

A stylized, light blue graphic of a leafy branch is positioned on the left side of the slide, extending from the top towards the bottom.

# HUMAN EVOLUTION

PSC  
Circle

## Various Theories of Evolution

- ❑ Theory of Spontaneous Generation – Abiogenesis
- ❑ Theory of Extra territorial origin of life
- ❑ Naturalistic theory or Chemical evolution
- ❑ Theory of Organic evolution

## Organic Evolution

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- Herbert Spencer applied term Evolution to denote historical development of life.
- Geological evolution talks about evolution of planet earth, the changes involved in the rise of human civilization is 'Cultural Evolution'. 'Organic Evolution' is the change that takes place to living things viz. plants and animals.
- Organic evolution is the origin of new species of animals and plants from ancestors who previously lived on earth.

# Theories of Evolution

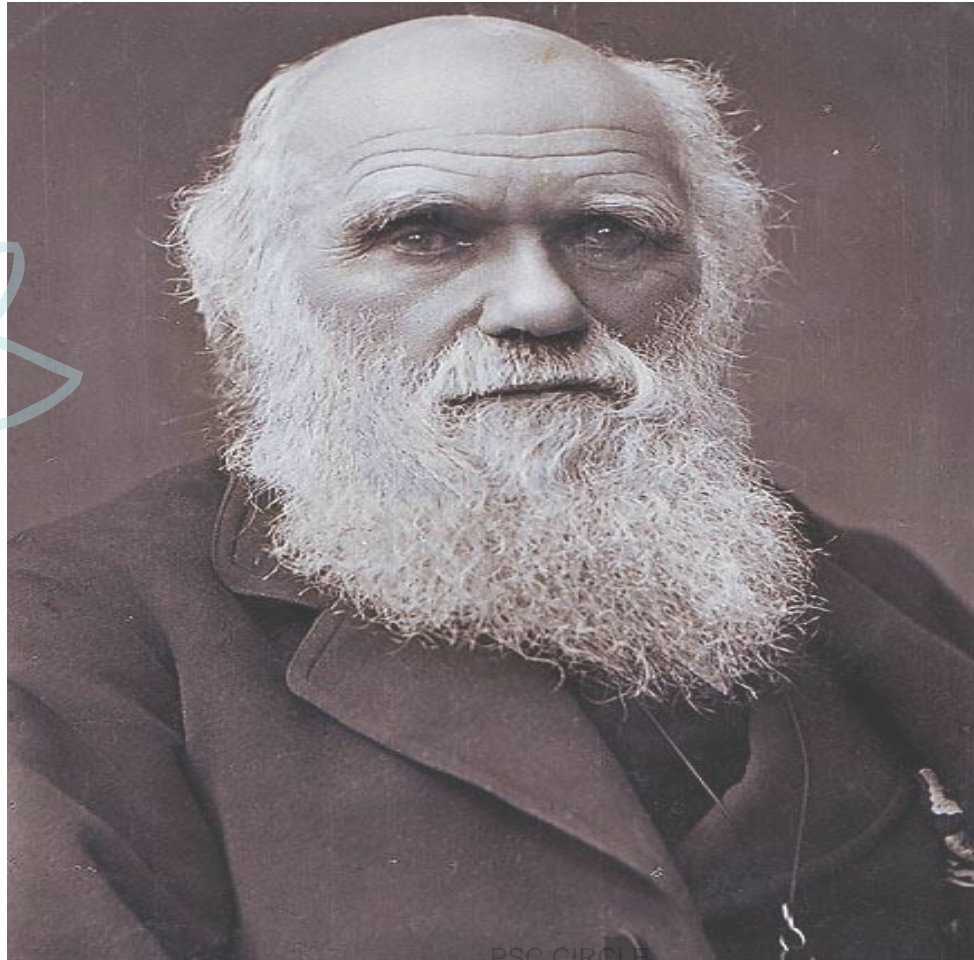
- Pre-Darwinian Phase
- Theory of Inheritance of Acquired Characters (Lamarckism)
  - ▣ French naturalist, Lamarck propounded this theory. Four main propositions
    - Living organism and their component parts tend to continuously increase in size
    - New organ results from New need
    - Organ used constantly becomes highly developed and disuse results in degeneration
    - Modification produced during a life time of species will be inherited by off-spring
- Two causes of variability – Environment and time - To explain above Lamarck used examples like long neck of Giraffe, limblessness of snakes, webbed feet of duck etc;
- Significance of this theory was that it was simple to understand and led to testing.

