and folding**. Uplifting and folding is a very slow geological process that bends layers of the Earth's crust and sometimes turns them upside down. Older rock layers may end up above younger ones.

Radioactive dating is a way to find the age of rocks by measuring the decay of radioactive elements in them. As a radioactive element decays, it slowly breaks down into other elements. Each element decays at a certain rate. By comparing the decay rates of certain radioactive elements in rocks, scientists can tell when the rocks formed. These elements act as geological clocks. The radioactive element uranium is often used to find the age of rocks.

✓ What does the arrangement of rock layers usually tell us about the age of rocks?

Fossils and the History of Life

Geologists can learn a lot about the Earth's history from fossils. For example, fossils show that the Earth's continents and climates have changed a great deal over time. Fossils of tropical plants have been discovered close to the Arctic Circle. The remains of woolly mammoths have been found in New York State. Woolly mammoths lived in very cold climates.

✓ **What do fossils tell geologists about climate?**

Lesson Review

1. How does uplifting and folding affect rock layers?
2. How does radioactive dating determine the age of rocks?
3. **CRITICAL THINKING** What would you think if you found a fish fossil in desert rock? Why?

On the Cutting Edge

GREENLAND ICE CORE PROJECT

Geologists can also learn about the past from the Earth's ice sheets. A huge ice sheet more than 1 mile (1.6 kilometers) thick covers Greenland. The ice built up over thousands of years and shows how the climate changed over that time. The ice also contains particles and gases from the ancient air that became trapped. So, each ice layer gives us clues to patterns of precipitation, gases in the air, and past volcanic eruptions.

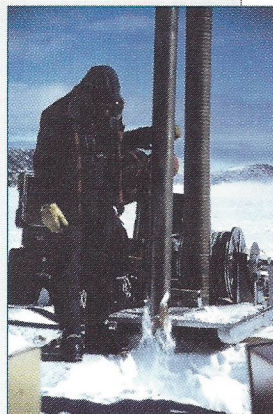
In 1993, an American team of scientists drilled a core 9,160 feet (2,792 meters) into the ice. Scientists are still studying the core. It contains a record of the Earth's history that goes back more than 110,000 years.

CRITICAL THINKING What might scientists find in an ice core that shows ancient volcanic eruptions?

Science Fact



Shark teeth fossils have been found on the tops of mountains. The shark teeth were lifted up when new mountains slowly formed out of parts of the ocean floor.



Scientists drilled holes in Greenland's ice to unlock its secrets.

Words to Know

geological era	a huge period of time in the Earth's history
Precambrian era	the geological era that started 4.5 billion years ago and lasted nearly 4 billion years
Paleozoic era	the geological era that started 570 million years ago and lasted 346 million years
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Remember

Extinct means "gone forever."

Scientists divide the history of the Earth into four main time periods. Each time period is called a **geological era**. A geological era is a huge period of time in the Earth's history. Each era has different kinds of fossils. The land and climate changed in each era. At the end of each era, many life forms suddenly became extinct.

The Precambrian Era

The **Precambrian era** started when the Earth formed. Most scientists think this happened about 4.5 billion years ago. The era lasted nearly 4 billion years. That is most of geological time. Every continent has Precambrian rocks. Some of the granite and marble used in building today is from the Precambrian era.

There are few fossils from this era. However, scientists have found signs of early plant life and bacteria. They have also found fossil mud tunnels made by worms.



How long did the Precambrian era last?

The Paleozoic Era

The **Paleozoic era** started about 570 million years ago. It lasted about 346 million years. The Paleozoic era is known as the Age of Invertebrates and Marine Life. There are a lot of fossils from this period. Scientists have found fossils of jellyfish, sponges, snails, seaweed, and ferns.

Many coal beds were formed in the Paleozoic era. Coal is made mostly from the remains of plants. This suggests that many plants grew during this era. The Earth must have been warm and wet. There must have been many swamps filled with giant ferns.

Near the end of the Paleozoic era, many mountain ranges formed. The Appalachian Mountains in the eastern United States are an example. As parts of the Earth's crust rose up from the sea, many swamps dried up. Many of the ferns died out.

✓ **Why do scientists call the Paleozoic era the Age of Invertebrates and Marine Life?**

The Mesozoic Era

The **Mesozoic era** began about 225 million years ago and lasted about 160 million years. It is known as the Age of Reptiles because there were so many reptiles during this era. Flowering plants replaced the ferns that died out at the end of the Paleozoic era.

The animals known as dinosaurs were reptiles. Many kinds of dinosaurs lived during the Mesozoic era. Some dinosaurs lived in the forests. Some lived in swamps. Others lived on the open plains. Some dinosaurs were as small as chickens. Others were as large as houses. Some dinosaurs ate only meat. Others ate just plants. Some dinosaurs traveled in herds, and most were able to move fast.

Remember

An invertebrate is an animal without a backbone.



Fossils show that ferns were common during parts of the Paleozoic era.

