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# 11.1

# Geologic History and the Evolution of Life

## INQUIRY

### What happened here?

A meteorite 50 m in diameter crashed into Earth 50,000 years ago. The force of the impact created this crater in Arizona and threw massive amounts of dust and debris into the atmosphere. Scientists hypothesize that a meteorite 200 times this size—the size of a small city—struck Earth 65 million years ago. How might it have affected life on Earth?



Write your response in your interactive notebook.









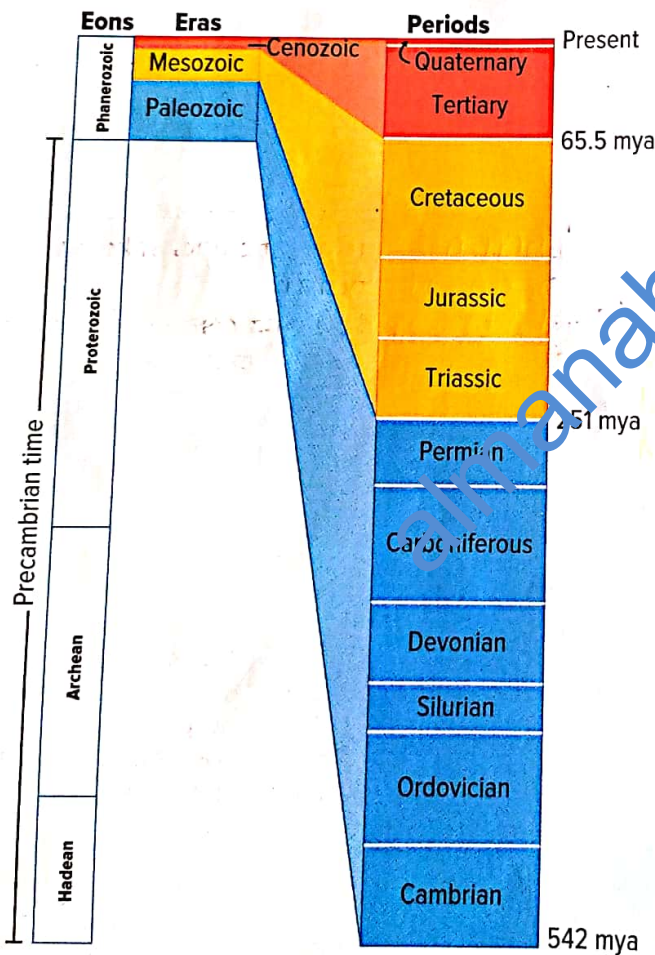
### Discover

Before reading this lesson, write down what you already know in the first column. In the second column, write down what you want to learn. After you have completed this lesson, write down what you learned in the third column.

What I Know	What I Want to Learn	What I Learned
	<ul style="list-style-type: none"> <li>• What is the Geological time scale?</li> <li>• What caused <u>Mass Extinctions</u>?</li> </ul>	

## Developing a Geologic Time Line

Think about what you did over the last year. Maybe you went on vacation during the summer or visited relatives in the fall. To organize events in your life, you use different units of time, such as weeks, months, and years. Geologists organize Earth's past in a similar way. They developed a time line of Earth's past called the geologic time scale. As shown in **Figure 1**, time units on the geologic time scale are thousands and millions of years long—much longer than the units you use to organize events in your life.



**Figure 1** In the geologic time scale, the 4.6 billion years of Earth's history are divided into time units of unequal length.

### Units in the Geologic Time Scale

**Eons** are the longest units of geologic time. Earth's current eon, the Phanerozoic (fan er oh ZOH ihk) eon, began 542 million years ago (mya). **Eons are subdivided into smaller units of time called eras.** Eras are subdivided into **periods.** Periods are subdivided into **epochs** (EH pocks). Epochs are not shown on the time line in **Figure 1**. Notice that the time units are not equal. For example, the Paleozoic era is longer than the Mesozoic and Cenozoic eras combined.



