Scientific Event:
The Formation of the Earth

Time Frame: ~4.56 billion years ago

The scientific descriptions on these pages are derived from AI investigations using ChatGPT and Gemini 3 asking about the formation of the earth. 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 the *Solar System*

About 4.6 billion years ago, the solar system began forming from a vast cloud of gas and dust floating in space. Gravity caused part of this cloud to collapse, and as it did, most of the material collected at the center, becoming the young Sun. The remaining gas and dust flattened into a wide, spinning disk around the Sun, known as a protoplanetary disk. This disk contained the raw materials from which all the planets, moons, asteroids, and comets would eventually form.

Within this disk, tiny solid particles began sticking together, forming small rocky clumps. Over time, these clumps grew into larger bodies called planetesimals. Many of these early objects still survive today as asteroids or meteorites, which scientists study to learn about the solar system's earliest conditions. As collisions continued, some planetesimals grew large enough to become planetary embryos—small, developing planets.

One of the most important events during this time was the early formation of Jupiter. Jupiter grew quickly and became extremely massive, and its powerful gravity reshaped the young solar system. It disrupted the region where the asteroid belt now exists, preventing a planet from forming there, and influenced how material moved throughout the solar system. Jupiter's early presence played a major role in shaping the orbits and growth of the inner rocky planets.

Closer to the Sun, Earth was slowly forming through repeated collisions between planetary embryos and smaller bodies. These impacts released enormous amounts of energy, causing Earth to heat up and partially melt. Heavy materials like iron sank toward the center, forming Earth's core, while lighter rocks formed the mantle and crust. By about 4.54 billion years ago, Earth had gained most of its mass and had become a distinct planet, although its surface was still extremely hot and unstable.

- **Time Frame:** ~4.6 to 4.54 billion years ago (Ga)
- **Evidence:** Radiometric dating of chemicals in meteorites is often used since meteorites in space were not melted by plate tectonics. Also, comparisons with other planets and astronomical observations of other star systems can often provide confirmations of theories.

Development of the Initial Formation of the Earth

The focus of this Genesis event is how the Earth was formless and empty. So, the details given here are only for the early stages of the Earth's history.

1. **The Sun was Born**
   Something (probably a shock wave from a nearby exploding star) caused part of the cloud to collapse in on itself. As it collapsed, the center got hotter and hotter until it formed our Sun
   a. **Time Frame:** ~ 4.7 Ga
   b. **Evidence:** Radiometric dating of primitive meteorites. Astronomical observations show young stars with protoplanetary disks show similar processes happening today.
2. **Dust and Rocks Started to Stick Together**
   As the Sun formed, the leftover dust and gas around it began to spin like a giant pancake-shaped disk.
   a. **Time Frame:** ~ 4.567 Ga
   b. Inside the spinning disk, tiny grains of dust bumped into each other
   c. Static electricity and gravity made them stick together
   d. Small bits became bigger bits
   e. Bigger bits became **rocky clumps** the size of mountains
   f. These clumps grew into objects called **planetesimals** - basically mini-planets
   g. **Evidence:** Isotope dating of meteorites (chondrites)
3. **Earth Begins to Grow**
   The early Earth started out as one of these planetesimals.
   a. **Time Frame:** ~4.56 to 4.54 Ga
   b. It grew larger by **colliding** with other planetesimals
   c. **Melting and mixing** happened from all the heat created by those collisions
   d. This allowed **heavier materials** (like iron) to sink to the center, forming Earth's core
   e. This left **lighter materials** on the outside, forming the first version of the crust
   f. This process was violent—imagine giant space rocks smashing together again and again. The early Earth was extremely **hot**, almost entirely **molten** (melted rock), and probably looked like a glowing ball of lava.
   g. **Evidence:** The 4.54 Ga "birthdate" of Earth is derived from isotope dating of ancient meteorites and Earth's oldest rocks.

Over time, as Earth continued to grow, it attracted even more material through gravity. This relentless bombardment not only added mass but also released tremendous energy, keeping the young planet in a molten state. Because of this, Earth's surface was unstable and constantly changing, with new crust forming and being destroyed rapidly.

Description in Genesis 1 of This Event

Now the earth was formless and empty, darkness was over the surface of the deep, and the Spirit of God was hovering over the waters.
Genesis 1:2a (NIV)

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.

The Scriptural description in Genesis 1:2a of the earth initially being without form and void is very consistent with what science has discovered about initially there being no earth, and then gas and small dust particles in the solar nebula going through the accretion process to build up the initial planet earth. So, we take this event to have happened right before the final formation of the earth, around 4.56 billion years ago.