

## Theories of origin of life on earth

Different scientists and philosophers have put forwards different explanation of origin of life on earth from time to time. Among them, some of popular theories of origin of life are following:

1. **Theory of Special Creation**
  2. **Theory of Spontaneous generation or Abiogenesis theory**
  3. **Biogenesis theory**
  4. **Panspermia Theory or Cosmogeny theory**
  5. **Modern theory of origin of life or Oparin-Haldane theory of origin of life**
1. **Special creation theory:**

This theory is stated that **God created this whole universe, sun, moon, stars, earth and all the different living creatures present on earth as the form that they are existed today.** This theory was strongly supported by father Suarez (1548-1671 AD) and major religions and civilization of world. Popularity of this theory was decrease with increase of scientific thinking in people.

2. **Theory of Spontaneous generation or Abiogenesis theory or Autogenesis theory:**

This is the oldest theory of origin of life that was proposed. Aristotle and Anaximander appreciated this theory. This theory is stated that **living things were originated from the non-living substances or inanimate matters spontaneously or automatically and they remain unchanged.** In ancient time, Chinese people believed that aphids and other insects were arose under the influence of heat and moisture. Aristotle (384-322 BC) proposed that worms, insects, fish and tape worm were developed from excreta, crab and salamander from earth. This theory was widely appreciated and accepted until mid17<sup>th</sup> century. However, belief on this theory was decreased with establishment of experimental biology. Scientists like Francisco Redi, Lazzaro Spallanzani and Louis Pasteur experimentally rejected this theory.

3. **Biogenesis theory:**

French microbiologist Louise Pasteur (1822-1895 AD) proposed this theory. It is stated that **life originated from pre-existing life only, not from inanimate substances.** This theory is rejected because it is unable to explain the process of origin of life.

### **Pasteur's experiment**

To support the biogenesis theory, Pasteur conducted an experiment. In his experiment, he prepared hay infusion in swam neck flask. To kill the microbes and sterilize both infusion and flask, the infusion was boiled. The opening of flask was unsealed and left the apparatus undisturbed for several days. No life or microbes were appeared in flask because the design of flask was such that its neck trapped all viable microbial particles

and only allowed the pure air into the infusion. When he broke the neck of flask, microbes were appeared in infusion. Thus, he proved that life could arise from pre-existing life only.

#### **4. Cosmozoic theory or Panspermia theory**

Richter (1865 AD) proposed this theory. According to this, **life came on earth from other planet in the form of seeds or spores; called panspermia, along with dust particles and they subsequently found suitable environment to grow into life.** It was rejected because it could not able to explain the mechanism by which panspermia survived at adverse condition of temperature and lethal radiation of inter-planetary space during migration.

#### **5. Modern theory of origin of life or Chemosynthesis theory of life or Oparin-Haldane theory of origin of life**

This theory was proposed by Russian biochemist Alexander Ivanovich Oparin in 1923AD in his book of title “The origin of life on the earth”. This was supported by English biochemist JBS Haldane in 1928 AD. Thus, this theory is also known as Oparin-Haldane theory. This theory is based on that **primitive form of life originated on the primitive earth from inorganic matters through the evolution in chemicals and their aggregates (coacervates), under the influence of natural force and later, coacervates evolved into primitive life form.** Theory can be explained in following headings;

##### **A. Origin of earth**

##### **B. Origin of life on earth**

##### **A. Origin of earth**

The earth was supposed to be originated about 4.6 to 5 billion years ago and it is believed to be formed by condensation of clouds of cosmic dust particles and gases called ylem.

##### **B. Origin of life on earth**

It was expected that life was originated on earth about 3.7 billion years ago and involved following changes

##### **1. Chemogeny**

##### **2. Biogeny**

##### **3. Cognogeny**

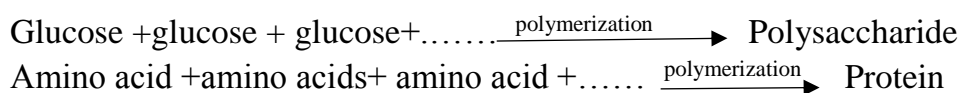
##### **1. Chemogeny**

It is a stage of formation of chemical constituents required for formation of living organisms by the evolution in chemicals especially lighter gases (like hydrogen, carbon, nitrogen and oxygen etc.). At the time of earth's origin, it was red-hot rapidly rotating gaseous cloud of free atoms of different elements. As the temperature of earth gradually cooled down, condensation and stratification of gaseous cloud were

occurred. Gaseous atoms were moved, collided and combined, forming various types of inorganic elements and compounds. Oxygen was not existed in free form. Thus, primitive atmosphere became reducing type.

