10. Origin and Evolution of Life

- **Origin of life**
  - **Evolutionary biology** is the field of science that deals with the study of evolutionary development of life forms on earth
  - **Big-bang theory** explains the origin of the universe.
  - Scientists believed that life originated through chemical evolution.
  - Formation of biomolecules → First life form

  - **According to Oparin and Haldane,** the primitive atmosphere was reducing as it lacked oxygen. The atmosphere was rich in methane, water vapour, ammonia and carbon dioxide.
  - The temperature was high and volcanic eruptions were frequent.
  - **Urey and Miller** experimentally confirmed that formation of life was preceded by chemical evolution.
  - **Branching descent** and **natural selection** are the key concepts of **Darwin's theory.**

- **Evidences of evolution -**
  - Fossils
  - Homologous organs
  - Analogous organs
  - Vestigial organs
  - Comaprative anatomy and morphology
  - Embryological evidences
  - Molecular evidences

- The slow and gradual process of change of one organism into another is known as **Organic Evolution**.
- The occurrence of evolution has been supported by various theories put forth by biologists.
- In 1809, Jean Baptiste Lamarck a French zoologist put forth the theory of inheritance of acquired characters; also known as **Lamarckism**.
- He stated that according to their need, organisms put some organs in their bodies to maximum use while some of the organs were not used. The part of the body put to maximum use will have the tendency to grow larger and stronger while the part less used will become less prominent and ultimately disappear altogether. Thus, the organisms acquired new characters. For example, giraffe have developed long necks as a result of attempts to eat leaves high up on trees.

Darwinism

- According to Darwin, evolution took place by natural selection.

- Another aspect of natural selection is the survival of the fittest, where nature selects the individuals, which are most fit, to adapt to their environment.

Speciation- formation of new species

Causes of Evolution
Natural selection- a process that results in an increased survival and reproductive success of individuals that are well adjusted to the environment

Genetic drift- accidental change in the frequency of genes in a small population
Geographical isolation- Two sub-populations of the same species cannot interbreed because of the appearance of geographical barriers such as rivers, mountains etc.

Homologous organs:

The homologous organs are similar in form , but perform different functions in different organisms.

Analogous organs:

The organs that perform similar functions in different organisms of different origins are **analogous**.

What are fossils?

Fossils are the remains of organisms that once existed on Earth. They represent the ancestors of plants and animals.

Appearance of fossils

Fossils have the same shape as that of the original animal, but their colour and texture may vary widely. The colour of a fossil depends upon the type of minerals that form it.

The science dealing with the study of fossils is called Palaeontology.

Formation of Fossils

1. Organisms decay after their death, but the hard parts of the organisms are preserved.
2. When organisms die, they get buried under the sediments of sand .
3. Sediment deposition occurs and their hard parts absorb minerals.
4. Many years later, minerals replace their hard parts and convert them into fossils.
5. The sediments which cover the fossils get converted into sedimentary rocks.

Importance of Fossils

(i) They inform us about the types of living things that existed in the past.

(ii) They inform us about the extent to which living things have changed over time.

(iii) They inform us about the time when a particular life form existed.

Evolutionary line

We can organize animals in an evolutionary line on the basis of the following factors:

1. **Increasing complexity of organs:**

- **Evolution of the eye**
  - Earlier, eye was present in the form of a simple patch of photosensitive cells called an eyespot.
  - This eyespot modified into a structure called pit eyes which have the ability to discriminate between light and darkness.
  - Insects have compound eyes, which are made of a thousand units.
  - Human eyes are highly complex in structure and function.
- **Decreasing complexity of organs:**
  - **Vestigial organs-** Such organs, which are present in a reduced form and do not play any role in the normal body functions, are known as vestigial organs**. For example, the nictitating membrane of the eye, vermiform appendix.**

Evolution and progress

Evolution cannot always be equated with progress.

Evolution simply creates more complex body designs, but the simple body designs are not inefficient. Bacteria, with a simple body design, are still the most widely found organisms on Earth.

Therefore, humans are only a branch of evolution and cannot be considered as the highest evolved species or culminating species.

Adaptive Radiation

- It is the development of different species in a given geographical area from an original homogenous population.
- Example: Darwin's finches and Australian marsupials

Hardy Weinberg Principle

- It states that the total gene and allele frequencies in a population are stable and constant from generation to generation.
- Disturbances in the gene equilibrium can result in evolution.
- **Factors affecting Hardy Weinberg equilibrium–**

1. Gene migration or gene flow
2. Genetic drift
3. Mutation
4. Gene recombination
5. Natural selection

Natural selection causes allele frequencies of a population to change. Depending upon which traits are favoured in a population it can produce three different results.

(1) Stabilizing selection
(2) Directional selection
(3) Disruptive selection

Evolution of Plants

- Cellular life forms occurred on earth about 2000 million years ago.
- Some of these cells had the ability to produce oxygen.
- Slowly, single-celled organisms became multicellular.

Evolution of animals

- Animals evolved about 500 million years ago. The first of them to evolve were invertebrates.
- The modern fishes have probably evolved from jawless fishes, amphibians evolved into reptiles, while reptiles evolved into birds and mammals.
- During continental drift North America joined with South America, the primitive mammals suffered whereas pouched mammals of Australia survived due to lack of competition.

Evolution of man

Homo sapiens

Modern man

↑

Neanderthal man (Cranial capacity around 1400cc)

↑

Homo erectus (Cranial capacity around 900cc)

↑

Homo habilis (Cranial capacity around 650 – 800cc)

1st human-like being

↑

Australopithecus (2 mya)

↑

Dryopithecus and Ramapithecus (15 mya)

(More ape-like) (More human-like)