

## Scientific Event:

# Oxygen Increase in Atmosphere Enhances Visibility

**Time Frame: ~400 million years ago**

The scientific descriptions on these pages are derived from AI investigations using ChatGPT and Gemini 3 asking for the history of . The AI output has been revised appropriately for improved accuracy, ease of comprehension, and relevance to this study of Genesis 1.

## Background: The Origin of Oxygen in Earth's Atmosphere

For the first billion years or more, Earth's atmosphere remained essentially oxygen-free. During this time, the Sun's ultraviolet (UV) radiation reached the surface much more easily because there was no ozone layer to block it. Then around 3.5 billion years ago, simple microscopic organisms called cyanobacteria appeared in the oceans. These organisms used sunlight to make food through photosynthesis, releasing oxygen as a byproduct. However, for a very long time, this oxygen did not accumulate in the atmosphere. Instead, the oxygen reacted with dissolved iron in the oceans, sulfur and volcanic gases, and reduced minerals in Earth's crust. Because of this, the atmosphere remained almost completely lacking in oxygen, even though oxygen was being produced biologically.

A major turning point occurred about 2.4 billion years ago, known as the **Great Oxidation Event** (GOE). By this time, many of Earth's major oxygen "sinks" had become saturated, meaning they could no longer remove oxygen as efficiently. As a result, oxygen began to accumulate in the atmosphere. Atmospheric oxygen likely rose from near zero to roughly 0.1–1% of today's level. This was still very low compared to modern oxygen levels (21%), but it was a dramatic change for Earth. One of the strongest pieces of evidence for this event comes from sulfur isotopes preserved in ancient rocks. Before the GOE, sulfur showed special isotope patterns that can only form in an oxygen-free atmosphere. These patterns disappear after the GOE, indicating that oxygen had permanently altered atmospheric chemistry.

The rise of oxygen had important effects on how light passed through the atmosphere. Even small amounts of oxygen allowed ozone (O<sub>3</sub>) to form in the upper atmosphere. Ozone absorbed harmful UV light, making Earth's surface safer for life. Higher oxygen reduced methane levels, which likely decreased thick organic hazes that had previously made the sky more opaque and possibly orange-colored. Although oxygen itself does not strongly

affect visible light, its indirect effects made Earth's atmosphere more transparent and stable.

- **Time Frame:** 4.5 to 2.4 Ga
- **Evidence:** The Archean sedimentary rocks sulfur chemistry (S-MIF)

## Development of Greater Visibility in the Atmosphere

After the Great Oxidation Event, oxygen levels did not continue rising quickly. For nearly 1.5 billion years, Earth experienced a long interval where atmospheric oxygen remained low but stable, probably less than 1% of today's level.

### 1. Low Oxygen World

- a. **Time Frame:** ~2.3 to 0.8 Ga
- b. Oceans were often low in oxygen
- c. Complex life was limited
- d. Ozone layer existed but was relatively thin
- e. UV radiation was lower than before GOE but higher than today

### 2. Oxygen Rises Before Age of Animals

- a. **Time Frame:** 800 to 540 Ma
- b. By 540 Ma, oxygen may have reached 1-10% of modern levels
- c. Changes in ocean chemistry
- d. Greater burial of organic carbon
- e. Appearance of larger, more complex life forms
- f. **Evidence:** Chromium, Uranium isotope, Iron speciation

### 3. Oxygen Levels Continue to Rise

- a. **Time Frame:** 540 to 430 Ma
- b. By 430 Ma, oxygen may have reached 10-15% of modern levels
- c. Higher oxygen reduced methane levels, which likely decreased thick organic hazes that had previously made the sky more opaque and possibly orange-colored.
- d. Oxygen high enough to support larger animals and more active lifestyles
- e. **Evidence:** Computer models of Earth's carbon and oxygen cycles, fossil charcoal records which suggest widespread fires that require more oxygen

# Description in Genesis 1 of This Event

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*And God said, “Let there be lights in the vault of the sky to separate the day from the night, and let them serve as signs to mark sacred times, and days and years, and let them be lights in the vault of the sky to give light on the earth.” And it was so. God made two great lights—the greater light to govern the day and the lesser light to govern the night. He also made the stars. God set them in the vault of the sky to give light on the earth, to govern the day and the night, and to separate light from darkness. And God saw that it was good. And there was evening, and there was morning—the fourth day.*

