Name _____ Class _____ Date _____

CHAPTER 19 History of Life on Earth

SECTION 2

The Age of Earth

KEY IDEAS

As you read this section, keep these questions in mind:

- How is the fossil record used to learn about the history of life?
- How do paleontologists date fossils?
- What evidence was used to make the geologic time scale?

READING TOOLBOX

Compare After you read this section, make a chart comparing and contrasting relative dating and radiometric dating.

How Do Scientists Study Past Life?

How do scientists know what Earth was like in the past? One way is by studying *fossils*, or the traces of organisms that are preserved in rock or other materials. The figure below shows one way that a fossil can form.

Some fossils form when an organism dies and is buried in sediment before it decays. Over time, the organism's body dissolves and leaves an impression in the sediment. More sediment can fill the impression and solidify to form a fossil.

LOOKING CLOSER

1. Infer What do you think is the reason that most organisms do not become fossils?

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The **fossil record** is the history of life on Earth that is shown by fossils. By studying the fossil record, scientists can learn both where and when different organisms lived. Although the fossil record is not complete, it presents strong evidence that evolution has taken place. For example, fossils provide evidence of forms of life that suggest how living and extinct organisms are related. ☑

READING CHECK

2. Identify What are two things that a scientist can learn about organisms by studying the fossil record?

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How Do Scientists Learn the Ages of Fossils?

To use a fossil to learn about Earth's history, scientists must know how old the fossil is. One way to learn the age of a fossil is by using relative dating. **Relative dating** involves determining whether one rock or fossil is older or younger than another.

In many cases, a scientist can determine the relative age of a fossil by examining the rock in which it is found. In general, older rocks lie below younger rocks. Therefore, older fossils generally lie below younger fossils.

ABSOLUTE DATING

Relative dating can be used only to learn whether one fossil is older or younger than another. To determine the actual age of a fossil in years, scientists often use radiometric dating. In **radiometric dating**, scientists use isotopes to determine the actual age of a rock or fossil.

Some isotopes are unstable, or *radioactive*. These *parent isotopes* can break down into other isotopes called *daughter isotopes*. Each parent isotope breaks down at a specific rate that does not change. The time it takes for one-half of a sample of the parent isotope to break down is called its **half-life**.

As the parent isotope breaks down, it forms the daughter isotope at a constant rate. Therefore, scientists can compare amounts of parent and daughter isotopes in a material as one method of learning its age.

How Do Scientists Describe Geologic Time?

Earth is more than 4.5 billion years old. To describe Earth's history, scientists use the **geologic time scale**. It is based on evidence from the fossil record and from rock layers around the world.

In the geologic time scale, Earth's history is divided into different segments of time. The divisions between many of these segments are based on **mass extinctions**, or times when many different species became extinct.

The Geologic Time Scale

Era	Period	When the period began (millions of years ago)
Cenozoic	Quaternary	1.8
	Tertiary	65.5
Mass extinction		
Mesozoic	Cretaceous	146
	Jurassic	200
	Triassic	251
Mass extinction		
Paleozoic	Permian	299
	Carboniferous	359
	Devonian	416
	Silurian	444
	Ordovician	488
	Cambrian	542
Mass extinction		
Precambrian time (not an era)		more than 4,500

Background

Recall that *isotopes* are atoms of the same element that have different numbers of neutrons.

Critical Thinking

3. Infer If parent isotopes decayed randomly instead of at a constant rate, could they be used to determine the ages of rocks and fossils? Explain your answer.

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LOOKING CLOSER

4. Identify Name the three eras in the geologic time scale.

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Section 2 Review

SECTION VOCABULARY

fossil record the history of life in the geologic past as indicated by the traces or remains of living things

geologic time scale the standard method used to divide Earth's long natural history into manageable parts

half-life the time required for half of a sample of a radioactive isotope to break down by radioactive decay to form a daughter isotope

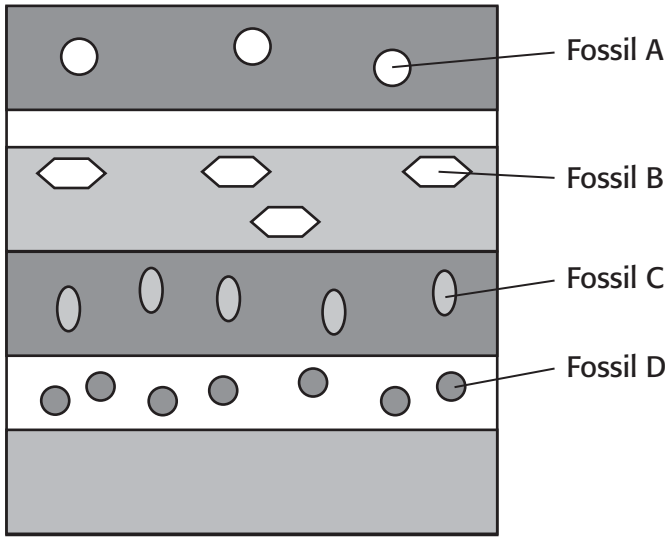
mass extinction an episode during which large numbers of species become extinct

radiometric dating a method of determining the absolute age of an object, often by comparing the relative percentages of a radioactive (parent) isotope and a stable (daughter) isotope

relative dating a method of determining whether an event or object, such as a fossil, is older or younger than other events or objects without referring to the object's age in years

1. **Describe** How does the fossil record provide evidence that evolution has occurred?

2. **Apply Concepts** The diagram below shows several rock layers that contain fossils. Which fossil is probably the oldest? Which fossil is probably the youngest?



3. **Identify Relationships** How is the fossil record related to the geologic time scale?