

Timeline of Evolution

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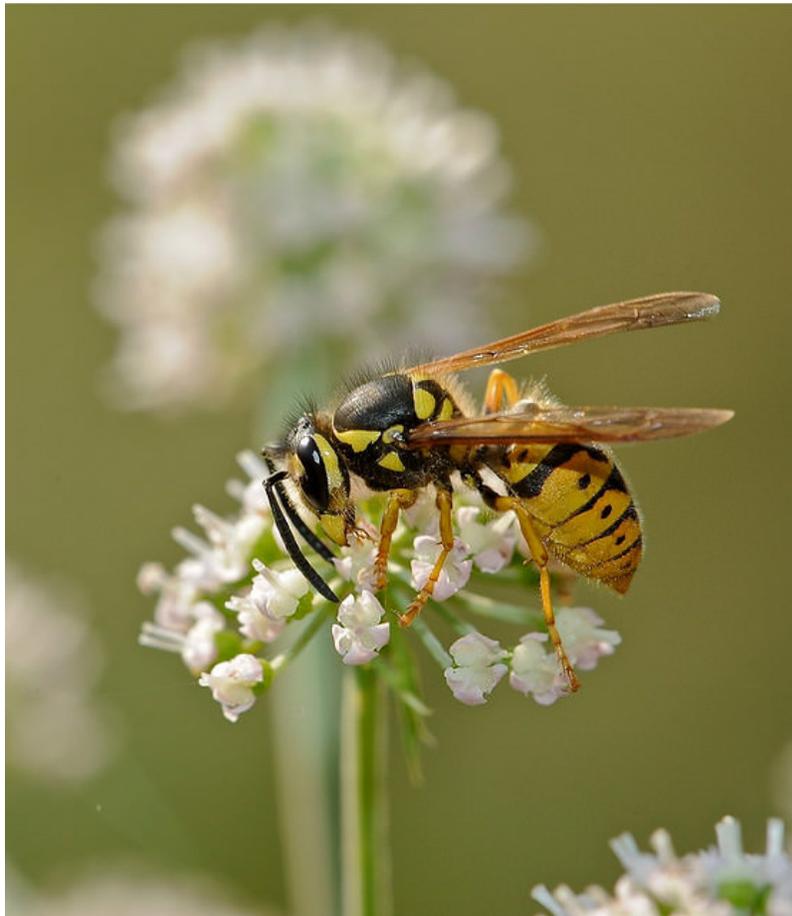
CHAPTER

1

Timeline of Evolution

Learning Objectives

- Define geologic time scale.
- Outline the age of the Earth and the basic timeline of the development life on Earth.



Which was first, the insect or the flower?

Although the land plants were here before insects, the first flowers evolved long after the first insects. The first land plants did not have flowers. Today insects and flowers are so interconnected, it's hard to imagine one without the other.

Timeline of Evolution

For life to evolve from simple single-celled organisms to many millions of species of prokaryotic species to simple eukaryotic species to all the protists, fungi, plants, and animals, took some time. Well over 3 billion years.

The Age of Earth

How old is Earth? How was it formed? How did life begin on Earth? These questions have fascinated scientists for centuries. During the 1800s, geologists, paleontologists, and naturalists found several forms of physical evidence that confirmed that Earth is very old.

The evidence includes:

- Fossils of ancient sea life on dry land far from oceans. This supported the idea that the Earth changed over time and that some dry land today was once covered by oceans.
- The many layers of rock. When people realized that rock layers represent the order in which rocks and fossils appeared, they were able to trace the history of Earth and life on Earth.
- Indications that volcanic eruptions, earthquakes, and erosion that happened long ago shaped much of the Earth's surface. This supported the idea of an older Earth.

The Earth is at least as old as its oldest rocks. The oldest rock minerals found on Earth so far are crystals that are at least 4.404 billion years old. These tiny crystals were found in Australia. Likewise, Earth cannot be older than the solar system. The oldest possible age of Earth is 4.57 billion years old, the age of the solar system. Therefore, the age of Earth is between 4.4 and 4.57 billion years.

