

JSR IAS ACADEMY

GENERAL SCIENCE

BIOLOGY

Evolution

Origin and Evolution of Man

Molecular evidences

- A slight change that occurs over time in these conserved molecules (DNA, RNA and protein) are often called **molecular clocks**.
- Molecules that have been used to study evolution are cytochrome c (respiratory pathway) and rRNA (protein synthesis).

Theories of biological evolution**Lamarck's theory**

Jean Baptiste de Lamarck, was the first to postulate the theory of evolution in his famous book 'Philosophie Zoologique' in the year 1809. The two principles of Lamarckian theory are:

i. The theory of use and disuse -

- Organs that are used often will increase in size and those that are not used will degenerate.
- **Neck in giraffe** is an example of use and **absence of limbs in snakes** is an example for disuse theory.

ii. The theory of inheritance of acquired characters –

- Characters that are developed during the life time of an organism are called acquired characters and these are then inherited.

The main objection to Lamarckism

- Lamarck's "Theory of Acquired characters" was disproved by **August Weismann** who conducted experiments on mice for twenty generations by **cutting their tails** and breeding them.
- All mice born were with tail. Weismann proved that change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.

Darwin's theory of Natural Selection

Darwin published his observations and conclusions under the name '**Origin of species**' in 1859.

Principles of Darwinism**1. Over production (or) prodigality of production**

- All living organisms increase their population in larger number.

- For example, Salmon fish produces about 28 million eggs during breeding season.
- Elephant, the slowest breeder that can produce six young ones

2. Struggle for existence

- Organisms struggle for food, space and mate.

Darwin denoted struggle for existence in three ways –

1. Intra specific struggle
2. Inter specific struggle
3. Struggle with the environment

Mutation theory

- **Hugo de Vries** put forth the Mutation theory.

Modern synthetic theory

Five basic factors involved in the process of organic evolution.

i. Gene mutation

refers to the **changes in the structure of the gene**. It is also called **gene/ point mutation**.

ii. Chromosomal mutation

refers to the **changes in the structure of chromosomes** due to deletion, addition, duplication, inversion or translocation.

iii. Genetic recombination

due to crossing over of genes during **meiosis**.

iv. Natural selection

does not produce any genetic variations but once such variations occur it favours some genetic changes while rejecting others (driving force of evolution).

v. Reproductive isolation

helps in **preventing interbreeding** between related organisms.

Paleobotany

- **Kaspar Maria Von Sternberg** He is the "**Father of Paleobotany**" (1761– 1838) was born in Europe.

- He established the **Bohemian National Museum in Prague**
- **Birbal Sahani** He is the “Father of Indian Paleobotany” (1891–1949).

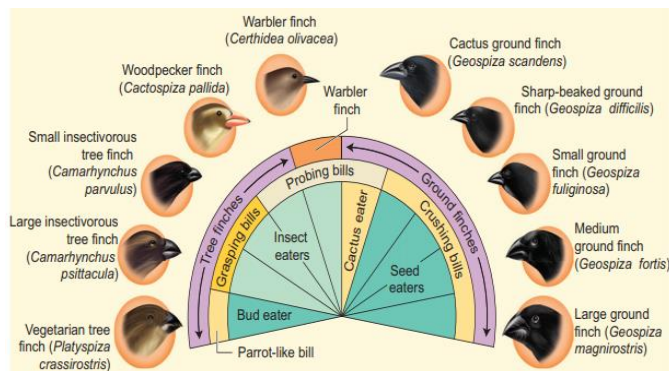
Evolution by anthropogenic sources

Natural Selection (Industrial melanism)

- Natural selection can be explained clearly through **industrial melanism**.
- Industrial melanism is a classical case of Natural selection exhibited by the **peppered moth (Biston betularia)**
- These were available in **two colours, white and black**.
- **Pre-industrialization** witnessed white coloured background of the wall of the buildings hence the white coloured moths escaped from their predators.
- **Post industrialization**, the tree trunks became dark due to smoke and soot let out from the industries.
- The black moths camouflaged on the dark bark of the trees and the white moths were easily identified by their predators.
- Hence the dark coloured moth population was selected and their number increased when compared to the white moths.
- The above proof shows that in a population, organisms that can adapt will survive and produce more progenies resulting in increase in population through natural selection.

Darwin's finches

Genetic variation in the **ALX1 gene** in the DNA of Darwin finches is associated with variation in the **beak shape**.



Genetic drift / Sewall Wright Effect

Genetic drift is a mechanism of evolution in which allele frequencies of a population change over generation due to chance (sampling error).

Hardy - Weinberg Principle

For example in a wolf population, there may be a shift in the frequency of a gene variant for black fur than grey fur.

their colour is determined by 'A' gene.

'AA' and 'Aa' beetles are dark grey

'aa' beetles are light grey.

In a population let's say that 'A' allele has frequency (p) of 0.3 and 'a' allele has a frequency (q) of 0.7. Then $p+q=1$.

$$(p + q)^2 = p^2 + 2pq + q^2$$

p^2 = frequency of AA

$2pq$ = frequency of Aa

q^2 = frequency of aa

$p = 0.3$, $q = 0.7$ then,

$p^2 = (0.3)^2 = 0.09 = 9\% \text{ AA}$

$2pq = 2(0.3)(0.7) = 0.42 = 42\% \text{ Aa}$

$q^2 = (0.7)^2 = 0.49 = 49\% \text{ aa}$

Origin and Evolution of Man

Mammals evolved in the early Jurassic period, about 210 million years ago.

Hominid:-

- Hominid evolution occurred in **Asia and Africa**.
- Hominids proved that human beings are superior to other animals and efficient in making tools and culture.
- The earliest fossils of the prehistoric man like **Ramapithecus** and **Sivapithecus** lived some **14 mya** and were derived from ape like **Dryopithecus**.
- **Dryopithecus** and **Ramapithecus** were hairy and walked like **gorillas and chimpanzees**.

Australopithecus:-

- Australopithecus lived in **East African grasslands** about **5 mya** and was called the **Australian ape man**.
- He was about **1.5 meters tall**, low brain capacity of about **350 – 450 cc**,

Mass extinction

- eliminates half or more species in a region or ecosystem, as might occur following a volcanic eruption.
- **Five major mass extinction** that occurred since the **Cambrian period**.
- This mass extinction is often referred to as K-T extinction.
- K-T Extinction refers to the German word Cretaceous and Tertiary periods.
- Snow ball Earth and extinction following elevation in CO2 levels are example.

Homo habilis:-

- Homo habilis lived about **2 mya**.
- Their brain capacity was between **650 – 800cc**, and was probably vegetarian.

Homo erectus:-

- Homo erectus the first human like being was around **1.7 mya**
- a large brain capacity of around **900 cc**.
- Homo erectus probably ate meat.
- **Homo ergaster and Homo erectus** were the **first to leave Africa**.

Neanderthal:-

- Neanderthal human was found in Neander Valley, **Germany** with a brain size of **1400 cc** and lived between **34,000 - 1,00,000 years ago**.
- They used animal hides to protect their bodies, knew the use of fire and buried their dead.

Cro-Magnon:-

- Cro-Magnon was one of the most talked forms of modern human found from the rocks of Cro-Magnon, **France** and is considered as the **ancestor of modern Europeans**.
- They were not only adapted to various environmental conditions, but were also known for their cave paintings, figures on floors and walls.

Homo sapiens:-

- Homo sapiens or modern human arose in **Africa** some **25,000 years ago** and moved to other continents and developed into distinct races.
- They had a brain capacity of **1300 – 1600 cc**.
- They started cultivating crops and domesticating animals.