

# Module 1: What is Oceanography

## Topic 1 Content: How the Oceans Formed Notes



Imagine that you're in a time-traveling deep-ocean submersible

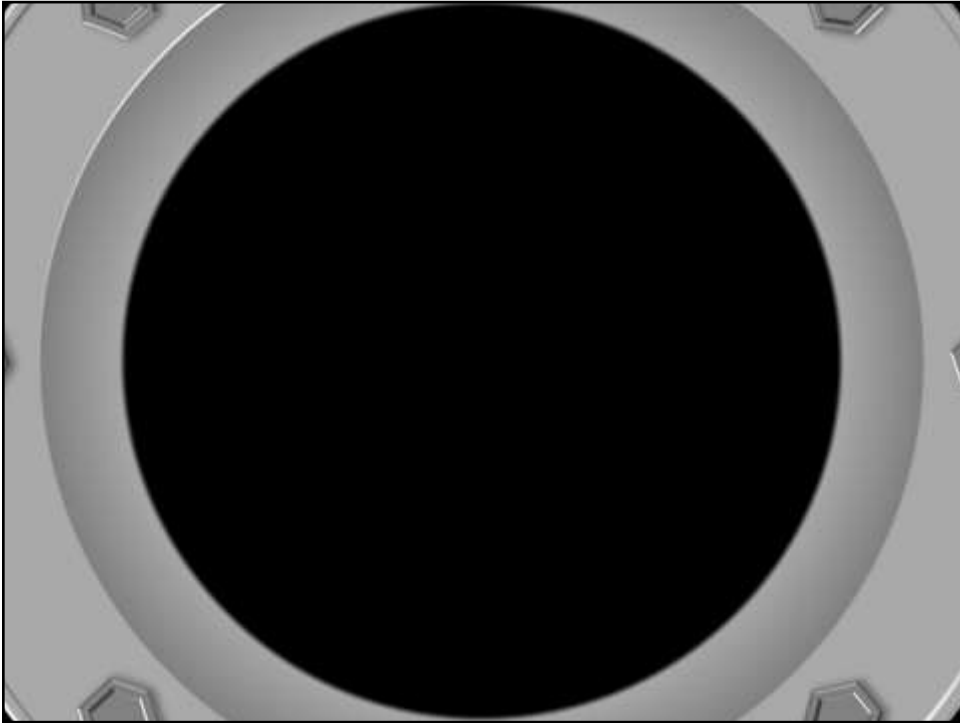
Watch through your viewport as we journey billions of years into the past to discover how scientists theorize the oceans formed.

Hang on, it could be a bumpy ride

Image source: NASA

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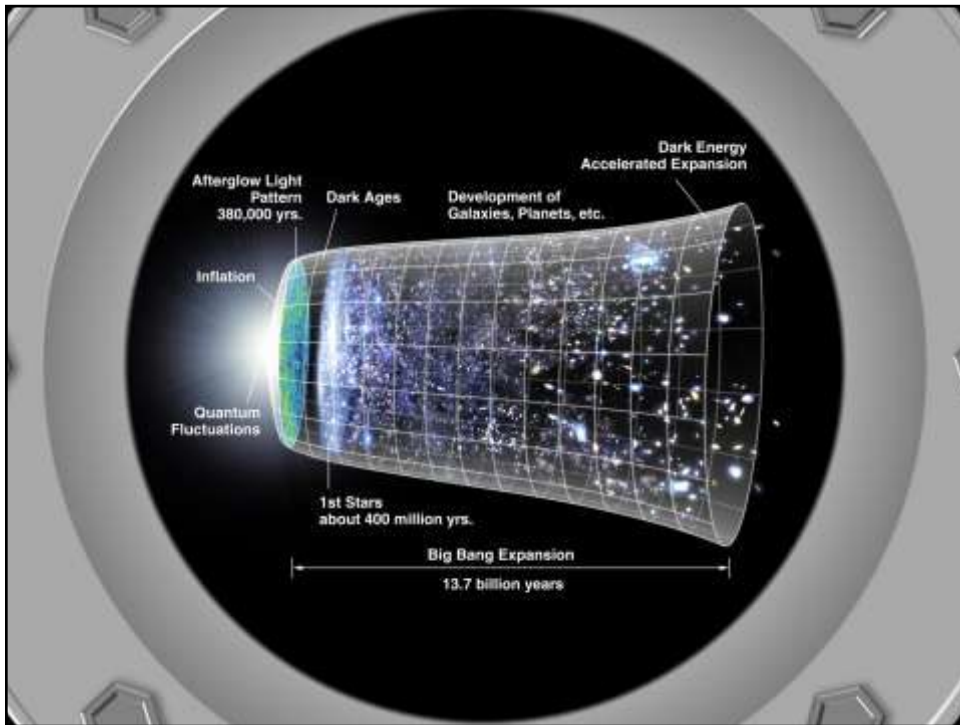
The singularity.