Temperature of earth cool down further 100 °C or below, depressions of earth surface was able to hold water and form large sized water bodies like primitive oceans or seas. The hot oceanic water contained large amounts of dissolved gases, elements and inorganic compounds like ammonia, methane, metal carbides and metal nitrides etc. When these compounds reacted with each other in presence of water, formed variety of saturated and unsaturated hydrocarbons. They reacted with water and formed oxy and hydroxy derivatives likes aldehydes, ketones, alcohols, organic acids (amino acids, fatty acids), glycerol, glucose, nitrogen bases (purines and pyrimidines) etc. Energy required for all these reactions were supplied by ultra-violet rays of sun, electrical discharges from thunder, heat from volcanic eruption and radio-active elements etc.

Simple organic compounds like glucose, amino acids, glycerol and fatty acids etc. were polymerized by losing water molecules and formed complex organic compounds like polysaccharides, proteins and lipids etc. in primitive oceanic water. The oceanic water mixed with these (carbohydrates, proteins and lipids) complex organic compounds are called **hot dilute soup** or **prebiotic soup** or **primordial soup** by Haldane. These complex molecules are constituents of protoplasm. Therefore, formation of these compounds especially protein is crucial start of transformation of non-living to living form.

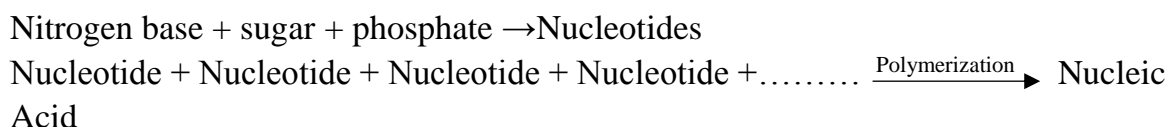


## 2. Biogeny

Process of formation of self-multiplying biological units or primordial life from chemical constituents like carbohydrates, proteins and lipids etc. called biogeny. It occurs by following steps:

### i. Formation of nucleotides and nucleic acid

When Nitrogen bases like purines and pyrimidines combined with simple sugars and phosphate group present in primitive sea water formed the nucleotides. Later on, the nucleotides were polymerized and formed nucleic acids like DNA and RNA.



### ii. Formation of coacervates or aggregates

The complex organic compounds were collided, reacted and aggregated in various combination to form a new type of large, complex and insoluble colloidal organic particles in primitive sea water called coacervates. [The process of formation of

coacervates is coacervation.] The coacervates absorbed organic substances from the seawater, acquired variable chemical composition and were grow into their optimum sizes. Then, they broke down into small droplets to increase their numbers. Thus, coacervates had some properties of living beings i.e., absorbed substances, grown in size and replicated themselves. So, they are considered to be the foundation of life.

### **iii. Formation of primitive life or primordial life**

Some of protein droplets of coacervates along with metal ions and water, acted as catalytic agent in breaking down and synthesis reaction. It is believed that coacervates would have been undergone further series of chemical changes due to formation of enzymes. The coacervate like nucleoprotein was surrounded by a thin fold of phospholipids molecules as limiting membrane and developed pre-cell like structure called as **eobiont** or **proto-biont** or **pre-biotic** structure. Later, they modified their parts due to chemical changes in their nucleic acids and internal re-arrangement of phospholipid coat that may have produced primitive cell. The primitive cell lacked a definite nucleus and feed on the organic matters present in primordial soup. Thus, the first formed cell was prokaryotic, chemo-heterotrophic and anaerobic type and believed to be originated approximately 3.7 billion years ago.

### **3. Cognogeny**

Cognogeny is evolution in living organisms from simple first formed living cell. With gradual increased in number of prokaryotic, anerobic and chemo-heterotrophs, most of organic matters present in primitive seawater gradually decreased. However, in due course of time, some of them developed certain enzymes or mechanism that helped them to synthesize organic molecules from the inorganic molecules and energy required for this process was supplied by the anaerobic break down reactions. In this way, prokaryotic, anaerobic and chemoautotrophs were evolved. Later on, certain chemoautotrophs developed chlorophyll molecules, which acts as catalyst, enable them to use water and carbon dioxide to synthesis organic molecules in presence of solar energy. With increased of photosynthetic prokaryotes, oxygen was released in the sea and then in atmosphere which turned the reducing environment into oxidizing type. With the released of free oxygen in the environment, the condition was suitable for aerobic respiration upon the earth which was probably about 2.7 billion years ago. The anaerobic prokaryotes gradually modified to adopt for aerobic mode of respiration and they, later developed a true nucleus, mitochondria and other cells organelles. Thus, free-living eukaryotes were formed from some prokaryotes in the ocean of about 1.5 billion years ago and from them developed different types of higher organisms.

[**Note:** Oxygen revolution- With increased of photosynthetic organisms, free oxygen molecules were available in atmosphere which converted reducing atmosphere to oxidizing type]