# Earth Habitable 4 Billion Years Ago

**Source: DTE**

## Why in News?

Recently, analyses of ancient rocks and minerals revealed that Earth may have had the **necessary conditions** to support life **around 600 million years** after its formation, with **fresh water and dry land** present as far back as **4 billion years ago.**

## What are the Key Highlights of the Recent Study?

- **Water Cycle and Life Emergence**: The interaction between freshwater and land, referred to as the **water cycle** might have created conditions conducive to life.
  - This interaction was previously believed to have **started around 3.5 billion years ago based on** fossil evidence.
  - A study of **oxygen isotopes** in ancient rocks reveals the origins of Earth's water cycle.
    - It suggests fresh water and land interactions occurred several kilometres **below the Earth's surface,** challenging the theory that Earth was completely covered by ocean **four billion years ago.**
- **Implications for Early Life:** These findings indicate that the conditions for life to flourish existed relatively early in Earth's history.

## What are the Key Facts About Origin of Earth?

- **Age of Earth:** While Earth is estimated to be around **4.5 billion years old**, the study suggests that fresh water and dry land were present as far back as 4 billion years ago.
- **Theories Related to the Origin of Earth:**
  - **Nebular Hypothesis**: It was given by **Immanuel Kant** and revised by Laplace.
    - It considered that the **planets were formed out of a cloud of material** associated with a youthful sun, which was slowly rotating.
  - In 1950, Otto Schmidt in Russia and Carl Weizascar in Germany revised the **nebular hypothesis.**
    - They considered that the sun was surrounded by a **solar nebula** containing mostly **hydrogen, helium,** and dust.
    - The friction and collision of particles led to the formation of a disk-shaped cloud and the planets were formed through the process of accretion.
  - **Big Bang Theory:** It was given by **Edwin Hubble, in 1920**. It is the idea that the universe began as just a single point, then expanded and stretched to grow as large as it is right now.

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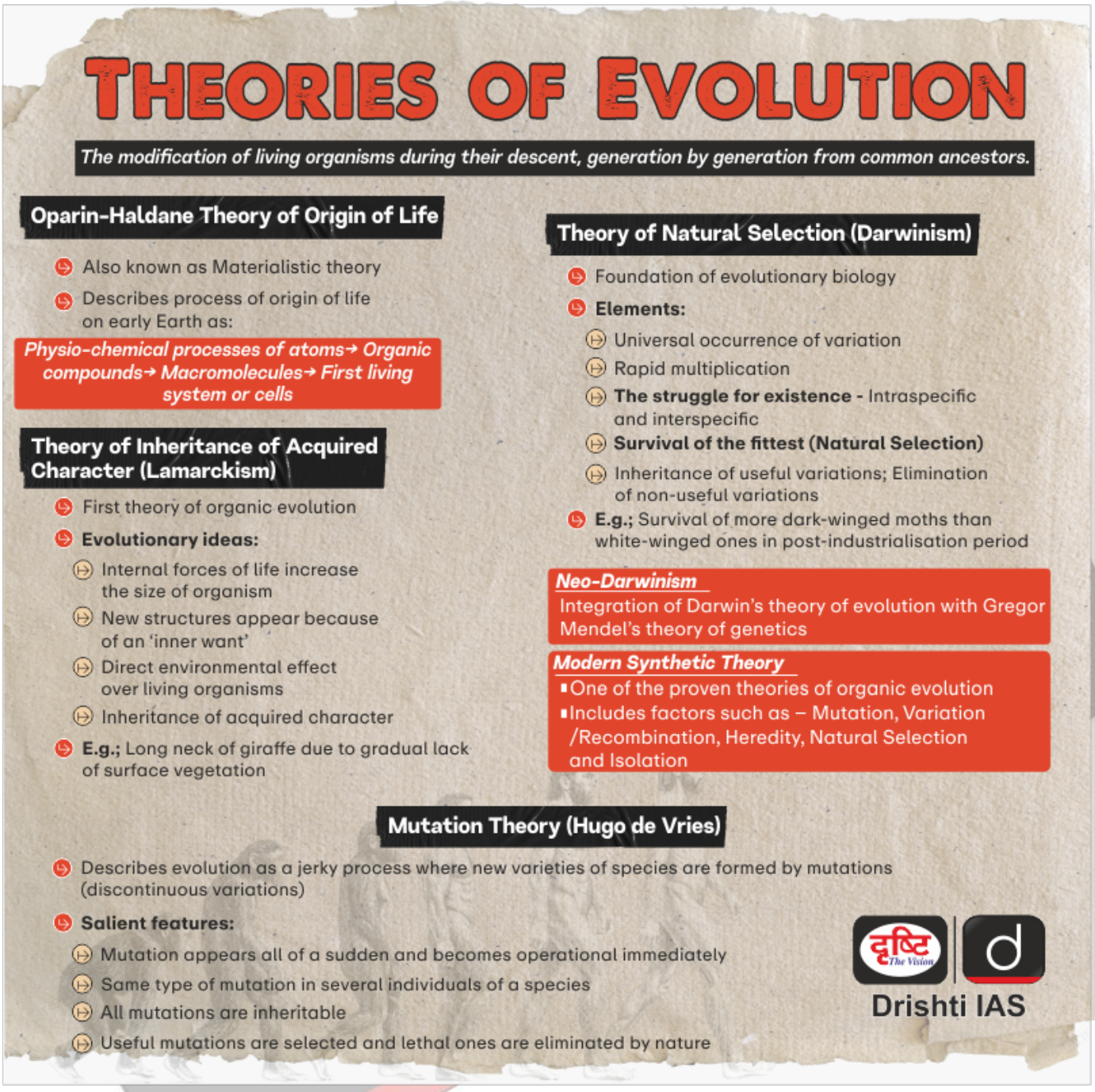
## Geological Time Scale

