

## Lesson 20 The Fossil Record

**You will learn that scientists have established a fossil record that reveals that evolution can proceed slowly with gradual changes or in spurts with sudden changes. You will also learn that some organisms represent “living fossils” because they look very much like their ancestors that lived long ago.**

The **fossil record** is a timeline that shows how life has evolved on Earth. It is organized according to the age of fossils and their similarities.

**Gradualism** is the process of evolution in which a species changes very slowly over a very long period.

**Punctuated equilibrium** is the process of evolution where a species experiences little or no change for long periods, followed by a sudden change.

A **living fossil** is a species that shows little or no change since its ancestor first appeared on Earth.



### GUIDED INSTRUCTION

---

**DIRECTIONS** Read the following information and answer the questions.

Suppose you wanted to create a picture of life on Earth long ago. You couldn't go back and visit that time, so how would you know what to draw? Scientists have been faced with that same dilemma for a long time. They use the evidence they can gather to infer what life was like during Earth's past. Much of that evidence comes from fossils. As a whole, this evidence is known as the **fossil record**, which is a timeline that is organized according to the age and similarities of fossils. The fossils can be preserved organisms, such as insects preserved in amber. In addition, a fossil can be part of an organism, such as a bone, or it might be some proof that it once existed. Such proof can be a mold or cast. A mold is an imprint usually found in rock. A mold is formed when a dead organism leaves an impression in sediments that slowly harden into rock. The organism decays, leaving only the impression as a record of its existence. A fossil can also be a cast. A cast forms when a mold fills with hard minerals that slowly form a rock-like model of the organism.

To construct the fossil record, scientists must determine the age of a fossil. This dating process can be done in two ways. One way involves finding the relative age of a fossil. A relative age only indicates which of two fossils is older. For example, a girl would be indicating relative age by saying that she is older than her brother. Scientists determine the relative age of a fossil by comparing the layer of rock in which the fossil is found to the layers that contain

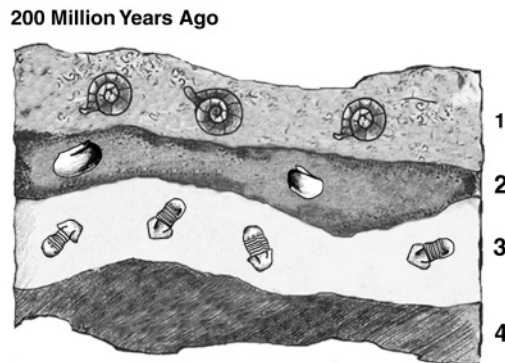
### Guided Questions

Name four types of fossils that make up the **fossil record**.

---

---

other fossils. Fossils in the same rock layer are of the same approximate age. Successive layers of sediment are deposited on top of one another to form rock layers. Therefore, the higher the rock layer in which a fossil is found, the younger the fossil. The illustration below shows fossils in different rock layers.

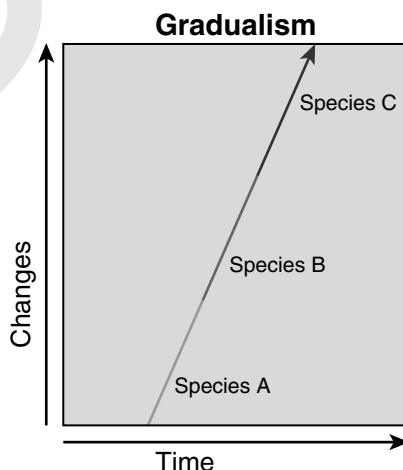


A second method of dating fossils involves finding absolute age. A girl might indicate absolute ages by saying she is 15 years old and her brother is 9 years old. Notice that absolute ages tell an exact age but can also indicate a relative age. In this case, the girl is 15 years old, but she is also six years older than her brother.

Scientists determine the absolute age of fossils by measuring their radioactivity. When scientists measure radioactive materials, such as rocks and fossils, they measure the changes in the atoms that make up the materials. Over time as the atoms change, the materials become less radioactive. Because radioactive materials change at a known, constant rate, scientists can determine the absolute age of a fossil.

