



Micro-Lightning and Origin of Life

[Source: Stanford](#)

Why in News?

A Stanford University study suggests that **micro-lightning** i.e. **tiny electrical discharges** within water droplets could have played a crucial role in **forming organic molecules necessary for life on earth**, challenging the **Miller-Urey hypothesis**.

What are the Highlights of the Study About the Origin of Life on Earth?

- **Key Findings:**
 - The study found that **splashing/spraying water droplets** generate **electrical charges**, and their interaction produces **micro-lightning (tiny sparks)**, facilitating the formation of **essential biomolecules**.
 - It also demonstrated the spontaneous synthesis of **uracil** (a key RNA and DNA component), **glycine** (a fundamental amino acid for protein synthesis), and **hydrogen cyanide** (a precursor to complex biochemical compounds).
 - These findings suggest that **microlighting in natural water bodies like oceans**, waterfalls, and rainfall may have **driven prebiotic chemistry**, aiding the **emergence of life on Earth**.
- **Implications:**
 - **Challenges to the Miller-Urey Model:** It suggests that **frequent micro lightning in water bodies might have played a larger role** than rare lightning strikes.
 - **Astrobiological Potential:** Similar mechanisms could operate on icy moons like **Europa** and **Enceladus**, increasing the possibility of extraterrestrial life.

What is the Miller-Urey Hypothesis?

- The **Miller-Urey hypothesis** (1952) proposes that **life on Earth originated** through **chemical reactions triggered by lightning (atmospheric electricity)** in the early Earth's atmosphere.
- It demonstrated that **amino acids (the building blocks of life)** could form when **electricity was applied** to a mix of **water, methane, ammonia, and hydrogen**, suggesting that **organic molecules necessary for life could form naturally** under **early Earth conditions**.
 - It provided a scientific explanation for **abiogenesis** (the origin of life from non-living matter).

THEORIES OF EVOLUTION

The modification of living organisms during their descent, generation by generation from common ancestors.

Oparin-Haldane Theory of Origin of Life

- ↳ Also known as Materialistic theory
- ↳ Describes process of origin of life on early Earth as:

Physio-chemical processes of atoms → Organic compounds → Macromolecules → First living system or cells

Theory of Inheritance of Acquired Character (Lamarckism)

- ↳ First theory of organic evolution
- ↳ **Evolutionary ideas:**
 - ↳ Internal forces of life increase the size of organism
 - ↳ New structures appear because of an 'inner want'
 - ↳ Direct environmental effect over living organisms
 - ↳ Inheritance of acquired character
- ↳ **E.g.;** Long neck of giraffe due to gradual lack of surface vegetation

Theory of Natural Selection (Darwinism)

- ↳ Foundation of evolutionary biology
- ↳ **Elements:**
 - ↳ Universal occurrence of variation
 - ↳ Rapid multiplication
 - ↳ **The struggle for existence** - Intraspecific and interspecific
 - ↳ **Survival of the fittest (Natural Selection)**
 - ↳ Inheritance of useful variations; Elimination of non-useful variations
- ↳ **E.g.;** Survival of more dark-winged moths than white-winged ones in post-industrialisation period

Neo-Darwinism

Integration of Darwin's theory of evolution with Gregor Mendel's theory of genetics

Modern Synthetic Theory

- One of the proven theories of organic evolution
- Includes factors such as – Mutation, Variation / Recombination, Heredity, Natural Selection and Isolation

Mutation Theory (Hugo de Vries)

- ↳ Describes evolution as a jerky process where new varieties of species are formed by mutations (discontinuous variations)
- ↳ **Salient features:**
 - ↳ Mutation appears all of a sudden and becomes operational immediately
 - ↳ Same type of mutation in several individuals of a species
 - ↳ All mutations are inheritable
 - ↳ Useful mutations are selected and lethal ones are eliminated by nature



UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims:

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

Theory/Law Associated	Scientist
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- | | |
|---|--|
| 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)

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