Origin of Life

Introduction

- All living organisms have originated through the evolutionary process and show diversity, yet some similarities exist among the e.g. Amphibians, reptiles and mammals have limbs for locomotion, fishes have fins for swimming in water and birds have wings for flying.
- A close examination reveals that the limbs, fins and wings are formed on the same basic structural plan.
- All such examples can be explained if we consider that the diverse groups of organisms share common ancestors from whom they have diverged and formed two different species. Such processes of change in biological system is called as evolution.
- The doctrine of the Organic Evolution states that the organisms existing at present are the descendant of much simpler ancestors.

Origin of Life

• Several theories have been put forward to explain the origin of life

(i) Theory of special creations: Acording to this theory life was created by some super Natural Power (God)

• The theory proposed by suarez.

(ii) Theory of spontaneous generation: According to this theory life is originated repeatedly from nonliving materials automatically from time to time. This theory was supported by Thales and Aristotle.

(iii) Theory of Biogenesis: Scientists like Redi, Lazzaro spallanzani, Louis Pasteur proposed and proved the biogenesis concept of Huxley and Harvey that new organisms arise from preexisting ones.

- (i) Cosmozoic theory: It states that, life came to earth from some heavenly bodies in the form of spores and seeds.
- (ii) Modern theory (Naturalistic theory): Life originated upon earth by a long series of physiochemical changes which brought about a gradual evolution of first inorganic and then organic compounds (Chemical evolution). It results in the formation of protoplasm. The includes -

- Oparin Haldance Theory.
- Oparin's views were later on published in his bood "The origin of life".
- According to this theory earth was formed about 4600 million years ago. The atoms of nitrogen, hydrogen, oxygen, argon, carbon etc. Formed the primitive atmosphere.
- Large quantities of H₂, N₂, water vapours, CH₄ and NH₃ were present, but free oxygen was not present in significant amount.
- Further fall in temperature allowed H2O to remain in liquid form so that oceans and water bodies were formed containing large amount of dissolved NH₃, CH₄,HCN, nitrites, carbides and various gases.
- Reacting with water and it's oxygen, simple saturated hydrocarbons such as CH₄ formed unsaturated hydrocarbons like ethylene, acetylene. Later aldehydes, ketones, alcohols and organic acids were formed.
- Abundant energy was available in the form of heat, cosmic rays and lightening. Using this energy. The organic molecules of ocean water formed complex compounds like amino acids, Sugar, glycerol, fatty acids, nitrogenous organic bases etc.
- These molecules further formed large linear polymers, or macromolecules like protein, carbohydrates, and fats, the oceanic water became a rich mixture of organic compound called "prebiotic soup".

• Stanley Miller and H.C. Urey Experiment: [Experiment for verification of prebiotic soup]:

- This experiment verified the Oparin Haldane theory by creating [stimulating] in their laboratory the probable condition on the primitive earth.
- The resultant mixtures were allowed to condense.
 Experiment was run for one week. Chemical composition of the liquid revealed glycine, alanine and aspartic acid.
- Thus biotic synthesis of organic molecules was confirmed.



Organic Evolution:

(i) Though life originated by chemical evolution on the primitive earth. It was later replaced by organic evolution.

(ii) Organic evolution states "Descent with modification" i.e. present day complex living organisms have evoloved from earlier simpler organisms by small but gradual changes which have occurred over million of years.

(iii) Though living organisms show great diversity in size, structure, function, behaviour etc. They also show basically similar metabolic processes indication some common ancestors.

Fossils

- The plants and animals that lived in remote past have left proofs of the existence in the form of remains in the rocks. These are called as fossils.
- Palaentology is the study of fossils.
- Leonardo- da vince was called as Father of Palaeontology.
- Founder of modern Palaeontology is George Cuvier.

Morphological evidences

- (a) Homologous organs or Homology:
 - [Same structure but different function] Homology can be defined as the relationship between the structures which have similarity due to common ancestors, although these structures might show difference in their function.
- E.g.

(i) Fore limbs of vertebrates having pentadactyl limb, origin and similar arrangement of bones, Muscles etc.

