10.1 Early Ideas About Evolution

VOCABULARY

evolution
species
fossil
catastrophism
gradualism
uniformitarianism

KEY CONCEPT **There were theories of biological and geologic change before Darwin.**

MAIN IDEAS

- Early scientists proposed ideas about evolution.
- Theories of geologic change set the stage for Darwin's theory.

Connect to Your World

Why are there so many kinds of living things, such as the strange looking star-nosed mole? Earth is home to millions of species, from bacteria to plants to ocean organisms, that look like something from science fiction. The search for reasons for Earth's great biological diversity was aided in the 1800s, when Charles Darwin proposed his theory of evolution by natural selection. But long before Darwin, evolution had been the focus of talk among scholars.

READING TOOLBOX

TAKING NOTES

Create a chart with a column for each scientist mentioned in this section and a second column for his contribution to evolutionary theory.

Scientist	Contribution
Linnaeus	
Buffon	

MAIN IDEA

Early scientists proposed ideas about evolution.

Although Darwin rightly deserves much of the credit for evolutionary theory as we know it today, he was not the first person to come up with the idea. **Evolution** is the process of biological change by which descendants come to differ from their ancestors. This concept had been discussed for more than 100 years when Darwin proposed his theory of the way evolution works. Today, evolution is a central theme in all fields of biology.

The 1700s were a time of great advances in intellectual thought. Many fields of science came out with new ways of looking at the world. Four scientists in particular are important. They not only made valuable contributions to biology in general, but they also laid the foundations upon which Darwin would later build his ideas. **FIGURE 1.1** highlights the work of some of these early scientists.

Carolus Linnaeus In the 1700s, the Swedish botanist Carolus Linnaeus developed a classification system for all types of organisms known at the time. Although Linnaeus used his system to group organisms by their similarities, the system also reflects evolutionary relationships. This system is still in use by scientists today. Years into his career, Linnaeus abandoned the common belief of the time that organisms were fixed and did not change. He proposed instead that some might have arisen through hybridization—a crossing that he could observe through experiments with varieties, or species, of plants. A **species** is a group of organisms so similar to one another that they can reproduce and have fertile offspring.

Georges Louis Leclerc de Buffon Buffon, a French naturalist of the 1700s, challenged many of the accepted ideas of the day. Based on evidence of past life on Earth, he proposed that species shared ancestors instead of arising separately. Buffon also rejected the common idea of the time that Earth was only 6000 years old. He suggested that it was much older. This argument was similar to that of Charles Lyell, a geologist whose work helped inspire Darwin's writings. You will read more about Lyell later in this section.

Erasmus Darwin Born in 1731, Charles Darwin's grandfather was a respected English doctor and a poet. He proposed that all living things were descended from a common ancestor and that more-complex forms of life arose from less-complex forms. This idea was expanded upon 65 years later by his grandson.

Jean-Baptiste Lamarck In 1809, the year of Darwin's birth, a French naturalist named Lamarck proposed that all organisms evolved toward perfection and complexity. Like other scientists of the time, he did not think that species became extinct. Instead, he reasoned that they must have evolved into different forms.

Lamarck proposed that changes in an environment caused an organism's behavior to change, leading to greater use or disuse of a structure or organ. The structure would become larger or smaller as a result. The organism would pass on these changes to its offspring. For example, Lamarck thought that the long necks of giraffes evolved as generations of giraffes reached for leaves higher in the trees. Lamarck's idea is known as the inheritance of acquired characteristics.

CONNECT TO

SCIENTIFIC PROCESS

Recall from **Biology in the 21st Century** that in every scientific field, knowledge is built upon evidence gathered by earlier scientists.

FIGURE 1.1 Early Naturalists

Evolutionary thought, like all scientific inquiry, draws heavily upon its history. The published works of these scientists contributed important ideas prior to Darwin's theory.

