Fossils (pp. 310–316)

This section explains what fossils are and how they form.

Use Target Reading Skills

As you preview the section headings and visuals, write what you know about the topic in the box What You Know. As you read the section, complete the What You Learned box.

<table>
<thead>
<tr>
<th>What You Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fossils come from ancient organisms.</td>
</tr>
<tr>
<td>2.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What You Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
</tbody>
</table>
A Trip Through Geologic Time • Guided Reading and Study

Fossils (continued)

Introduction (p. 310)

1. The preserved remains or traces of living things are called _____________________________.

2. List three things that scientists learn by studying fossils.
   a. _____________________________
   b. _____________________________
   c. _____________________________

How a Fossil Forms (pp. 310–313)

3. Is the following sentence true or false? Most fossils form when living things die and are buried by sediments. _____________________________

4. Is the following sentence true or false? Fossils are usually found in igneous rock. _____________________________

5. The type of rock that is made of hardened sediment is _____________________________.

6. Why do only the hard parts of organisms generally leave fossils? _____________________________.

7. Is the following sentence true or false? Fossils can form when the remains of an organism decay. _____________________________

8. Circle the letter of each sentence that is true about molds and casts.
   a. Both molds and casts copy the shape of ancient organisms.
   b. A mold forms when the hard part of an organism is buried in sediment.
   c. A cast is a hollow area in sediment in the shape of an organism.
   d. Molds and casts do not show details of the organism’s structure.

9. Fossils in which minerals replace all or part of an organism are called _____________________________.

10. Is the following sentence true or false? Petrified fossils can form when the minerals in water make a copy of the organism. _____________________________

11. What is a carbon film? _____________________________

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12. Is the following sentence true or false? A carbon film forms when minerals preserve the delicate parts of an organism.

13. Circle the letter of each trace fossil.
   a. footprints
   b. animal trails
   c. animal shells
   d. burrows

14. What can a scientist infer by looking at fossil footprints?

15. What are three ways that the remains of organisms have been preserved?
   a. 
   b. 
   c. 

Change Over Time (pp. 314–316)

16. Scientists who study fossils are called

17. Is the following sentence true or false? Paleontologists classify organisms based on the organisms' similarities and when they lived.

18. All the information that paleontologists have gathered about past life is called the

19. Circle the letter of each sentence that is true about the fossil record.
   a. It provides evidence for the history of life on Earth.
   b. It shows that organisms have changed over time.
   c. It reveals that complex organisms have given rise to simpler organisms.
   d. It provides evidence to support the theory of evolution.

20. Is the following sentence true or false? It is very difficult for scientists to learn about Earth's past environments by studying fossils.
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Fossils (continued)

21. Circle the letter of the environment in which coal can form.
   a. warm, shallow seas
   b. cold, icy regions
   c. warm, swampy regions
   d. cold ocean bottoms

22. What is a scientific theory?

23. The gradual change in living things over long periods of time is called

24. Is the following sentence true or false? The fossil record shows that millions of types of organisms have evolved

25. A type of organism that no longer exists and will never again live on Earth is

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The Relative Age of Rocks (pp. 317-321)

This section explains how scientists determine whether a rock is older or younger than other rocks.

Use Target Reading Skills

Complete the first column in the chart by previewing the red headings in this section in your textbook and asking a what or how question for each. As you read the section, complete the second column with the answers.

<table>
<thead>
<tr>
<th>Relative Age</th>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What does the position of rock layers reveal?</td>
<td>The position of rock layers shows ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Introduction (p. 317)

Match the term with its definition.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. relative age</td>
<td>a. The number of years since the rock formed</td>
</tr>
<tr>
<td>2. absolute age</td>
<td>b. The age of a rock compared to the ages of other rocks</td>
</tr>
</tbody>
</table>
The Relative Age of Rocks (continued)

The Position of Rock Layers (p. 318)
3. According to the law of superposition, the __________________________ layer is at the bottom. Each higher layer is __________________________ than the layers below it.

4. Is the following sentence true or false? The deeper one travels into the Grand Canyon, the younger the rocks become. __________________________

Determining Relative Age (pp. 319–320)
5. Complete the table below about the clues that geologists use to find the relative ages of rocks.

<table>
<thead>
<tr>
<th>Clues</th>
<th>How It Forms</th>
<th>What Clues Tell Geologists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrusion</td>
<td>a.</td>
<td>b.</td>
</tr>
<tr>
<td>Intrusion</td>
<td>c.</td>
<td>d.</td>
</tr>
<tr>
<td>Fault</td>
<td>e.</td>
<td>f.</td>
</tr>
</tbody>
</table>

6. g. A fault cuts through an extrusion. Which layer is the older? __________________________

What is an unconformity?