- (ii) Legs of different insects.
- (i) Teeth of man.

(b) Analogous organs or Analogy:

[Different structure but similar function] Analogy can be defined as a relationship which differ between structures. though but would anatomically have superficial similarity due to similar functions.



- (i) Wings of insects and wings of birds.
- (ii) Sting of bee and scorpio.
- (iii) Fins of fish and flipper of whales.

(c) Vestigial Organs:

Those organs which no longer remain functional are known as vestigial organs. These organs have reduced structurally as well as functionally.

- It appears that these organs were well developed in ancestors but due to their reduced or less use they became functionless.
- E.g.
 - (i) Vermiform appendix in man.
 - (ii) External ear in man.
 - (iii) Nictitating membrane. (iv) Wisdom tooth.



Vestigial organs of man

(d) Common Ancestry and Inter- relationship

- Various organisms are interconnected.
- Their resemblance suggest a common ancestry.
- E.g.
 - (i) Heart of fish is 2 Chambered.
 - (ii) Heart of amphibians is 3 chambered.
 - (iii) Heart of birds and mammals is 4 chambered.

(e) Connecting Links:

As we know that animals are sharply differentiated and classified into phyla and classes but there are some existing animals which represent an intermediate position between the two groups. Such organisms are called as connecting links.

• E.g.

(i) Lung fish shows conncetion between fishes and amphibians.

(ii) Amphibians are the connecting links between fishes and reptiles.

(iii) Viruses are connecting links between living and nonliving.

(iv) Euglena is connecting link between plants and animals.

(v) Protospongia is connecting link between protozoa and porifera.

(vi) peripatus is connecting link between Annelida and Arthopoda.

• Archaeopteryx is connecting link between reptiles and birds.

Embryological evidences

- Embryology can be defined as brach of science that deals with study of development of an organism from zygote to an adult form inside the egg or mother's womb.
- The study of embryos from various organisms reveals similarity in the earyly stages of embryo development and this theory suggests that these organisms have evolved from common ancestors.
- E.g.

(i) Embryos of fish, tortoise, child, rabbit and man shows the similarity during embryo development.



vertebrate embroys A. Fish, B. Salamander C. Tortoise, D. Chick, E. Calf, F. Human

Darwinism

"Darwinism" or theory of natural selection was proposed jointly by charles Darwin and A.R. Wallace in 1859. This theory was later on explained by chartes Darwin in his Bood "Origin of species by means of Natural Selection" (1859). Charles Darwin traveled in a ship named beagle for five years.

(a) Postulates of Darwinism:

He had proposed 3 important postulates namely.

(i) Multiplication of individual: Due to geometric multiplication and due to the availability of limited food and space for these individuals the struggle for existence is seen.

(ii) Existence of variation: It is a rule of nature and is proved to be beneficial for better existence.

(iii) Natural Selection: Natural selection is the principle element of Darwin's theory. The principle by which the preservation of useful variation is brought about was called as natural selection.

(b) Merits of Darwinism:

(i) The major achievement of Darwin was to recognize one of the major factor in adaptation i.e. natural selection.

(c) Demerits of Darwinism:

(i) In Darwin's natural selection principle the death of the unit and the survival of the fittest was conceived.

(ii) Darwin also believed that the natural selection operates on variations but he did not consider the possibility of the origin of new hereditary variations. Which are really responsible for origin of species.

NEO- Darwinism

- It is a modified form of Darwinism, along with the recent research of Weisman, Mendel, Huxley, Gates, Devries etc.
- Neo-Darwinism comprises three important postulates. They are as follows:

(a) Genetic Variability:

It means the variations that occur in a genetic constitution of an organism. They could be of following types:

(i) Chromosomal aberrations [deletion, duplication, translocation and inversion]

(ii) chromosomal numbers [haploidy, polyploidy etc.]

(iii) Gene mutation

(b) Natural Selection:

According to Neo- Darwinism the organism which is more adapted toward environment matures first and produces more progenies, as compared to less adapted organism.

- It can overcome environmental stress.
- It produces greater progency than others.

