

# Earth's Story and Those Who First Listened

## BEFORE YOU READ

**After you read this section, you should be able to answer these questions:**

- How fast do changes on Earth happen?
- What is paleontology?

## National Science Education Standards

ES 2a, 2b

## How Fast Do Changes on Earth Happen?

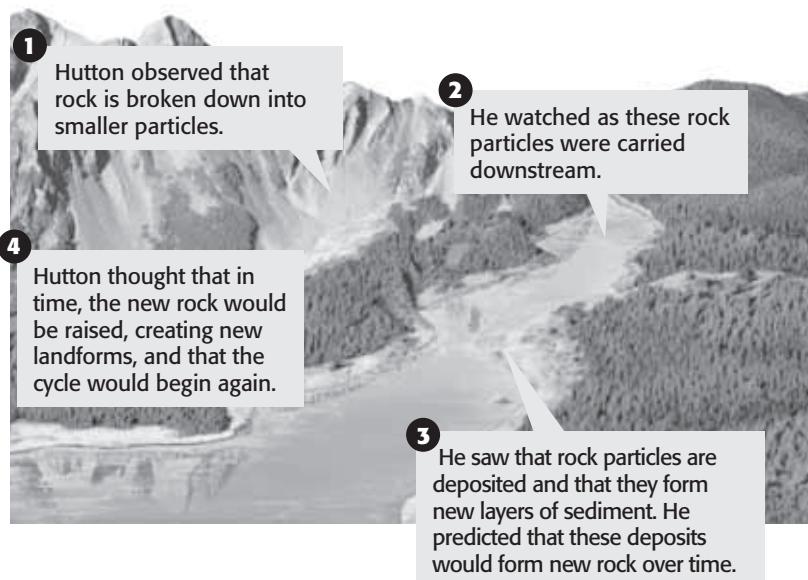
Earth has not always looked the way it does today. Our planet is slowly changing all the time. Through history, many people have studied these changes. Many different ideas have been put forward to explain how Earth changes with time.

Until about 200 years ago, most people believed that Earth changes because of sudden events, such as floods. The belief that Earth changes only because of sudden events is called **catastrophism**. However, scientists soon realized that catastrophism could not explain all of their observations about the things that happen on Earth.

James Hutton was one of the scientists who first realized that geologic changes can happen very slowly. Hutton observed the processes that were happening around him. He hypothesized that the same processes have been happening for all of the Earth's history. The figure below shows some examples of these processes.

### STUDY TIP

**Graphic Organizer** As you read this section, make a table comparing catastrophism, uniformitarianism, and modern ideas about how the Earth changes.



## TAKE A LOOK

1. **Describe** What did Hutton predict would form new rock over time?
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**SECTION 1** Earth's Story and Those Who First Listened *continued***UNIFORMITARIANISM**

James Hutton reasoned that the slow processes that shape Earth now have been the same through all of Earth's history. Over a very long time, these processes have added up to form the features we see on Earth today. The theory that the Earth's features form only because of small changes over long periods of time is called **uniformitarianism**.

**TAKE A LOOK**

- 2. Identify** Fill in the blank spaces in the table to show how catastrophism is different from uniformitarianism.

Catastrophism	
Uniformitarianism	

Hutton published his ideas in the late 1700s, but they were not accepted by most scientists at that time. However, in the early 1800s, a scientist named Charles Lyell reintroduced the idea of uniformitarianism. Lyell provided more evidence to support uniformitarianism. His work helped to convince many scientists that uniformitarianism was valid.

By the mid-1800s, many scientists had accepted that uniformitarianism can explain many of the Earth's features. However, they also saw that sudden events can change Earth's surface. For example, large storms can cause the Earth's surface to change very quickly. These observations helped scientists realize that not all changes on Earth happen slowly.

**SLOW CHANGES AND SUDDEN EVENTS**

Today, scientists understand that neither catastrophism nor uniformitarianism is completely correct. They know that most geologic change is slow, but sudden changes happen sometimes. 

Sudden changes can have short-term or long-term effects. The wind from a hurricane affects only a small part of Earth for a short time. However, the impact of a comet on Earth may put clouds of dust into the atmosphere. These clouds may decrease the temperature everywhere on Earth for many years.

 **READING CHECK**

- 3. Explain** According to scientists today, how fast do changes on Earth happen?
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**SECTION 1** Earth's Story and Those Who First Listened *continued***How Do Scientists Study Earth's Past?**

Scientists can use fossils to learn about what Earth was like in the past. A *fossil* is any evidence of past life. Some fossils are made from the remains, such as shells, of dead organisms. Other fossils are simply signs, such as footprints, that an organism once existed. The study of fossils and ancient life is called **paleontology**. The root *paleo* means "old." The root *onto* means "life."

Scientists who study paleontology are called *paleontologists*. Different paleontologists study different certain kinds of organisms. For example, *vertebrate paleontologists* study the remains of *vertebrates*, or animals with backbones. *Paleobotanists* study fossils of ancient plants.