The Earth was very dry at the beginning of the Mesozoic era. There were many volcanoes erupting. Later in the era, the Sierra Nevada mountains and the Coast Ranges of California were pushed up. There were fruit trees, willow trees, grasses, and grains. Dinosaurs became extinct by the end of the Mesozoic era.

✓ What large group of reptiles became extinct by the end of the Mesozoic era?



Figure 25-1 Huge dinosaurs, such as the plant-eating Apatosaurus, lived during the Mesozoic era.

The Cenozoic Era

The **Cenozoic era** is the geological era of today. It began about 65 million years ago. This era is known as the Age of Mammals and Birds.

There have been several ice ages in the Cenozoic era. During each one, huge glaciers spread south from the Arctic Circle. The glaciers covered the northern parts of Europe, Asia, and North America. The ice was almost one mile (1.6 kilometers) thick in places. The last ice age ended about 12,000 years ago.

Humans first appeared late in the Cenozoic era. There is evidence of species with human features that dates back several million years. But these pre-humans were not as tall as humans today. Their brains were smaller. Their skulls were not as rounded as ours. They also did not walk as erect, or upright.

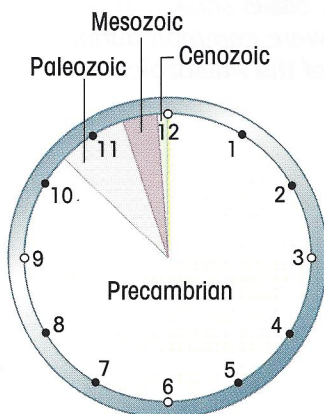


Figure 25-2 Suppose all the Earth's history was squeezed into 12 hours. This clock shows how much time each geological era would last.

The earliest fossil evidence of our species, called *Homo sapiens*, is between 100,000 and 120,000 years old. These early humans lived in Africa. By 40,000 years ago, *Homo sapiens* looked very much like humans do today. They had spread as far as Europe and Southeast Asia by that time.

✓ According to the fossil evidence, when did humans first appear?

The Future

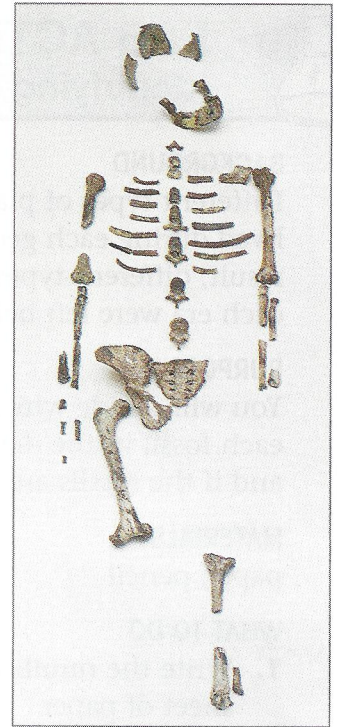
No one knows for sure what will happen with the geology of the Earth in the future. Some scientists think that the Earth will have another ice age. Others think that pollution will cause the atmosphere to heat up and melt the polar caps. One thing is certain. Things will not stay the way they are today.

For sure, the sun will eventually use up its fuel and die out. All stars do. Without the sun, there can be no life on Earth. Fortunately, there is no danger of the sun dying out in your lifetime or the lifetime of your children or grandchildren. In fact, it will probably be billions of years before the sun dies out.

✓ What do scientists think will happen to the Earth in the future?

Lesson Review

1. Which geological era started when the Earth formed?
2. During what era did most of the coal found today form?
3. What kinds of animals were found in great numbers during the Mesozoic era?
4. **CRITICAL THINKING** How would our knowledge of the Earth's history be different without fossils?



Scientists think this incomplete skeleton, nicknamed Lucy, is an early ancestor of modern humans.



LAB ACTIVITY

Identifying Fossils From Rock Layers

BACKGROUND

Different types of plants and animals lived during each geological era. As a result, different types of fossils from each era were left behind.

PURPOSE

You will decide which geological era each fossil in the diagram comes from and if the fossils are arranged by age.

MATERIALS

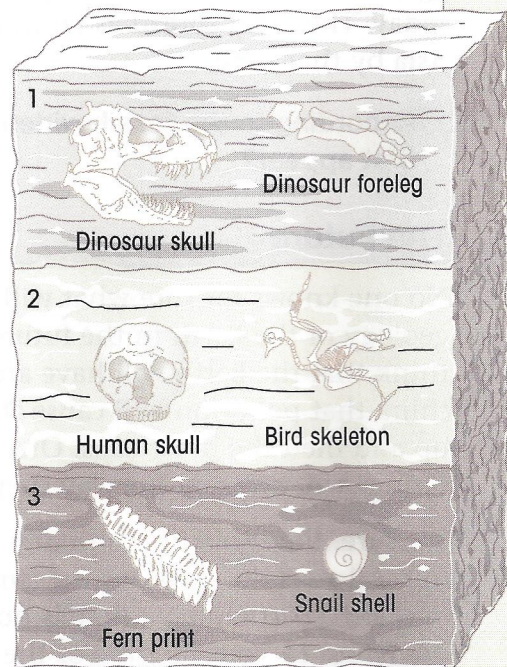
paper, pencil

WHAT TO DO

1. Write the numbers 1, 2, and 3 on a sheet of paper.
2. Identify the fossils in the diagram. Look at the first layer. Decide which animal or plant formed each fossil shown there. Write the name next to the number on your paper.
3. Use information from this chapter to decide in which geological era each animal or plant lived. Write the name of the era next to the layer's number on your paper.
4. Repeat Steps 2 and 3 for the next two layers.