(c) Reproductive Isolation:

It is the failure of interbreeding between the related groups of living organisms and is essential to prevent the dilution of differences between the genetically different species.

Larmarckism

- Lamarck published his theory of evolution in 1809.
- His theory is often called as theory of Inheritance of Acquired characters' or theory of use and Disuse of Organs.'
- (a) Lamarcks's theory:

(i) Living organisms or their body parts tent to increase in size continually.

(ii) A new need gives rise to new organ.

(iii) Continuous use of an organ results in development while disuse results in degeneration.

(i) Modifications produced during lifetime

(b) Criticism of Lamarckism:

• Mendel's laws of inheritance and Weisman's theory of germplasm resulted in the erosion of Lamarck's concept.

EXERCISE

- **1.** Evolution is defined as
 - (a) History of race
 - (b) Development of race
 - (c) History and development of race with variations
 - (d) Progressive history of race
- 2. Homologous structures have
 - (a) Similar origin but dissimilar functions
 - (b) Dissimilar origin but similar functions
 - (c) Dissimilar origin but dissimilar functions
 - (d) Dissimilar origin but dissimilar structures
- **3.** Stanly miller synthesized
 - (a) Proteins (b) Viruses
 - (c) Amino acids (d) Vitamins
- **4.** According to Neo-Darwinism, natural selction operates through
 - (a) Fighting between organisms
 - (b) Killing the weaker organism
 - (c) Differential reproduction
 - (d) None of the above
- 5. Study of fossils is called-
 - (a) Palaeobotany (b) Palaeontology
 - (c) Misology (d) Systematics
- 6. Lamarck's theory of evolution is also called
 - (a) Survival of the fittest
 - (b) Theory of special creation
 - (c) Evolution through natural selection
 - (d) Inheritance of acquired characters
- **7.** Which of the following is the most primitive ancestor of man?
 - (a) Homohabilis
 - (b) Homoneanderthalensis
 - (c) Australopithecus
 - (d) Ramapithecus punjabicus
- **8.** Which one is the most essential for origin of life?
 - (a) Enzymes (b) Proteins
 - (c) carbohydrates (d) Nucleic acids
- 9. Which was not proposed by Darwin?
 - (a) Struggle for existence
 - (b) Natural selection
 - (c) Genetic drift
 - (d) Survival of the fittest
- 10. There is no life on moon because there is no
 - (a) Carbon (b) Nitrogen

(c) Silicate (d) Water

- **11.** For origin of life, the most important condition is the presence of-
 - (a) Water (b) Carbn
 - (c) Nitrogen (d) Oxygen
- **12.** Adaptation of species is it's
 - (a) Acquired character
 - (b) Mutation
 - (c) Metamorphosis
 - (d) Hereditary character
- **13.** Who proposed spontaneous generation of life?
 - (a) Van Helmont (b) Pasteur
 - (c) Lamarck (d) Oparin
- **14.** According to modern hypothesis life originated by
 - (a) Spontaneous generation
 - (b) God
 - (c) Spores came from other planets
 - (d) Chemical development
- **15.** Ontogeny recapitulates phylogeny is the brief definition of
 - (a) Mutation theory
 - (b) Biogenetic law

- (c) Abiogenesis
- (d) Darwinism
- **16.** Which one of the following represents an example of organic evolution?
 - (a) Progressive attainment of immunity against infectious disease by means of vaccinations.
 - (b) Progressive changes in water breathing tadpole leading to air breathing frog.
 - (c) Progressive attainment of erect posture in human ancestors.
 - (d) Development of unfertile of insects.
- **17.** Which of the following forms the basis of the concept of organic evolution proposed by lamarck?
 - (a) Enormous fertility and heredity
 - (b) Struggle for existence and use and disuse of organs
 - (c) Variation, heredity and natural selection
 - (d) Use and disuse of organs and inheritance of acquired characters

ANSWER - KEY

ORIGIN OF LIFE										
Q.	1	2	3	4	5	6	7	8	9	10
Α.	С	Α	С	С	В	D	D	D	С	D
Q.	11	12	13	14	15	16	17			
Α.	Α	Α	Α	D	В	С	D			