1735 *Systema Naturae*	1749 *Histoire Naturelle*	1794–1796 *Zoonomia*	1809 *Philosophie Zoologique*
Carolus Linnaeus proposed a new system of organization for plants, animals, and minerals, based upon their similarities.	**Georges Buffon** discussed important ideas about relationships among organisms, sources of biological variation, and the possibility of evolution.	**Erasmus Darwin** considered how organisms could evolve through mechanisms such as competition.	**Jean-Baptiste Lamarck** presented evolution as occurring due to environmental change over long periods of time.
			

Summarize **Explain why Darwin cannot be considered the first scientist to consider evolution.**

Lamarck did not propose how traits were passed on to offspring, and his explanation of how organisms evolve was flawed. However, Darwin was influenced by Lamarck's idea that changes in physical characteristics could be inherited and were driven by environmental changes over time.

Compare **What common idea about organisms did these scientists share?**

MAIN IDEA

Theories of geologic change set the stage for Darwin's theory.

The age of Earth was a key issue in the early debates over evolution. The common view was that Earth was created about 6000 years earlier, and that since that time, neither Earth nor the species that lived on it had changed.

French zoologist Georges Cuvier did not think that species could change. However, he did think that they could become extinct, an idea considered radical by many of his peers. Cuvier had observed that each stratum, or rock layer, held its own specific type of fossils. **Fossils** are traces of organisms that existed in the past. He found that the fossils in the deepest layers were quite different from those in the upper layers, which were formed by more recent deposits of sediment. Cuvier explained his observations in the early 1800s with the theory now known as catastrophism, shown in **FIGURE 1.2.**

CONNECT TO

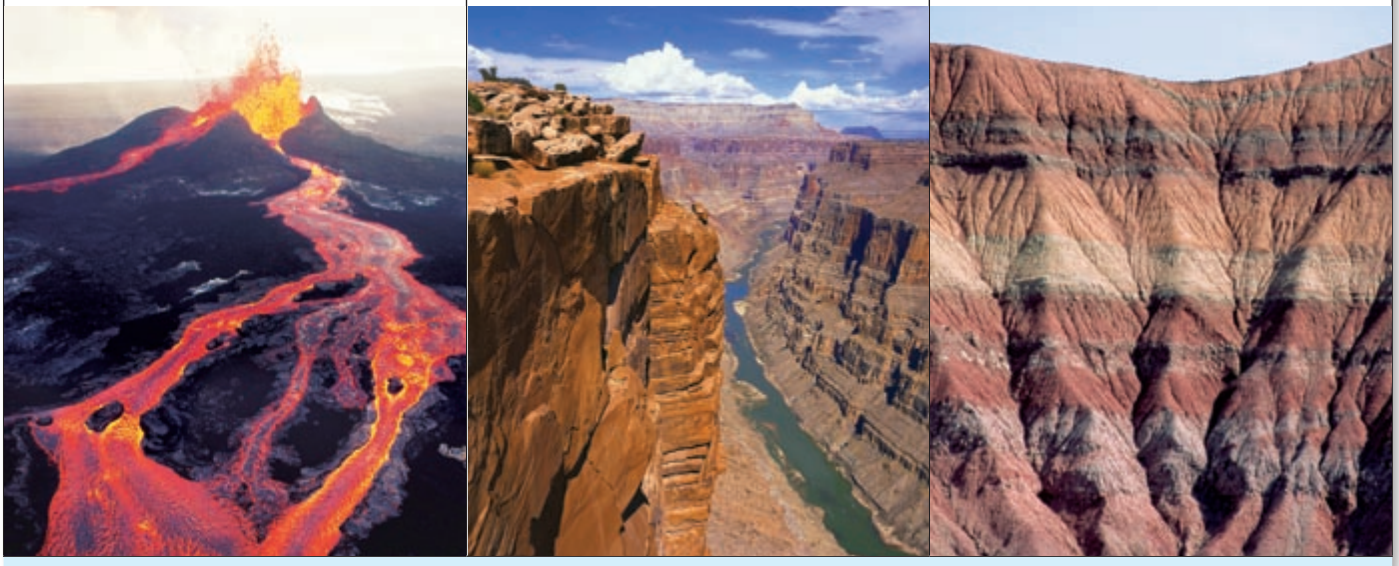
EARTH SCIENCE

Cuvier based his thinking on what we know as the Law of Superposition. It states that in a sequence of layered rocks, a given layer was deposited before any layer above it.