| *Eons* | *Era* | *Period* | *Epoch* | *Age / Years Before Present* | *Life / Major Events* |
|---|---|---|---|---|---|
| | Cainozoic (From 65 million years to the present times) | Quaternary | Holocene | 0 - 10,000 | Modern Man |
| | | | Pleistocene | 10,000 - 2 million | Homo Sapiens |
| | | Tertiary | Pliocene | 2 - 5 million | Early Human Ancestor |
| | | | Miocene | 5 - 24 million | Ape: Flowering Plants and Trees |
| | | | Oligocene | 24 - 37 Ma | Anthropoid Ape |
| | | | Eocene | 37 - 58 Million | Rabbits and Hare |
| | | | Palaeocene | 57 - 65 Million | Small Mammals : Rats – Mice |
| | Mesozoic 65 - 245 Million Mammals | Cretaceous | | 65 - 144 Million | Extinction of Dinosaurs |
| | | Jurassic | | 144 - 208 Million | Age of Dinosaurs |
| | | Triassic | | 208 - 245 Million | Frogs and turtles |
| | Palaeozoic 245 - 570 Million | Permian | | 245 - 286 Million | Reptile dominate-replace amphibians |
| | | Carboniferous | | 286 - 360 Million | First Reptiles: Vertebrates: Coal beds |
| | | Devonian | | 360 - 408 Million | Amphibians |
| | | Silurian | | 408 - 438 Million | First trace of life on land: Plants |
| | | Ordovician | | 438 - 505 Million | First Fish |
| | | Cambrian | | 505 - 570 Million | No terrestrial Life : Marine Invertebrate |
| Proterozoic | Pre-Cambrian 570 Million - 4,800 Million | | | 570 - 2,500 Million | Soft-bodied arthropods |
| Archean | | | | 2,500 - 3,800 Million | Blue green Algae: Unicellular bacteria |
| Hadean | | | | 3,800 - 4,800 Million | Oceans and Continents form – Ocean and Atmosphere are rich in Carbon dioxide |
| Origin of Stars | 5,000 - 13,700 Million | | | 5,000 Million | Origin of the sun |
| Supernova | | | | 12,000 Million | Origin of the universe |
| Big Bang | | | | 13,700 Million | |

- **Evolution Of The Earth:**
  - **Formation of the Lithosphere**: Initially, Earth was extremely hot and volatile. As it cooled, **heavier elements like iron sank towards the centre,** while lighter materials rose to the surface, forming the crust.
  - **Evolution of Earth's Atmosphere in Three Stages.**
    - First, the loss of primordial atmosphere.
    - Second, the **hot interior of the earth** contributed to the evolution of the atmosphere. The **process through which the gases were outpoured from the interior is called degassing.**
    - Finally, the **atmosphere** was modified by the living world through the process of **photosynthesis** and volcanic activity.
  - **Development of the Hydrosphere:** As Earth cooled, water vapour in the atmosphere condensed and fell as rain, filling the planet's depressions to form oceans.
  - **Impact of Biological Processes on Atmosphere**: Photosynthesis began to flood the atmosphere with oxygen paving the way for more complex life forms that rely on oxygen.
  - **Origin of Life**: A kind of **chemical reaction,** which first generated **complex organic**

**molecules** and assembled them.




## UPSC Civil Services Examination, Previous Year Question (PYQ)

### ***Prelims:***

**Q. Which of the following pairs is/are correctly matched? (2008)**

**Theory/Law Associated Scientist**

1. Continental Drift : Edwin Hubble
2. Expansion of Universe : Alfred Wegener
3. Photoelectric Effect : Albert Einstein

**Select the correct answer using the code given below:**

**(a)** 2 and 3 only

**(b)** 3 only

**(c)** 2 only

**(d)** 1 only

**Ans: (b)**