

## MANIDHANAHEYAM FREE IAS ACADEMY – TNPSC GROUP II & IIA

### UNIT – I-BIOLOGY

#### The Science of Heridity

#### 1. Theories on Origin of Life

1. **Special creation:** This idea embodies that life on Earth is a divine creation and also attributes to supernatural event at a particular time in the past. It also emphasizes that life has not changed ever since its origin.

2. **Spontaneous generation (Abiogenesis):** According to this theory life originated spontaneously from lifeless matter. It was believed that fishes originated from mud, frogs from moist soil and insects from decaying matter.

3. **Biogenesis:** It was speculated by Louis Pasteur (1862) that life originates from preexisting life. He showed that pre-sterilised flasks kept closed airtight, with killed yeast, did not give rise to any life form, while in another flask kept open to azzzzzir living organisms arose from killed yeast.

4. **Extraterrestrial or Cosmic origin:** Some scientists still believe that life came from outer space. This states that units of life called spores (Panspermia) were transferred to different planets including earth. This is still an idea of some astronomers.

5. **Chemical Evolution of Life:** This idea was developed by Oparin (1922) and Haldane (1929). They proposed that with the conditions prevailing on earth, life arose by a series of sequential chemical reactions. The first form of life could have come from pre-existing nonliving inorganic molecules which gave rise to formation of diverse organic molecules which are transformed into colloid system to produce life. The modern concept on chemical evolution regarding origin of life was accepted.

#### 2. Evidences of Evolution

Evolution can be better understood only by observing the interrelationship between the existing organisms and also relating the similarities with the extinct organisms. The inter relationship of the organisms is also supported by evidences from different branches of biology. These evidences support the concept that all organisms have evolved from common ancestors.

##### 1. Evidences from Morphology and Anatomy

The comparative study of morphology and anatomy of animals, reveal that they possess common set of characteristics.

- **Homologous organs:** The homologous organs are those which have inherited from common ancestors with similar developmental pattern in embryos. The fore limbs of mammals are homologous structures. A human

## MANIDHANAHEYAM FREE IAS ACADEMY – TNPSC GROUP II & IIA

### UNIT – I-BIOLOGY

hand, a front leg of a cat, flipper of a whale and a bat's wing look dissimilar and adapted for different functions. Their mode of development and basic structure of bone are similar.

- **Analogous organs:** The analogous organs look similar and perform similar functions but they have different origin and developmental pattern. The function of the wings of a bat, the wings of a bird and wings of an insect are similar, but their basic structures are different.
- **Vestigial organs:** The degenerated and non-functional organs of animals are called vestigial organs. The same organs are found to be well developed and functional, in some of the related forms. Some of the vestigial organs in man are vermiform appendix, nictitating membrane, caudal vertebra, coccyx etc.
- **Atavism:** The reappearance of ancestral characters in some individuals is called atavism. e.g. Presence of rudimentary tail in new born babies, presence of thick hair on the human body

#### 2. Evidences from Embryology

The study of comparative embryology of different animals, supports the concept of evolution. The embryos from fish to mammals are similar in their early stages of development. The differentiation of their special characters appear in the later stages of development.

Biogenetic law or Recapitulation theory was given by Ernst Haeckel. According to this theory, Ontogeny recapitulates Phylogeny. The stages of development of the individual animal repeats the evolutionary history of the entire race of the animal.

#### 3. Evidences from Palaeontology

Palaeontology deals with the study of fossils. Leonardo da Vinci is called the Father of Palaeontology. The study of fossils helps us to understand the line of evolution of many invertebrates and vertebrates. Fossil records show that the evolution has taken a gradual process from simple to complex organisms. The origin of modern birds is supported by the evidences from palaeontology.

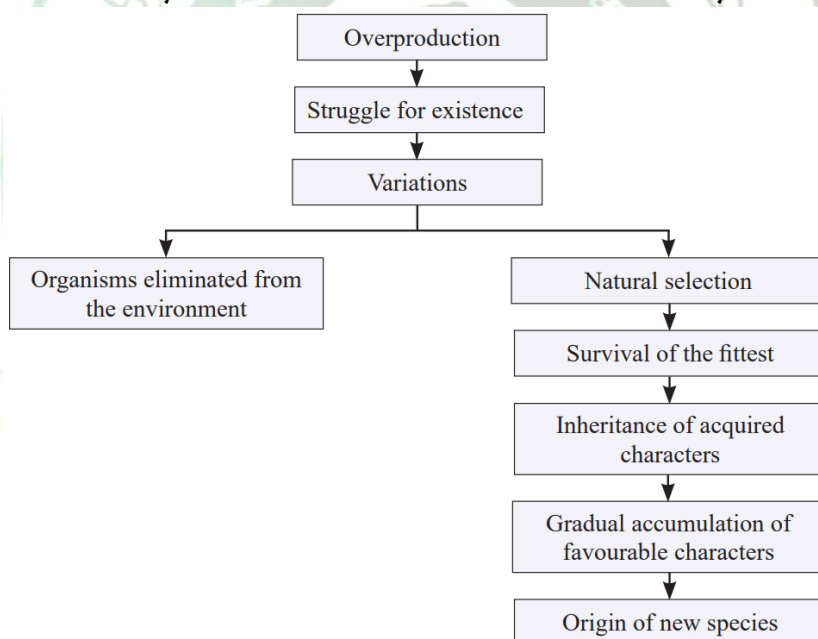
**Archaeopteryx:** Archaeopteryx is the oldest known fossil bird. It was an early birdlike form found in the Jurassic period. It is considered to be a connecting link between reptiles and birds. It had wings with feathers, like a bird. It had long tail, clawed digits and conical teeth, like a reptile.