______________________________

______________________________

______________________________
A Trip Through Geologic Time: Guided Reading and Study

7. Look carefully at the figure "Unconformity" in your textbook. Then describe how an unconformity can form.

Using Fossils to Date Rocks (pp. 320–321)

8. Geologists use ____________ fossils to match rock layers in different locations.

9. Circle the letter of each sentence that is true about index fossils.
   a. Index fossils must be found in many different areas.
   b. Index fossils must represent an organism that lived for a very long time.
   c. Index fossils tell the absolute ages of the rock layers in which they occur.
   d. A type of ammonite that is different from other ammonites is a useful index fossil.
Radioactive Dating (pp. 323–326)

This section describes how scientists determine the age of fossils and rocks in years.

Use Target Reading Skills

As you read about radioactive dating, complete the graphic organizer by filling in the details.

Main Idea

Using radioactive dating, scientists can determine . . .

<table>
<thead>
<tr>
<th>Detail</th>
<th>Detail</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>b.</td>
<td>c.</td>
</tr>
</tbody>
</table>

Radioactive Decay (p. 324)

1. A type of matter in which all the atoms making up the matter are the same is called a(n) _______.

2. Is the following sentence true or false? All elements decay over time. _______

3. What occurs during radioactive decay? _______

4. Circle the letter of the kind of rock for which radioactive dating works well.
   a. sedimentary
   b. igneous
   c. metamorphic
   d. layered

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5. How do scientists use the rate at which radioactive elements decay in rocks?

6. Circle the letter of each sentence that is true about radioactive decay:
   a. Over time, the amount of a radioactive element in igneous rock will increase.
   b. The rate of decay of each radioactive element is always changing.
   c. The rate of radioactive decay is an element’s half-life.
   d. The half-life of a radioactive element is the time it takes for half of the radioactive atoms to decay.

Determining Absolute Ages (pp. 325–326)

7. Is the following sentence true or false? Geologists use radioactive dating to find the absolute ages of rocks.

8. What two things must scientists measure to find the absolute age of a rock?
   a.  
   b.  

9. Is the following sentence true or false? By comparing the amount of the radioactive element with the amount of the stable element, scientists can determine the absolute age of a rock.

10. Complete the table to compare two different types of radioactive dating.

<table>
<thead>
<tr>
<th>Elements Used in Radioactive Dating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Potassium-40</td>
</tr>
<tr>
<td>Carbon-14</td>
</tr>
</tbody>
</table>

g. Suppose a geologist wants to determine the absolute age of an igneous rock. Based on the rock’s place in the geologic record, the geologist thinks the rock might have formed about 400 million years ago. Would you use potassium-40 or carbon-14 to date the igneous rock? Explain your answer.
Radioactive Dating (continued)

11. Is the following sentence true or false? Carbon-14 can be used to date only organic materials that are less than about 50,000 years old. 

12. Is the following sentence true or false? Radioactive dating can be used only for igneous rocks, not sedimentary or metamorphic rocks. 

13. Can radioactive dating be used to date sedimentary rocks? Explain your answer.

14. How do scientists date sedimentary rock layers?
The Geologic Time Scale (pp. 327–329)

This section tells what the geologic time scale is and how it is used to show Earth's history.

Use Target Reading Skills.

As you read about the geologic time scale, fill in the flowchart to show the sequence of eras and periods.
A Trip Through Geologic Time • Guided Reading and Study

The Geologic Time Scale (continued)

Introduction (p. 327)

1. Complete the diagram by writing the events that would have occurred at each time if geologic time went by in a single day.

   One second before midnight
   e.

   d. ____________________________
      ____________________________

   12:01 A.M. a. ____________________________

   9:00 P.M. b. ____________________________

   7:00 A.M. c. ____________________________

   Noon

   7:00 A.M. — 9:00 P.M.

   9:00 P.M. — 9:00 P.M.

   6:00 P.M.

   9:00 P.M.

The Geologic Time Scale (pp. 327–328)

2. Is the following sentence true or false? Using months, years, and centuries is a very useful way of thinking about Earth's long history.

   ____________________________

3. What is the geologic time scale?

   ____________________________

   ____________________________

   ____________________________

Divisions of Geologic Time (p. 329)

4. The divisions of the geologic time scale depend on events in the history of ____________________________ on Earth.

5. Geologic time begins with a long span of time called ____________________________.

6. The basic units of the geologic time scale are a. ____________________________ and b. ____________________________.
A Trip Through Geologic Time: Guided Reading and Study

**Early Earth** (pp. 330–333)

This section explains when and how Earth formed, how its physical features developed, and what early life was like.

**Use Target Reading Skills**

As you read about the physical features of early Earth and later Precambrian Earth, fill in the graphic organizer below to compare and contrast the atmosphere, oceans, and continents that developed during each period of time.

