Scientific Event:
The Water Cycle Develops

Time Frame: ~3.8 to ~3.5 billion 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 *Water* on the Earth

When Earth first accreted from dust and rock in the early Solar System, any water associated with the planet at that stage could not exist as liquid; instead, it was either dissolved within molten rock or present as water vapor in a transient atmosphere. The impact around 4.50 billion years ago that led to the formation of the Moon did not completely remove Earth's water. A substantial fraction appears to have survived within the mantle, chemically bound in minerals, where it was protected from escape.

As Earth cooled following the impact, volcanic activity shaped the surface and atmosphere. Between roughly 4.45 and 4.30 billion years ago, intense volcanic degassing released large quantities of water vapor, carbon dioxide, and nitrogen from the interior, forming a dense secondary atmosphere. Water at this time existed primarily as superheated steam under extremely high pressures.

By about 4.40 to 4.10 billion years ago, cooling had progressed to the point that water vapor in the atmosphere could condense. Once surface temperatures fell below the critical point of water, prolonged global rainfall likely occurred, lasting thousands to millions of years. This process led to the formation of Earth's first stable oceans. Geochemical evidence preserved in ancient zircon crystals indicates that liquid water interacted with solid crust by about 4.4 billion years ago.

During the interval from approximately 4.10 to 3.90 billion years ago, Earth underwent a period of intensified asteroid and comet impacts often referred to as the Late Heavy Bombardment. These impacts intermittently vaporized portions of the oceans and atmosphere, locally resetting surface conditions. However, they did not permanently eliminate Earth's water. While some additional water was delivered during this time - particularly from water-rich asteroids - the isotopic composition of Earth's oceans indicates that this contribution was secondary rather than primary.

By around 3.8 billion years ago, Earth had transitioned into a more stable state. Long-lived global oceans were present, the atmosphere supported a functioning hydrologic cycle, and surface temperatures allowed liquid water to persist continuously. Geological evidence from the oldest sedimentary rocks indicates sustained interaction between water, crust, and atmosphere. By this time, Earth had become a persistently wet planet.

- **Time Frame:** 4.54 to 3.8 billions of years ago
- **Evidence:** Modern mantle minerals still contain large quantities of structurally bound water, supporting the water capture in early Earth**.** Zircon crystals (~4.4 Ga) from Western Australia suggest presence of stable crust and surface water.

The Development of the *Water Cycle* on Earth

The development of Earth's water cycle was not a single event but a gradual emergence tied to the planet's thermal evolution, atmospheric chemistry, and surface stabilization. By the early Archean eon (~4.0–3.5 Ga), Earth likely possessed persistent oceans and a stabilized crust, allowing the water cycle to take on a more recognizable form. Evaporation from ocean surfaces, atmospheric transport of water vapor, condensation into clouds, and precipitation became cyclic processes rather than one-time events.

1. **Fully active water cycles**
    a. **Time Frame:** ~3.8 billion years ago
    b. River like flows of water show in sediments from that time
    c. **Evidence:** Isua sedimentary rocks from southwest Greenland from 3.7 to 3.8 billion years ago show the presence of liquid water and a dynamic atmosphere.
2. **Mature global hydrologic cycle**
    a. **Time Frame:** ~3.5 billion years ago
    b. **Evidence:** Rounded pebbles from Barberton Greenstone Belt (South Africa) (~3.5-3.3 Ga) and Pilbara Craton (Western Australia) (~3.5 Ga), sedimentary basin architecture.

Description in Genesis 1 of This Event

And God said, "Let there be a vault between the waters to separate water from water." So God made the vault and separated the water under the vault from the water above it. And it was so. God called the vault "sky." *And there was evening, and there was morning—the second day.*

Genesis 1:6-8 (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 beginning of the water cycle has been estimated to be around 3.8 billion years ago. So, that is the value that we use for the overall timeline.