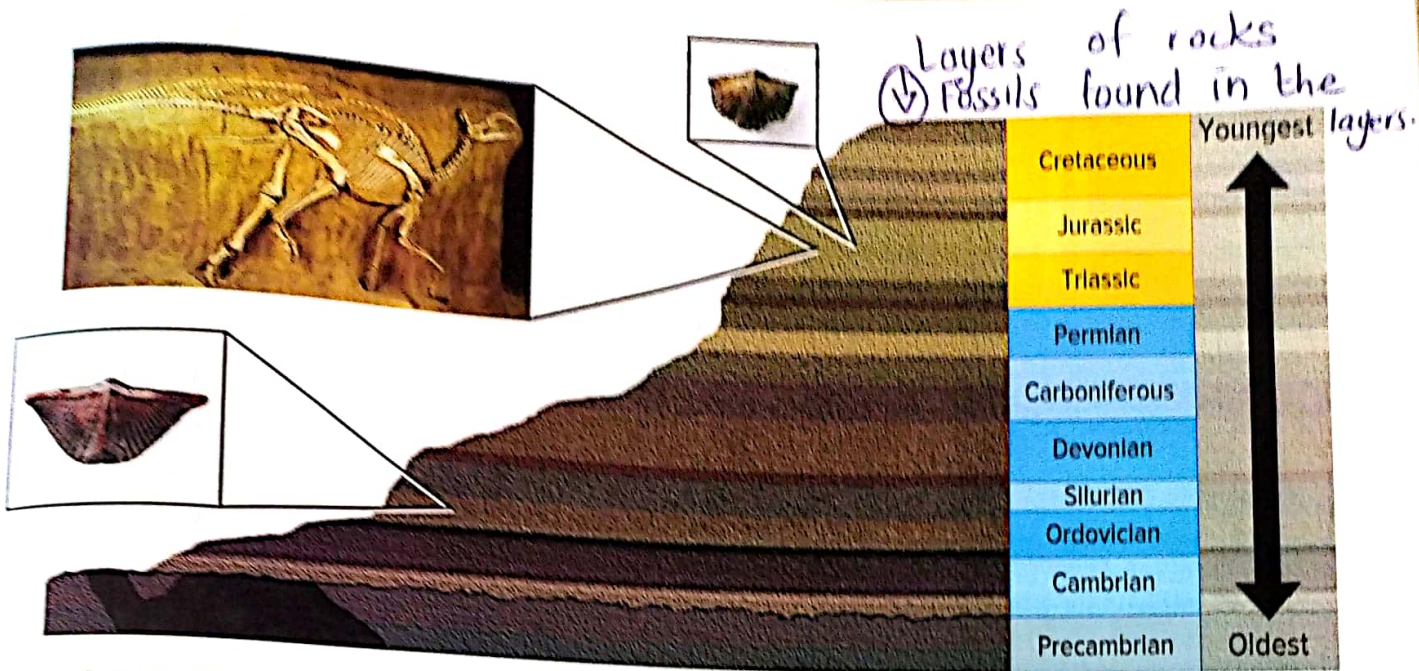


Figure 2 Both older and younger rocks contain fossils of small, relatively simple life-forms. Only younger rocks contain larger, more complex fossils.

## Foundations of geological time division (boundary)

### 1- Fossils

Hundreds of years ago, when geologists began developing the geologic time **scale**, they chose the time boundaries based on what they observed in Earth's rock layers. Different layers contained different fossils. For example, **old rocks contained only fossils of small, relatively simple life-forms**. Younger rocks contained these fossils as well as fossils of other more complex organisms, such as dinosaurs, as illustrated in Figure 2.

Old rock → small fossils  
 Young rock → large fossils

#### Science Use v. Common Use

##### scale

**Science Use** a series of marks or points at known intervals

**Common Use** an instrument used for measuring the weight of an object

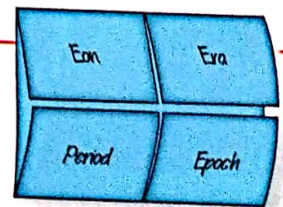
### 2. Major events in the geological time scale

While studying the fossils in rock layers, geologists often saw abrupt changes in the types of fossils within the layers. **Sometimes, fossils in one rock layer did not appear in the rock layers right above it.** It seemed as though the organisms that lived during that period of time had disappeared suddenly. Geologists used these sudden changes in the fossil record to mark divisions in geologic time. **Because the changes did not occur at regular intervals, the boundaries between the units of time in the geologic time scale are irregular.** This means the time units are of unequal length.

The time scale is a work in progress. Scientists debate the placement of the boundaries as they make new discoveries.

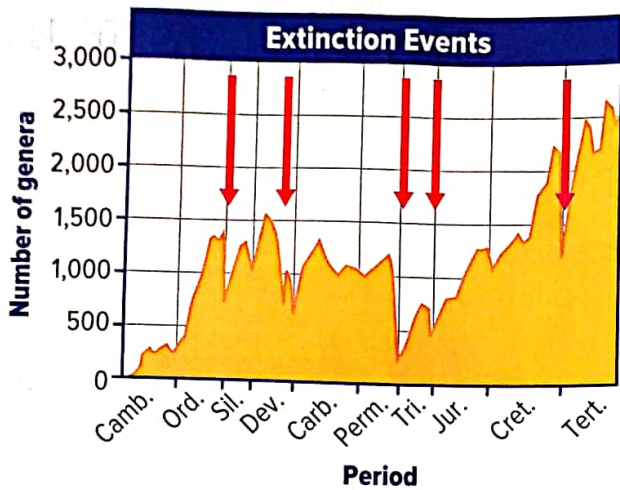
#### FOLDABLES®

Make a four-door book from a vertical sheet of paper. Use it to organize information about the units of geologic time.



