

Earth's Formation: Atmospheric Conditions

by Sophia

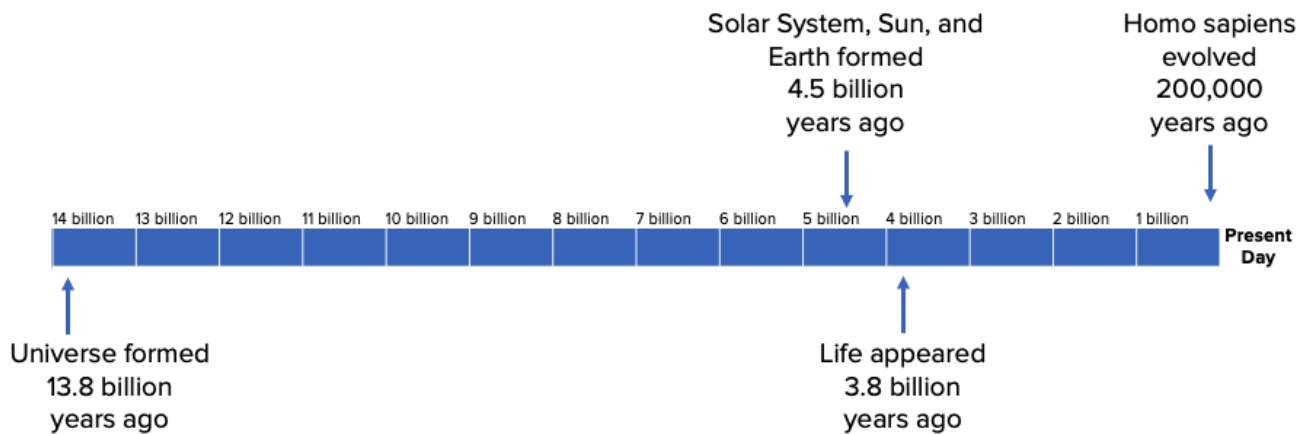


WHAT'S COVERED

In this lesson, we're going to cover the topic of Earth's formation. We will discuss how Earth and its atmosphere were formed, what Earth was like before life forms appeared, and what it was like once early life forms began to appear. Specifically, this lesson will cover the following:

1. History of Earth's Formation

According to the Big Bang theory, the universe came into existence 13.8 billion years ago. After that, approximately 4.5 billion years ago, our solar system, Sun, and Earth came into existence. It wasn't until 3.8 billion years ago that life first appeared on Earth. Furthermore, *Homo sapiens* appeared on Earth only 200,000 years ago.



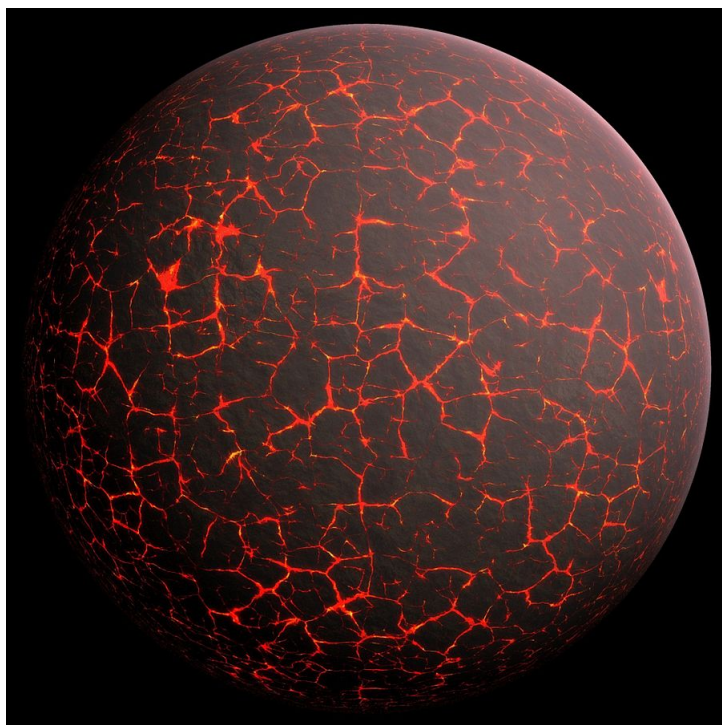
If we compress all that history into a single year, it will look something like this:



The Big Bang would happen on January 1 at the stroke of midnight. Eight months later, our solar system would have formed, and by September, life would have started appearing on Earth. Then, on the 31st of December at 11:54 PM, the first of the *Homo sapiens* would have emerged. Humans have only been around for the last six minutes at this scale, and the human practice of agriculture only appeared in the last 12 seconds.

2. Earth Before Life Forms

From about 3.8 to 4.5 billion years ago, Earth existed without any life forms. It was a planet filled with intense volcanic activity and frequent bombardments from meteorites. The entirety of Earth was incredibly hot as a result of the heat generated from its formation. The high temperatures were probably not conducive to any form of life. During this time, Earth's surface and core were cooling. Today, the surface is significantly cooler, but Earth's core is still molten iron and nickel.



Also during this time period, Earth's atmosphere contained no free oxygen. It did, however, consist of water, carbon dioxide, sulfur dioxide, carbon monoxide, sulfide, chloride, nitrogen, hydrogen, ammonia, and methane. This combination of gases was favorable for the eventual formation of life, due to the chemical

bonds and chemical processes that this combination of gases can create. During this time period, there was a lot of lightning energy and UV radiation, which provided the energy required for early formation of organic molecules.



3. Early Life Forms

Finally, starting about 3.8 billion years ago, a few early life forms developed the capacity of photosynthesis, which began to produce free oxygen. Over time, this saturated Earth's oceans and atmosphere until it reached a concentration of 20% oxygen, which is what we currently have today. Many of those early life forms, however, died out because the new oxygen concentration became a toxin for many species. Because oxygen is not conducive to forming chemical bonds, early life most likely evolved in a low-oxygen environment.

Humans live in a layer of Earth's atmosphere called the troposphere, represented by the blue dotted line in the diagram below. Just above the troposphere is the stratosphere, represented by the red dotted line. During the formation of Earth, free oxygen levels in the stratosphere increased and were exposed to UV radiation from Sun. This exposure led to the creation of O_3 , and eventually, the ozone layer. This new ozone layer protected Earth's surface from certain types of UV radiation by absorbing them. This allowed early life forms to survive and evolve on land.



SUMMARY

In this lesson, we talked about the **history of Earth's formation**, what **Earth was like before life forms**, and what it was like as **early life forms** began to appear.

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