*Genesis 1:14-19 (NIV)*

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Passages left highlighted are those most relevant to the scientific event of interest

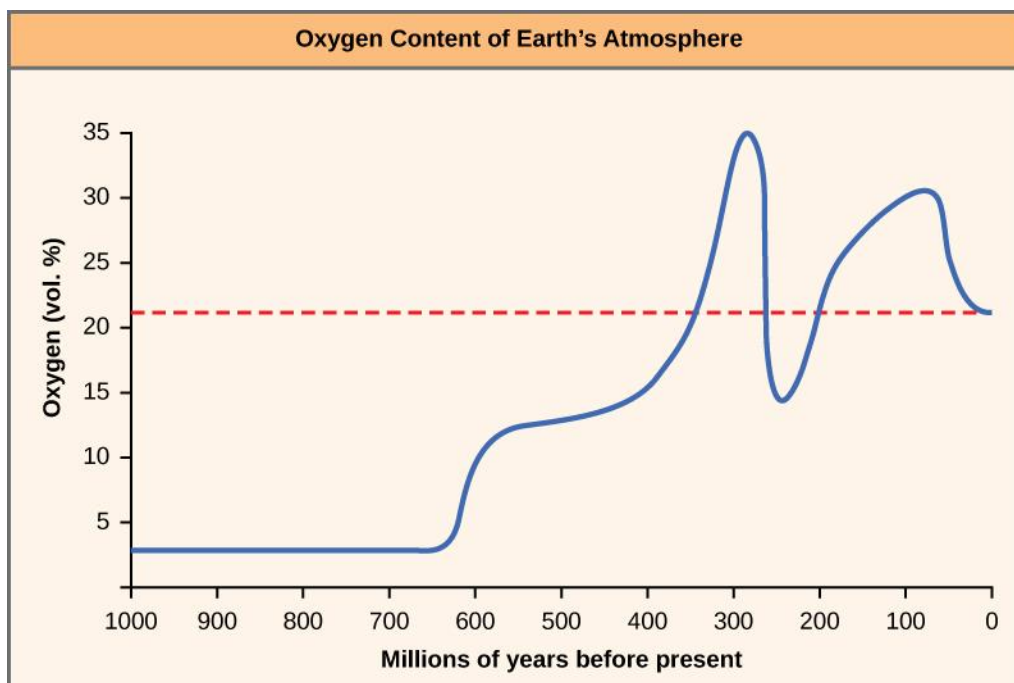
The approach that this supplement pack takes in making associations between Genesis 1 events and scientific events is to use the earliest scientific event that makes sense according to the Hebrew words used in Genesis 1 (i.e., the use of good hermeneutics) while also considering where the event would likely be placed on a timelines that is consistent with the sequence of events described in Genesis 1.

For this fourth day event, there are several considerations. First of all, as a reminder this supplement pack uses Genesis 1:2 to provide the frame of reference or point of view for the entire Genesis 1 narrative. The phrase “and the Spirit of God was hovering over the waters” suggests a point of view for the narrative from near the surface of the Earth. This is critical to using an Old Earth Creationism perspective in this Yom/Day 4 passage. We can then understand that the lights of the sun, moon, and stars appearing in the sky are from a clearing away of the clouds and any other phenomenon that would prevent a clear view of the stars, moon, and sun.

But this approach also presents some challenges. First of all, we are trying to determine an atmospheric situation from probably hundreds of millions of years ago. Unlike direct fossil evidence layered within radiometrically dated rocks, to determine atmospheric conditions from hundreds of millions of years ago scientists use more indirect measurement. So, the time frame for values like percentage of oxygen in the atmosphere is not as accurate as, for example, the time frame for when an animal lived that we know from fossil evidence.

Secondly, in the case of the visibility of stars, moon, and sun on the surface of the earth, we have to have some measure of the transparency of the atmosphere. Yet, there are numerous assumptions that need to be made about determining that transparency. Oxygen can be only an indirect predictor of transparency.

For this supplement pack, we are using an oxygen percentage of 21% for the clarity needed to see the sun, moon, and stars clearly in the Earth's atmosphere. This is the same oxygen percentage in our current atmosphere, which provides clear views of the sun, moon, and stars. Using the value of 21% and the oxygen concentration graph listed below, then this puts the time frame for Yom/Day 4 and event 8 at about 340 million years ago.



Graph used from <https://courses.lumenlearning.com/wm-nmbiology2/chapter/the-cambrian-explosion/>