Picture a place where an infinite density of matter exists in an infinitesimal space. You may be thinking about your locker at school, but according to scientists, the singularity was an invisible point from which emerged all the matter and energy that would eventually become the universe, as we know it today.

In 1949, Sir Fred Hoyle, an English scientist, coined this phenomenon, the Big Bang Theory.

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Although scientists continue to study how the universe evolved, they theorize that the Big Bang was more of a big expansion of sorts, rather than an explosion.

According to scientists, about 13.7 billion years ago, an extremely hot and dense state of matter and energy suddenly emerged from the singularity. This hot and dense state expanded rapidly in all directions as it cooled over billions of years.

Gradually, the cooling matter and energy formed the elements that would become galaxies, stars, and eventually, planets like the Earth and its vast oceans.

Image source: NASA/WMAP

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As you now know, scientists theorize that from the singularity emerged all the matter and energy necessary to form everything in our universe.

About 4.6 billion years ago, nestled in an outer arm of the Milky Way galaxy, a tiny portion of this matter coalesced into a spiraling cloud of superheated hydrogen gas and dust, which scientists call a solar nebula.

Pictured here is the Orion Nebula, which scientists suggest resembles the birthplace of our own star, the Sun.

Image source: NASA

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According to the nebular hypothesis, or the Solar Nebular Theory, the Sun formed near the center of this solar nebula when intense gravitational forces condensed enough hydrogen gas to begin nuclear fusion.

The remaining gas and dust continued orbiting the early Sun for the next few million years. Gradually, this dust and gas aggregated into the planets and other material of the solar system.

Image source: NASA

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So, what do scientists theorize the Big Bang has to do with oceans, ocean features, or even ocean organisms?

Somewhere out there, orbiting a mere 93 million miles from the Sun – really just a blink in astronomical distance – was a molten, rocky mass of hot magma. According to scientists, this molten, rocky mass, like everything else in the universe, formed from matter left over from the Big Bang.

It may not have been a very hospitable place for its first few billion years, but this glowing ball of rock evolved into an oasis with great blue oceans filled with life. Of course, we call this beautiful rock our home: planet Earth.

But, how did the oceans form?

Scientists continue to find and study clues about the Earth's formation. Some of these clues may one day provide more conclusive evidence of how water formed on our planet.

Until then, scientists suggest an important factor that led to the formation of oceans was the Earth's imperfect spherical shape. Because the Earth formed from clumps of debris, its surface has low points, called basins, and high points, called landmasses.

Image source: Fahad Sulehria

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It seems unlikely that oceans of water would someday form on a huge ball of molten rock, but as we'll learn shortly, the next stage in the Earth's development provided the raw materials necessary to create a stable atmosphere, which in turn, made possible great oceans of water.

Scientific research suggests that violent volcanic activity shaped the Earth's surface as it cooled and solidified over billions of years. In the process, outgassing released massive volumes of gases trapped within the planet, including carbon dioxide, nitrogen, methane, sulfur dioxide, and water vapor.

Fortunately for life as we know it, the Earth's gravitational pull held these gases close to the surface, and eventually formed a dense, stable atmosphere. This early atmosphere consisted primarily of carbon dioxide with very little, if any, oxygen.

Image source: Smithsonian

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Imagine a weather forecast calling for rain; not just scattered showers over a few days, but torrential downpours for the next million or so years

Scientists suggest that these rains began soon after the atmosphere formed, and continued non-stop for thousands, if not millions, of years.

How exactly the Earth managed to produce enough water to form its oceans remains a puzzle.

Many scientists hypothesize that outgassing of water vapor from within the planet's surface resulted in these rains. Other scientists speculate that perhaps comets bombarded the planet, bringing with them debris, including trapped water vapor. Over time, the comets brought enough trapped water vapor to fill the Earth's basins with liquid water.

Image source: NASA



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The Earth we know today is a wet planet with water covering 71 percent of the surface. The landmasses we live on account for the remaining 29 percent.

The chemical composition of the oceans changed throughout the Earth's formation. The oceans we know today represent a balance of elements and compounds that originated from the land.

As water flowed from the rocky landmasses to the ocean basins, it carried many dissolved elements and compounds. These elements and compounds altered the water's chemistry, and, according to scientists, helped give rise to life on planet Earth.