Fossils provide evidence that life on Earth has changed with time. Different organisms have appeared and disappeared throughout Earth's history. For example, fossils show that dinosaurs once lived on Earth, even though none are alive today.



Fossils of dinosaurs have been found in many places on Earth. However, no dinosaurs are alive today. The fossils show that the kinds of life on Earth have changed over time.

Fossils also provide evidence of how Earth has changed over time. For example, there are fossils of sea life from millions of years ago in deserts and on the tops of mountains. The fossils show that some areas that are now deserts or mountains were once parts of an ocean.

**Critical Thinking**

- 4. Infer** Paleobotanists study the remains of ancient plants. What do botanists most likely study?
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**STANDARDS CHECK**

**ES 2b** Fossils provide important evidence of how life and environmental conditions have changed.

**Word Help:** evidence  
information showing whether an idea or belief is true or valid

**Word Help:** environment  
the surrounding natural conditions that affect an organism

- 5. Explain** What are two things that paleontologists can learn from fossils?
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# Section 1 Review

NSES ES 2a, 2b

## SECTION VOCABULARY

**catastrophism** a principle that states that geologic change occurs suddenly  
**paleontology** the scientific study of fossils

**uniformitarianism** a principle that geologic processes that occurred in the past can be explained by current geologic processes

- 1. Identify** How can sudden events affect Earth?

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- 2. Describe** What were two processes that James Hutton observed that helped him develop the idea of uniformitarianism?

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- 3. Define** What is a fossil?

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- 4. Describe** One kind of fossil forms from the body parts of organisms. What is another kind of fossil?

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- 5. Apply Concepts** Imagine that you find a layer of rock containing many fossil clams. The layer of rock is 50 km from the ocean. The fossils are about 5 million years old. Clams usually live in shallow ocean water. Based on the fossils, what can you guess about the environment in this area 5 million years ago? Explain your answer.

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- 3.** Burning coal contributes to acid precipitation. Surface mining of coal removes soil and can destroy habitats. Petroleum spills can poison the oceans. Burning petroleum contributes to smog. Natural gas is highly flammable.

### **SECTION 3 ALTERNATIVE RESOURCES**

- 1.** fission and fusion
- 2.** barium-142 and krypton-91
- 3.** Nuclear energy does not cause air pollution.
- 4.** two protons and two neutrons
- 5.** People haven't figured out how to control fusion reactions on Earth.
- 6.** Many windmills can get more energy from the wind than just one or two can.
- 7.** Windmills take up a lot of space.
- 8.** Fuel cells produce electricity, and water is the waste product.
- 9.** renewable, nonpolluting, inexpensive
- 10.** Habitats might be destroyed or species might become extinct.
- 11.** The hot water can be used to create electricity and heat buildings.
- 12.** Arrows follow the path of the numbered steps.

#### **Review**

- 1.** The sun cannot be used up.
- 2.** Because biomass grows back very quickly, it can be replaced. However, if people use biomass more quickly than it can grow back, it is no longer considered renewable.
- 3.** Geothermal energy is useful only if hot rock is near the surface. The city near the volcano is more likely to have hot rock near the surface, so it is more likely to be able to use geothermal energy.
- 4.** Wind energy is useful only in places that have strong, regular winds. Also, wind energy collection requires large areas of empty land for the windmills, so it is usually not usable in cities or other crowded areas.
- 5.** Answers will vary. Students should show an understanding of the requirements of their chosen kind of energy (e.g., a student living in the desert should not choose hydroelectric power).

## **Chapter 6 The Rock and Fossil Record**

### **SECTION 1 EARTH'S STORY AND THOSE WHO FIRST LISTENED**

- 1.** deposits of sediment
- 2.** Catastrophism: Earth changes only because of sudden events.  
Uniformitarianism: Earth changes only because of slow processes over time.
- 3.** Some changes on Earth happen quickly, but most happen slowly.
- 4.** plants
- 5.** Fossils can show how environments and life on Earth have changed with time.

#### **Review**

- 1.** Sudden processes can cause large changes or small changes. The changes can be long-term or short-term. For example, a hurricane can affect a small part of Earth for a few days. A comet impact on Earth could cause Earth's climate to change significantly.
- 2.** Rocks are broken down into smaller pieces. The pieces are carried over the Earth's surface and deposited in layers.
- 3.** A fossil is evidence that life once existed in a place.
- 4.** Some fossils are signs, such as footprints, that organisms once existed.
- 5.** Because the clams lived in shallow ocean water, the rock in which the fossils were found must have been part of a shallow ocean 5 million years ago. This probably means that the ocean in this area once reached much farther inland than it does today.

### **SECTION 2 RELATIVE DATING: WHICH CAME FIRST?**

- 1.** determining the age of a rock relative to other rocks
- 2.** superposition
- 3.** They combine information from rock sequences around the world.
- 4.** They are not horizontal.
- 5.** Folded rocks are bent or buckled. The shape of the rock layers has changed. Tilted rocks are simply moved so that they are no longer horizontal.
- 6.** igneous rock
- 7.** a break in Earth's crust