DRAW CONCLUSIONS

- Notice the order of the layers. Are they correct from bottom to top? Explain your answer.
- Do you think any of these layers were folded and overturned? Explain your answer.
- What can you now say about identifying fossils from where they are found?



This diagram shows different fossils in different rock layers.

SCIENCE IN YOUR LIFE

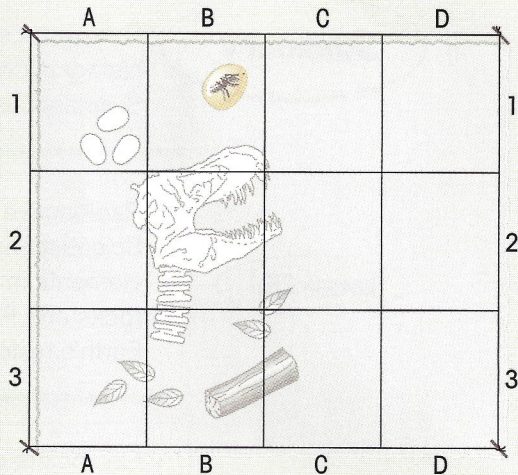
Going On Dino Digs

People who are interested in dinosaurs can go on digs with *paleontologists*. Paleontologists are scientists who use fossils to learn about life from the past, such as dinosaurs. Paleontologists explain to people on the dig how dinosaurs lived and how fossils formed. They teach the people how to look carefully for fossils. Then groups go out to the site and start digging as the paleontologists supervise their work.

A group of teenagers on a dig drew the grid to the right. It shows the area where they found fossils. The teens had to use drills to remove large pieces of rock that covered the fossils. Then they used small chisels, hammers, dental tools for scraping, and brushes to uncover the fossils.

Use the grid to answer these questions.

1. In which square did the teens find a dinosaur skull?
2. In which square should the teens dig to find the rest of the dinosaur—A2 or D1? Explain your answer.
3. In which square did the teens find an insect in hardened tree sap?
4. What objects do you think were found in square A1?



This grid shows where the teenagers found fossils.

Critical Thinking

Why is it more likely that the dinosaur shown in the grid lived in a forest rather than in a desert?

Summary

Geologists study rocks to determine their age. The Earth's history is divided into huge periods of time called eras. Scientists use rocks and fossils to learn about each era.

Lesson 25.1

Radioactive dating can determine the age of rocks. Scientists measure the rate of decay of radioactive elements in the rocks. This tells them how old certain rocks are. Fossils also provide scientists with clues to the Earth's history.

Lesson 25.2

Geologists divide the Earth's history into four eras. The Precambrian era is the longest era. Only the simplest life forms existed in this era. In the Paleozoic era, invertebrates and marine life were plentiful. Reptiles such as dinosaurs were common in the Mesozoic era. Humans appeared during the current era, the Cenozoic era.

Vocabulary Review

Write *true* or *false* for each sentence. If the sentence is false, replace the underlined term with another term to make the sentence true.

1. The geological era we live in is the Cenozoic era.
2. The Paleozoic era is known as the Age of Reptiles.
3. A process that sometimes turns layers of the Earth's crust upside down is called uplifting and folding.
4. A geological era is a small period of time in the Earth's history.
5. Dinosaurs lived during the Mesozoic era.
6. Radioactive dating is a way to find the age of rocks by measuring the decay of certain elements in them.
7. The Precambrian era lasted about 4 million years.

Chapter Quiz

Write your answers on a separate sheet of paper.

1. Why are the upper layers of rock in a canyon not always the youngest?
2. What happens to radioactive elements in rocks?
3. What is one important fact that fossils show geologists about the Earth's history?
4. Which are the four geological eras from earliest to most recent?
5. What major geological event started the Precambrian era?
6. In which era were dinosaurs common?
7. What happened to the Earth during the ice ages?
8. What kinds of animals became common in the era in which we live now?
9. According to fossil evidence, about how many years ago did *Homo sapiens* first appear?
10. What can you say for sure about the geology of the Earth in the future?

Test Tip

To practice for a test, make up questions for yourself as you read the chapter. When you finish your reading, try to answer the questions on your list.

Research Project

Research the work of a famous paleontologist such as Robert Bakker, Stephen Jay Gould, Jack Horner, Donald Johanson, Cathy Forster, or Paul Sereno. Find out what the scientist discovered and how it helped to build our knowledge of the Earth's history. Write a short report to present to the class. Include photos, maps, and drawings in your presentation.