FIGURE 1.2 Principles of Geologic Change

Ideas from geology played a role in Darwin's developing theory.

CATASTROPHISM	GRADUALISM	UNIFORMITARIANISM
Volcanoes, floods, and earthquakes are examples of catastrophic events that were once believed responsible for mass extinctions and the formation of all landforms.	Canyons carved by rivers show gradual change. Gradualism is the idea that changes on Earth occurred by small steps over long periods of time.	Rock strata demonstrate that geologic processes, which are still occurring today, add up over long periods of time to cause great change.



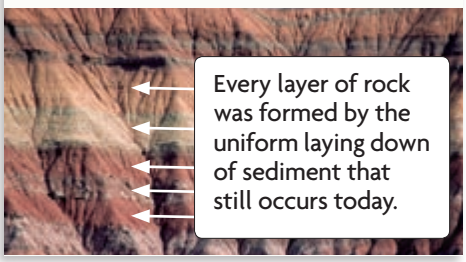
Compare and Contrast **How are these three theories similar, and what are their differences?**

The theory of **catastrophism** (kuh-TAS-truh-FIHZ-uhm) states that natural disasters such as floods and volcanic eruptions have happened often during Earth's long history. These events shaped landforms and caused species to become extinct in the process. Cuvier argued that the appearance of new species in each rock layer resulted from other species' moving into the area from elsewhere after each catastrophic event.

In the late 1700s, the Scottish geologist James Hutton proposed that the changes he observed in landforms resulted from slow changes over a long period of time, a principle that became known as **gradualism** (GRAJ-oo-uh-LIHZ-uhm). He argued that the laying down of soil or the creation of canyons by rivers cutting through rock were not the result of large-scale events. He believed, rather, that they resulted from slow processes that had happened in the past. This idea has become so important to evolution that today the term gradualism is often used to mean the gradual change of a species through evolution.

VISUAL VOCAB

Uniformitarianism proposes that present geologic processes are the key to the past.



One of the leading supporters of the argument for an ancient Earth was the English geologist Charles Lyell. In *Principles of Geology,* published in the 1830s, Lyell expanded Hutton's theory of gradualism into the theory of **uniformitarianism** (YOO-nuh-FAWR-mih-TAIR-ee-uh-NIHZ-uhm). This theory states that the geologic processes that shape Earth are uniform through time. Lyell observed processes that made small changes in Earth's features. He inferred that similar changes had happened in the past. Uniformitarianism combines Hutton's idea of gradual change over time with Lyell's observations that such changes have occurred at a constant rate and are ongoing. Uniformitarianism soon replaced catastrophism as the favored theory of geologic change. Lyell's theory greatly affected the scientific community—particularly a young English naturalist named Charles Darwin.

Compare **What important concepts about Earth did Hutton and Lyell agree upon?**

READING TOOLBOX

VOCABULARY

The names of these geologic theories can be broken down into familiar words.

- *Catastrophe* means "sudden disaster."
- *Gradual* means "moving or changing slowly."
- *Uniform* means "always staying the same."

CONNECT TO

SCIENTIFIC PROCESS

Recall from **Biology in the 21st Century** that in science, the term theory describes a well-supported explanation that incorporates observations, inferences, and tested hypotheses.

10.1 Formative Assessment

SELF-CHECK Online
HMDScience.com
PREMIUM CONTENT

REVIEWING MAIN IDEAS

1. Briefly describe two ideas about **evolution** that were proposed by scientists in the 18th century.
2. What ideas in Lyell's theory of **uniformitarianism** were important for evolutionary theory?

CRITICAL THINKING

3. **Contrast** What are the key differences between the theories of **gradualism** and **catastrophism**?
4. **Apply** Why are the ideas that Earth undergoes change and is billions of years old important for evolutionary theory?

CONNECT TO

GENETICS

5. How can you use the concept of genetic inheritance to disprove Lamarck's idea of the inheritance of acquired characteristics?