Geologic Time Scale

Geologists and other Earth scientists use **geologic time scales** to describe when events happened in the history of Earth. The time scales can be used to show when both geologic events and events affecting plant and animal life occurred. The geologic time scale pictured below (**Figure 1.1**) illustrates the timing of events like:

- Earthquakes.
- Volcanic eruptions.
- Major erosion.
- Meteorites hitting Earth.
- The first signs of life forms.
- Mass extinctions.

Evolution of Major Life Forms

Life on Earth began about 3.5 to 4 billion years ago. The first life forms were single-celled organisms similar to bacteria. These first life forms were, of course, very basic, and this then allowed for the evolution of more complex life forms. The first multicellular organisms did not appear until about 610 million years ago. Many different types of organisms evolved during the next ten million years, in an event called the **Cambrian Explosion**. This sudden burst of evolution may have been caused by some environmental changes that made the Earth's environment more suitable for a wider variety of life forms.

Plants and fungi did not appear until roughly 500 million years ago. They were soon followed by arthropods (insects and spiders). Next came the amphibians about 300 million years ago, followed by mammals around 200 million years ago and birds around 100 million years ago.

Even though large life forms have been very successful on Earth, most of the life forms on Earth today are still prokaryotes—small, relatively simple single-celled organisms. As it is difficult to identify, observe and study such small forms of life, most of these organisms remain unknown to scientists. Advancing technologies, however, do allow for the identification and study of such organisms.

Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; in fact, it is estimated that 99% of the species that have ever lived on Earth no longer exist.



FIGURE 1.1

The geologic time scale is used to describe events that occurred millions and billions of years ago. The geologic time scale of Earth's past is organized according to events that took place during different periods on the time scale. Geologic time is the same as the age of the Earth: between 4.404 and 4.57 billion years. Look closely for such events as the extinction of dinosaurs and many marine animals.

The basic timeline of a 4.6 billion-year-old Earth includes the following:

- About 3.5 - 3.8 billion years of simple cells (prokaryotes).
- 3 billion years of photosynthesis.
- 2 billion years of complex cells (eukaryotes).
- 1 billion years of multicellular life.
- 600 million years of simple animals.
- 570 million years of arthropods (ancestors of insects, arachnids and crustaceans).
- 550 million years of complex animals.
- 500 million years of fish and proto-amphibians.
- 475 million years of land plants.
- 400 million years of insects and seeds.
- 360 million years of amphibians.
- 300 million years of reptiles.
- 200 million years of mammals.
- 150 million years of birds.
- 130 million years of flowers.
- 65 million years since the non-avian dinosaurs died out.
- 2.5 million years since the appearance of *Homo*.
- 200,000 years since the appearance of modern humans.
- 25,000 years since *Neanderthals* died out.

Summary

- The age of Earth is between 4.4 and 4.57 billion years.
- Life on Earth began about 3.5 to 4 billion years ago, and the first life forms were single-celled organisms similar to bacteria.

Explore More

Use the resource below to answer the questions that follow.

- ***Anomalocaris* - Shape of Life**



MEDIA

Click image to the left or use the URL below.

URL: <http://www.ck12.org/flx/render/embeddedobject/57486>

1. Most fossils found are not of complete organisms. How have scientists responded to this situation? What challenges has this presented?
2. What were some of the theories as to what type of animal *Anomalocaris* was? What happened to cause these theories to be abandoned?
3. How is *Anomalocaris* an example of the scientific process?

Review

1. What is a significant piece of evidence that was used in the 1800s to suggest Earth is very old?
2. Relative to the length of time life has been on Earth, have modern humans appeared recently or in the distant past?
3. What types of geological events help define geological time scales?
4. When did life on Earth begin? What was the first form of life?
5. What was the Cambrian Explosion?

References

1. U.S. Geological Survey. [Picture of the geologic time scale](#) .