**Precambrian Earth**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Early Earth</th>
<th>Later Precambrian Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere</td>
<td>a.</td>
<td>b.</td>
</tr>
<tr>
<td>Oceans</td>
<td>c.</td>
<td>d.</td>
</tr>
<tr>
<td>Continents</td>
<td>e.</td>
<td>f.</td>
</tr>
</tbody>
</table>

**The Planet Forms** (pp. 330–331)

1. What method did scientists use to determine the age of Earth?

2. Scientists hypothesize that Earth is about ____________ years old.

3. How did Earth begin?

4. Is the following sentence true or false? Earth once had an atmosphere composed mostly of hydrogen and helium. ____________
Early Earth (continued)

Earth’s Surface Forms (p. 332)

5. Earth’s atmosphere, oceans, and continents began to form during a period of Earth’s history called ________________________.

6. Circle the letter of each statement that is true.
   a. Water vapor in Earth’s early atmosphere came from volcanoes.
   b. Continents formed from heavy, dense material at Earth’s core.
   c. The movements of oceans caused landmasses to move.
   d. Oceans formed from rainwater that condensed from the atmosphere.

Life Develops (p. 333)

7. Circle the letter of the present-day organism to which the earliest life forms were probably most similar.
   a. bacteria
   b. plants
   c. sponges
   d. worms

8. Is the following statement true or false? The earliest life forms probably appeared about 3.5 billion years ago. ________________________
9. Complete the flowchart to show how Earth’s atmosphere, oceans, and development of life forms are related:


2. b. ____________ condenses and accumulates to form oceans.

3. Life appears in the c. ____________ and releases oxygen into the atmosphere.

4. Life forms release d. ____________ into the atmosphere.

5. The amount of oxygen in the atmosphere begins to e. ____________

f. If Step 3 had not occurred, how might that have affected Step 5?

__________________________
Eras of Earth’s History (pp. 334–345)

This section describes the major events in Earth’s geologic history and in the development of living things on Earth.

Use Target Reading Skills

Look at the figure Geologic History in your textbook, and in the graphic organizer below write three questions you have about the visual. As you read about Earth’s history, write the answers to your questions.

Earth’s History

Q. What geologic events happened during Precambrian Time?

A.

Q.

A.

Q.

A.

The Paleozoic Era (pp. 335–337)

1. What happened during the Cambrian Explosion?
A Trip Through Geologic Time  •  Guided Reading and Study

2. Complete this flowchart to show how living things evolved during the Paleozoic Era.

**The Paleozoic Era**

During the Silurian Period, simple a. ____________ began to grow on land in damp areas.

During the Devonian Period, b. ____________, animals that live part of their life on land and part of their life in water, evolved.

During the Carboniferous Period, c. ____________, which have scaly skin and lay eggs with tough, leathery shells, first developed.

At the end of the Paleozoic Era, d. ____________, occurred, which means that many types of living things died out at the same time.

e. How did the event in the first box help lead to animals’ moving from water to land?

3. Is the following sentence true or false? During the Cambrian Period, all animals lived in the sea. ____________________

4. An animal with a backbone is called a(n) ____________.

5. What were the first vertebrates to evolve? ____________________

6. What is a mass extinction? ____________________

7. What is one theory for the mass extinction at the end of the Paleozoic Era? ____________________

8. What happened to Earth’s continents during the Permian Period? ____________________
A Trip Through Geologic Time  •  Guided Reading and Study

Eras of Earth's History (continued)

9. Is the following sentence true or false? The formation of Pangaea caused the climate on Earth to change.  

The Mesozoic Era (pp. 342–343)

10. Circle the letter of the type of living thing that was most successful during the Mesozoic Era.
   a. insects  
   b. fish  
   c. conifers  
   d. reptiles

11. __________________, the first warmblooded vertebrates that fed their young with milk, appeared during the Triassic Period.

12. One of the first birds appeared in the __________________ Period of the Mesozoic Era.

13. Circle the letter of each sentence that is true about living things in the Cretaceous Period.
   a. Mammals continued evolving, even though dinosaurs dominated the land.
   b. Flying reptiles were better adapted to flying than birds.
   c. Turtles and crocodiles became extinct.
   d. Flowering plants evolved.

14. What is one hypothesis for the mass extinction at the end of the Cretaceous Period?

The Cenozoic Era (pp. 344–345)

15. Why didn't mammals evolve more during the Mesozoic Era?

16. Is the following sentence true or false? Whales and dolphins are all mammals that evolved in the oceans during the Tertiary Period.

17. How did Earth's climate change in the Quaternary Period?

Key Terms

Test your knowledge of key terms from the chapter by doing the crossword puzzle.

Clues across

1. Vertebrate that lives part of its life on land and part in water
4. Scientist who studies fossils
5. Animal without a backbone
8. Preserved remains or traces of living things
9. Vertebrate with scaly skin that lays eggs
10. Tiny particles of an element
11. Matter composed of a single kind of atom

Clues down

2. Hollow area in sediment in the shape of an organism
3. Type of organism that no longer exists on Earth
4. One of the units of geologic time into which eras are divided
6. Kind of age that compares a rock with other rocks
7. Kind of age of rock that is given in years