JSR IAS ACADEMY

GENERAL SCIENCE

BIOLOGY

Evolution

Origin of life – Evolution of life forms

The present state of mankind on earth is the outcome of three kinds of evolution –

1. chemical,
2. organic
3. social or cultural evolution.

Origin of life – Evolution of life forms

Theory of special creation

- Life was created by a **supernatural power**, respectfully referred to as **"God".**
- According to Hinduism, Lord Brahma created the Earth. Christianity, Islam and most religions believe that God created the universe, the plants and the animals.

According to the theory of spontaneous generation or Abiogenesis,

living organisms originated from non-living materials

It was believed that

- **fishes** originated from **mud,**
- **frogs** from **moist soil**
- **insects** from **decaying matter.**

Thomas Huxley coined the term **abiogenesis.**

Big bang theory :-

- The primitive earth had no proper atmosphere, but consisted of ammonia, methane, hydrogen and water vapour.
- The climate of the earth was extremely high.
- UV rays from the sun split up water molecules into hydrogen and oxygen.
- Gradually the temperature cooled and the water vapour condensed to form rain.
- Ammonia and methane in the atmosphere combined with oxygen to form carbondioxide and other gases.

Biogenesis:-

- It was speculated by **Louis Pasteur (1862)** that life originates from preexisting life.
- while in another flask kept open to air living organisms arose from killed yeast.

Theory of biogenesis:-

- According to the theory of biogenesis life arose from pre-existing life.
- The term biogenesis also refers to the biochemical process of production of living organisms .
- This term was coined by **Henry Bastian.**

Extraterresterial or Cosmic origin:-

- Some scientists still believe that life came from outer space.

According to the theory of chemical evolution:-

- The primordial environment of the earth evolved spontaneously from inorganic substances and physical forces such, **as lightning, UV radiations, volcanic activities, etc.,.,**
- **Oparin (1924)** suggested that the organic compounds could have undergone a series of reactions leading to more complex molecules.
- He proposed that the molecules formed colloidal aggregates or **'coacervates'** in an aqueous environment.
- The coacervates were able to absorb and assimilate organic compounds from the environmen

Coacervates (large colloidal particles that precipitate out in aqueous medium) are the first pre-cells which gradually transformed into living cells.

Haldane (1929) proposed that

- the primordial sea served as a vast chemical laboratory powered by solar energy.
- The atmosphere was oxygen free and the combination of CO_2, NH_3 and UV radiations gave rise to organic compounds.
- **Haldane** coined the term **prebiotic soup**

Geological time scale

The duration of the earth's history has been divided into eras that include the

1. Paleozoic,
2. Mesozoic, and
3. Cenozoic.

The Paleozoic era :-

The seven periods of Paleozoic era in order from oldest to the youngest are

1. **Cambrian** (Age of invertebrates),
2. **Ordovician** (fresh water fishes, Ostracoderms, various types of Molluscs),
3. **Silurian** (origin of fishes),
4. **Devonian** (Age of fishes, many types of fishes such as lung fishes, lobe finned fishes and ray finned fishes),
5. **Mississippian** (earliest amphibians, Echinoderms),
6. **Pennsylvanian** (earliest reptiles),
7. **Permian** (mammal like reptiles).

Mesozoic era :-

Mesozoic era (dominance of reptiles) called the Golden age of reptiles, is divided into three periods namely

1. **Triassic** (origin of egg laying mammals),
2. **Jurassic** (Dinosaurs were dominant on the earth, fossil bird – Archaeopteryx)
3. **Cretaceous** (extinction of toothed birds and dinosaurs, emergence of modern birds).

Cenozoic era :-

Cenozoic era (Age of mammals) is subdivided into two periods namely Tertiary and Quaternary.

Tertiary period is characterized by abundant mammalian fauna.

This period is subdivided into five epochs namely,

1. **Paleocene** (placental mammals,
2. **Eocene** (Monotremes except duck billed Platypus and Echidna, hoofed mammals and carnivores),
3. **Oligocene** (higher placental mammals appeared),
4. **Miocene** (origin of first man like apes)
5. **Pliocene** (origin of man from man like apes).

Quaternary period witnessed

1. decline of mammals and
2. beginning of human social life.

Radioactive carbon(C14) dating method

- This method was discovered by **W.F. Libby (1956).**
- Carbon consumption of animals and plants stops after death and since then, only the decaying process of C14 occurs continuously.
- The time passed since death of a plant or animal can be calculated by measuring the amount of C14. present in their body.

DO YOU KNOW?

Thiruvakkarai fossil wood park (Villupuram district, Tamil Nadu): 2 million years ago tree trunks that got buried along the river, incourse of time the organic matter was replaced by silica and was fossilized. They retained their color, shape and texture and was converted into solid rocks. The annular rings, the texture, colors of the layers, nodes and every properties of plants are still visible.

Astrobiology/Exobiology

- Astrobiology/exobiology is the science which looks for the presence of extra terrestrial life in the universe.
- It must have an orbit at just the right distance from its star (Sun) that it allows liquid water to exist. Thus, the distance need to be neither too hot or not too cold and is often referred as Goldilock Zone for life.
- In our solar system 'Earth' is the only planet in the **goldilock zone.**
- Since, this zone varies at times as the star evolves, we know that Mars have also been habitable.

Biological evolution

Formation of protobionts

- Abiotically produced molecules can spontaneously self assemble into droplets that enclose a watery solution and maintain a chemical environment different from their surroundings.
- Scientists call these spheres as **'protobionts'.**
- **Liposomes** are lipids in a solution that can self assemble into a lipid bilayer.
- Two major cell types that appeared during this time were significant.

One form

- Such cells were similar to the **Monera.**
- They are considered as ancestral to the modern **bacteria** and **blue green algae.**

The other form

This membrane separated nucleoproteins from the cell substances. Such cells were referred to as **Protista.**

Experimental approach to the origin of life

- **Urey and Miller (1953),** In their experiment, a mixture of gases was allowed to circulate over electric discharge from an **tungsten** electrode.
- The only source of carbon was methane.

Evidences for biological evolution

i) Actual remains –

- The original hard parts such as bones, teeth or shells are preserved as such in the earth's atmosphere.
- For example, **Woolly Mammoth** that lived **22 thousand years ago** were preserved in the frozen coast of **Siberia** as such.
- Several human beings and animals living in the ancient **city of Pompeii** were preserved intact by **volcanic ash** which gushed out from **Mount Vesuvius.**

ii) Petrifaction –

When animals die the original portion of their body may be replaced molecule for molecule by minerals and the original substance being lost through disintegration.

iii) Natural moulds and casts –

Even after disintegration, the body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones.

Evidences from Palaeontology

- Palaeontology deals with the study of fossils.
- Leonardo da Vinci is called the Father of Palaeontology.

Archaeopteryx:

- Archaeopteryx is the oldest known fossil bird.
- It was an early birdlike form found in the Jurassic period.
- It is considered to be a connecting link between reptiles and birds.
- It had wings with feathers, like a bird. It had long tail, clawed digits and conical teeth, like a reptile.