Using dating methods, scientists have pieced together the fossil record. The fossil record shows that evolution can be an extremely slow process. Scientists call this slow process gradualism.

**Gradualism** states that a species changes very slowly over a very long time. The species may change so much that it no longer is considered the same species. As the species slowly changes, it leaves a fossil record of its evolutionary history. The graph below illustrates the process of gradualism.



### Guided Questions

In which layer are the oldest fossils found?

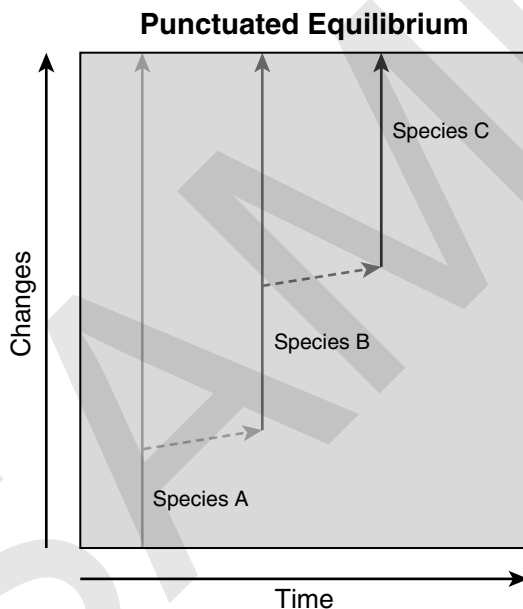
In which layer are the youngest fossils found?

How does the absolute age of a fossil differ from its relative age?

Define **gradualism**.

Notice that the changes occurring in a species are shown as a line that gradually slopes upward. According to this graph, Species A gradually evolves into Species B, which gradually evolves into Species C. The evolution of the modern horse is often used as an example of gradualism. The fossil record for the evolution of the modern horse consists of the skeletons of various ancestral species. An ancestral species is an early form of the organism from which the later species developed. These fossil skeletons can be arranged in a timeline to show how the horse gradually evolved from a much smaller ancestor that lived some 60 million years ago.

The fossil record is also used as evidence that evolution does not always happen slowly, as in gradualism. Rather, evolution can occur in sudden spurts. This process of evolution is called **punctuated equilibrium**. In the punctuated equilibrium model, a species remains unchanged for long periods. This period of little or no change is known as stasis. A species may then suddenly undergo a change that occurs rather rapidly. Keep in mind that even a sudden change in evolution refers to a period that can span many millions of years. The graph below illustrates the process of punctuated equilibrium.



Notice that each species exhibits little change for a long period. Then the species experiences sudden changes that result in the evolution of a new species. Consequently, Species B and Species C appear rather suddenly in evolutionary history. In other words, there is no gradual transition from one species to the new one, as proposed by gradualism.

Punctuated equilibrium was first suggested to explain “gaps” that exist in the fossil record. Unlike the fossil record for horses, the fossil record for many organisms does not include intermediate forms that show gradual changes over time. At first, scientists thought that the lack of intermediate forms were simply “gaps”

### Guided Questions

Why would **gradualism** produce a **fossil record** with intermediate forms?

---



---



---

What is **punctuated equilibrium**?

---



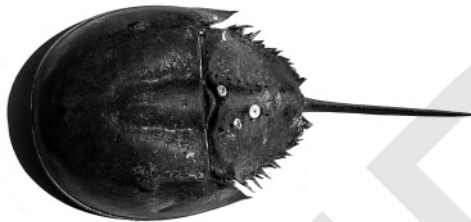
---



---

that represented fossils that remained to be discovered. However, scientists later proposed that these “gaps” show what actually happened. In many cases, there were no intermediate forms to be found in the fossil record. Rather, evolution can occur as a result of punctuated equilibrium where sudden changes result in a new species. Consequently, there would not be any intermediate forms that would leave a fossil record.

Besides revealing how evolution occurs, the fossil record also reveals something most unusual about the evolutionary history of some species. These species are known as living fossils. A **living fossil** is a species whose fossil record reveals little or no change since its ancestor first appeared on Earth. An example is the horseshoe crab, which is shown below. This species looks very much like its ancestor did more than 500 million years ago!