Still deciding on the correct time scale





**Figure 3** There have been five major mass extinctions in Earth's history. In each one, the number of genera—groups of species—decreased sharply.

### Key Concept Check

1. Describe a possible event that could cause a mass extinction.

Q:

Can you think of any animals that have become extinct recently?

### Word Origin

**extinct** from Latin *extinctus*, means "dying out"

## Responses to Change <sup>species dies out!</sup>

Sudden changes in the fossil record represent times when large populations of organisms died or became extinct. A **mass extinction** is the extinction of many species on Earth within a short period of time. As shown in **Figure 3**, there have been several mass extinction events in Earth's history.

## Changes in Climate <sup>e.g. weather over a long time.</sup>

What could cause a mass extinction? All species of organisms depend on the environment for their survival. If the environment changes quickly and species do not adapt to the change, they die.

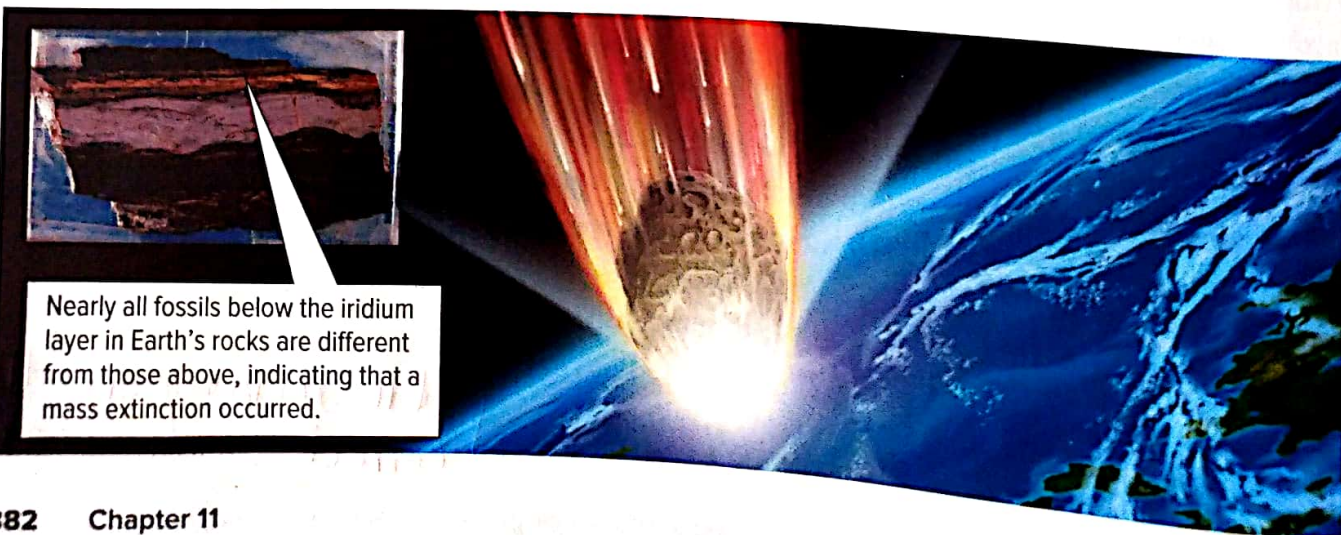
Many things can cause a climate change. For example, gas and dust from volcanoes can block sunlight and reduce temperatures. As you read on the first page of this lesson, the results of a meteorite crashing into Earth would block sunlight and change climate.

Scientists **hypothesize** <sup>think / guess / infer</sup> that a meteorite impact might have caused the mass extinction that occurred when dinosaurs became **extinct**.

Evidence for this impact is in a clay layer containing the element iridium in rocks around the world as shown **Figure 4**.

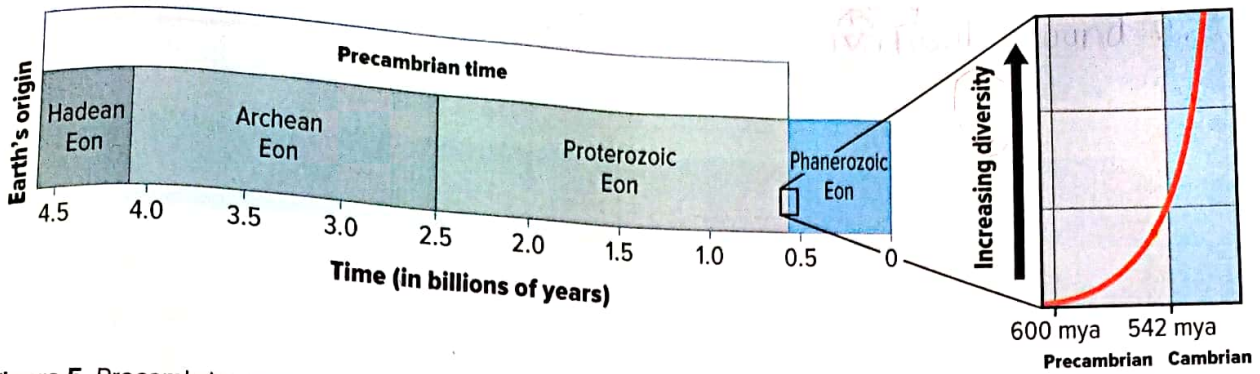
Proof / evidence.