**MANIDHANAHEYAM FREE IAS ACADEMY – TNPSC GROUP II & IIA**  
**UNIT – I-BIOLOGY**

### 3. Darwinism or Theory of Natural Selection

Charles Darwin (1809-1882) was one of the great naturalist and philosopher of 18th century. He was born in England in 1809. While studying in college through his friendship with Professor J.S.Henslow he was fascinated towards nature. At that time the British Admiralty planned a voyage of exploration for 5 years on a ship named H.M.S. Beagle around South America. Dr Henslow was asked to nominate a young naturalist for the voyage. Darwin was given the opportunity. During his five years (1831–1835) voyage he visited many parts of the world, a number of islands including the Galapagos island and Pacific island. Darwin made elaborate observations on nature of the land, plants and animals of the regions he visited. He further worked for a period of 20 years to develop the theory of natural selection.

Darwin published his observations and conclusions under the name ‘Origin of species’ in 1859. The book of Darwin demonstrates the fact of evolution. It elaborates on the theory of Natural selection for evolutionary transformation.



#### Principles of Darwinism

##### i. Overproduction

Living beings have the ability to reproduce more individuals and form their own progeny. They have the capacity to multiply in a geometrical manner. This will increase reproductive potential leading to overproduction.

##### ii. Struggle for existence

Due to over production, a geometric ratio of increase in population occurs. The space to live and food available for the organisms remain the same. This creates

**MANIDHANAHEYAM FREE IAS ACADEMY – TNPSC GROUP II & IIA**  
**UNIT – I-BIOLOGY**

an intense competition among the organisms for food and space leading to struggle.

**The struggle for existence are of three types:**

- Intraspecific struggle: Competition among the individuals of same species.
- Interspecific struggle: Competition between the organisms of different species living together.
- Environmental struggle: Natural conditions like extreme heat or cold, drought and floods can affect the existence of organisms

**iii. Variations**

The occurrence of variation is a characteristic feature of all plants and animals. Small variations are important for evolution. According to Darwin favourable variations are useful to the organism and unfavourable variations are harmful or useless to the organism.

**iv. Survival of the fittest or Natural selection**

During the struggle for existence, the organisms which can overcome the challenging situation, survive and adapt to the surrounding environment. Organisms which are unable to face the challenges, are unfit to survive and disappear. The process of selection of organisms with favourable variation is called as natural selection.

**v. Origin of species**

According to Darwin, new species originates by the gradual accumulation of favourable variations for a number of generations.

**Objections to Darwinism**

1. Some objections raised against Darwinism were –
2. Darwin failed to explain the mechanism of variation.
3. Darwinism explains the survival of the fittest but not the arrival of the fittest.
4. He focused on small fluctuating variations that are mostly non-heritable.
5. He did not distinguish between somatic and germinal variations.
6. He could not explain the occurrence of vestigial organs, over specialization of some organs like large tusks in extinct mammoths, oversized antlers in the extinct Irish deer, etc.,

**Neo Darwinism**

Neo Darwinism is the interpretation of Darwinian evolution through Natural Selection as it has been modified since it was proposed. New facts and discoveries

**MANIDHANAHEYAM FREE IAS ACADEMY – TNPSC GROUP II & IIA**  
**UNIT – I-BIOLOGY**

about evolution have led to modifications of Darwinism and is supported by Wallace, Heinrich, Haeckel, Weismann and Mendel. This theory emphasizes the change in the frequency of genes in population arises due to mutation, variation, isolation and Natural selection.

**4. Mutation theory**

Hugo de Vries put forth the Mutation theory. Mutations are sudden random changes that occur in an organism that is not heritable. De Vries carried out his experiments in the Evening Primrose plant (*Oenothera lamarckiana*) and observed variations in them due to mutation.

According to de Vries, sudden and large variations were responsible for the origin of new species whereas Lamarck and Darwin believed in gradual accumulation of all variations as the causative factors in the origin of new species.

**Salient features of Mutation Theory**

1. Mutations or discontinuous variation are transmitted to other generations.
2. In naturally breeding populations, mutations occur from time to time.
3. There are no intermediate forms, as they are fully fledged.
4. They are strictly subjected to natural selection.