### Guided Questions

Why is the evolution of the horse not an example of **punctuated equilibrium**?

---



---



---



---

### SHORT-ANSWER QUESTIONS

**DIRECTIONS** Answer the following questions.

1. A student decides to bake a cake to illustrate two types of fossils found in the fossil record. Explain what this student is trying to demonstrate.

---



---



---

2. Describe how relative dates of fossils are determined.

---



---



---

3. Besides relative dating, how can scientists determine the age of fossils?

---

4. What is a living fossil?

---



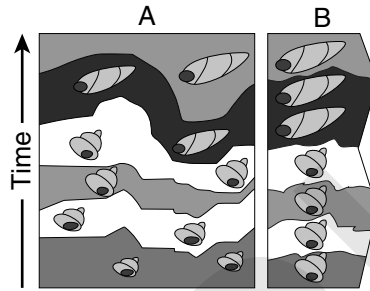
---



## APPLY THE TEKS

**DIRECTIONS** Read the paragraph, study the diagram, and answer the questions.

The fossil record provides evidence to suggest that the process of evolution does not occur in only one way. The illustration below shows how a species can evolve over time. Notice that the fossils are found in different rock layers.



1. In which layer are the oldest fossils found in A?

---

2. In which layer are the oldest fossils found in B?

---

3. What process is illustrated in A?

---

4. What process is illustrated in B?

---

5. What is found in the fossil record in A but not in the fossil record in B?

---



---

6. Does either A or B illustrate a living fossil? Explain your answer.

---



---

 STAAR PRACTICE

**DIRECTIONS** Read each question and choose the best answer.  
Then circle the letter for the correct answer.

- 1 Bryozoans are coral-like sea animals. These organisms first appeared in the fossil record about 140 million years ago and remained relatively unchanged for 40 million years. Then they experienced a great diversification. Which process does this illustrate?
  - A Gradualism
  - B Extinction
  - C Fossil formation
  - D Punctuated equilibrium
- 2 The cockroach is the oldest winged insect in the world. This insect is almost identical to the way it was some 350 million years ago. Therefore, the cockroach is an example of a(n) —
  - A intermediate fossil
  - B living fossil
  - C cast fossil
  - D mold fossil
- 3 Which statement describes the absolute dating of fossils?
  - A Fossil A was found in two layers of rock beneath Fossil B.
  - B Fossil A was determined to be older than Fossil B.
  - C Fossil A represents a living fossil.
  - D Fossil A was formed 45,000 years ago.
- 4 Which term applies to a period in evolutionary history when a species shows little or no change?
  - A Stasis
  - B Gradualism
  - C Fossil record
  - D Formation of a new species
- 5 Much of the High Plains and Texas Coastal Plains are covered by rocks formed from sediments that had been washed down from the Rocky Mountains. Which is most likely to be found in these areas of Texas?
  - A Living fossils
  - B Evidence of gradualism
  - C A fossil record
  - D Evidence of punctuated equilibrium



## CUMULATIVE REVIEW

**DIRECTIONS** Read each question and choose the best answer.  
Then circle the letter for the correct answer.

- 1 According to punctuated equilibrium, sudden changes can occur in a species. Which process is most likely responsible for these sudden changes in appearance?
- A Homeostasis
  - B Replication
  - C Mitosis
  - D Mutations
- 2 Which of the following is not supported by the fossil record?
- A Universality of the genetic code
  - B Evolution
  - C Gradualism
  - D Punctuated equilibrium
- 3 Assume that a fossil record reveals that a species evolves into a different species that is much more complex. Which process definitely played an important role in the development of this more complex species?
- A Stasis
  - B Punctuated equilibrium
  - C Cell specialization
  - D Gradualism
- 4 In 2010, scientists discovered a bone that was dated as being 40,000 years old. The bone came from a child and contained cells from which the scientists were able to extract fragments of the genetic code. Where would these fragments be found in this bone?
- A In the RNA
  - B In the proteins
  - C In the DNA
  - D In the lipids