**Figure 4** An iridium-enriched clay layer in Earth's rocks is evidence that a large meteorite crashed into Earth 65 million years ago. A meteorite impact can contribute to a mass extinction event.



Nearly all fossils below the iridium layer in Earth's rocks are different from those above, indicating that a mass extinction occurred.





**Figure 5** Precambrian time is nearly 90 percent of Earth's history. An explosion of life-forms appeared at the beginning of the Phanerozoic eon, during the Cambrian period.

**Reading Check**

3. What is the Cambrian explosion?

**Precambrian Time**

Life has been <sup>changing</sup> evolving on Earth for billions of years. The oldest fossil evidence of life on Earth is in rocks that are about 3.5 billion years old. These ancient life-forms were simple, unicellular organisms, much like present-day bacteria. The oldest fossils of multicellular organisms are about 600 million years old. These fossils are rare. Time before the Cambrian was called Precambrian time. Scientists have determined that Precambrian time is nearly 90 percent of Earth's history, as shown in Figure 5.

**Precambrian Life**

→ Types of fossils → soft body → rare

The rare fossils of multicellular life-forms in Precambrian rocks are from soft bodied organisms different from organisms on Earth today. Many of these species became extinct at the end of the Precambrian.

**Question**

Why were these fossils rare??

**Cambrian Explosion**

Precambrian life led to a sudden appearance of new types of multicellular life-forms in the Cambrian period. This sudden appearance of new, complex life-forms, indicated on the right in Figure 5, is often referred to as the Cambrian explosion. Some Cambrian life-forms, such as trilobites, were the first to have hard body parts. The trilobite fossils shown in Figure 6, are preserved in limestone. Because of their hard body parts, trilobites were more easily preserved. More evidence of trilobites is in the fossil record. Scientists (hypothesize) that some of them are distant ancestors of organisms alive today.

**Question**

Why were trilobites easy to preserve??

think/guess!

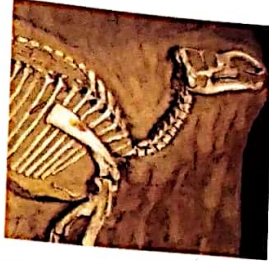


**Figure 6** The hard body parts of these trilobites were preserved as fossils.



# 11.1 Review

## Visualize It!



Earth's history is organized into eons, eras, periods, and epochs.



Climate change caused by the results of a meteorite impact could contribute to a mass extinction event.

## Summarize It!

1. How was the geologic time scale developed?

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2. What are some causes of mass extinctions?

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## Use Vocabulary

1. Distinguish between an eon and an era.  
Eons are the largest groups of time that can be divided into Eras.

2. A(n) \_\_\_\_\_ might form when continents move close together.
3. A(n) extinction might occur if an environment changes suddenly.

## Understand Key Concepts

4. Which could contribute to a mass-extinction event?
- A. an earthquake
  - B. a hot summer
  - C. a hurricane
  - D. a volcanic eruption

5. Explain how geographic isolation can affect evolution.

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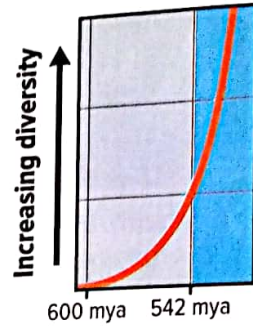
6. Distinguish between a calendar and the geologic time scale.

The geologic time scale is not yet definite as scientists are still deciding on the correct scale. It is not accurate.

A calendar is definite and accurate.

## Interpret Graphics

7. Explain what the graph below represents. What happened at this time in Earth's past?



Between 600-542 mya, diversity on earth was low.  
After 542 MYA, diversity increased.

8. Organize Information Copy and fill in the graphic organizer below to show units of the geologic time scale from longest to shortest.



## Critical Thinking

9. Suggest how humans might contribute to a mass extinction event.

Humans hunt, kill animals and destroy land that are homes to plants + animals.

10. Propose why Precambrian rocks contain few fossils.

- Diversity of life was low
- Only single, simple, unicellular organisms were present during Precambrian.