## Criticism of Lamarckism

- ❑ First proposition is not entirely correct. In many cases evolution proceeded with reduction in size rather than increase in size; more highly evolved flowering plants are smaller in size
- ❑ New needs necessarily does not result in new organs. If that was the case, Man would have acquired wings because of his need to fly.
- ❑ The fourth principle that modifications are acquired by off-spring have been tested by biologists and have been found to be not correct.
  - ❑ German scientist Weismann, cut the tail length of white mice for 20 generations to see if there is any reduction in new off spring but that was not the case – Distinction between heritable changes and those cannot be inherited.
  - ❑ Boring of ears and nostrils are done on Indian women for centuries. But off spring don't show any trace.
  - ❑ Chinese fancy shorter feet and so they bound the feet of their women but it has no effect on feet of subsequent generations
  - ❑ Muslims and Jews have a regular practice of circumcision for generations but no reduction of prepuce in the subsequent generations

## Some other Pre-Darwinian theories

- ❑ Neo – Lamarckism – Modified version of Lamarck which stated that adaptation and variation arise out of structure, environment and function.
- ❑ Saltationism – Sudden origin of new species
- ❑ Random variation – Neither environment, nor internal factors influencing variation and evolution.



## □ Darwinian Phase

Theory of Natural selection (Darwinism) – **The change in species by the survival of an organismal type exhibiting natural variation that gives it an adaptive advantage in an environment thus leading to new environment equilibrium, is evolution by natural selection**



Natural selection is a continuous process and involves the following through trial and error:

- Universal occurrence of variation – Variation is a characteristic of every group of plants and animals (Darwin did not understand the cause of variation and assumed it to be innate property)
- An excessive natural rate of multiplication – Species will multiply in geometric progression if there are no environmental checks and crowd the planet. Hence nature ensures that equilibrium is maintained.
- Struggle for existence – Since more individuals are born than those that can survive, there is a competition for food, mates and space. It is intra-specific and inter-specific i.e within species and amongst species.

- Survival of the fittest – In this struggle, the fittest will survive
- Inheritance of variations– The surviving individuals will give their characteristics to the next generation and thus successful variations will survive.
- Pangenesis Hypothesis – Darwin’s Pangenesis hypothesis assumed that all the organs and perhaps all the cells in the body of an animal produced miniatures of themselves called **Gemmules or Pangenesis** and this was carried by the sex glands and transmitted to the off-spring. However, this was subsequently disproved by experiments.

## Criticism of Darwin's Theory

- ❑ Survival of Fittest wrongly assumed to be 'teeth and claw'. Infact plants also evolve and there is no blood shed in them.
- ❑ It doesnot explain the origin and transmission of Variation within and amongst species.
- ❑ Indirectly accepted Lamarckian idea of inheritance.

**Despite above criticism, its Darwin's evolution theory which has been the corner stone for all further studies and is a landmark theory in understanding human and infact all species evolution.**

## MODERN SYNTHETIC THEORY

- Darwin and Wallace contributed the theory of natural selection amongst species.
- Mendelian theory contributed for genetics inheritance.
- Modern Synthetic theory of **Julian Huxley** realized that comprehensive explanation of organic evolution requires the synthesis of both **Genetic and Selective Process**.
- From perspective of modern synthesis, evolution is two stage process:
  - ▣ Production and redistribution of variation
  - ▣ Natural selection acts on this variation.

- Evolution is seen as new varieties of life forms evolving from previous forms over long period of time. But this is the end result of evolution.
- The evolutionary process involves accumulation of many small evolutionary changes occurring in each generation. **From Modern genetic perspective, evolution is change in allele frequency from one generation to the next.**
- Allelic frequencies are numerical indicators of the genetic make up of a population.
- An inherited trait is different form in different individuals. These variant genes that underlie these different forms of an inherited trait is called 'Alleles'.
- Individuals cannot change alleles. From conception, the genetic composition of an individual is fixed and he cannot evolve. Only a group of individuals can evolve over time. **Hence the Unit of evolution is always a Population and not an individual**

## □ Factors Responsible for Production and Redistribution of variation

### □ Mutation

- Actual alteration in genetic material is called mutation.
- For evolutionary significance, it must happen in the sex cells i.e sperm or ovary egg.
- Two types of mutations
  - Chromosomal aberrations – result in change in structural aspects of chromosome or number of chromosomes.
  - Point mutations – Permanent and heritable changes
- **Mutation is the only way to produce ‘New’ variation**
- Darwin not aware of Mutation. This has been possible because of developments in ‘Molecular Biology’
- This is also called as molecular evolution

## □ Migration

- Migration is movement of genes from one population to another due to choosing of mates outside ones group.
- It results in both in migration and out migration.
- However, as noted above, migration will take effect only when there is a point mutation of the chromosomes.

## □ Genetic Drift

- Random factor in evolution is genetic drift.
- Since evolution occurs in populations, it is not only dependant on the nature of initial allele frequency but the size of the group.
- Evolutionary change due to genetic drift is directly and inversely related to population size i.e smaller the population, larger is the effect of genetic drift.
- But genetic drift should not be confused with natural selection.

## ▣ Recombination

- In sexually reproducing species both parents contribute and the genetic information is reshuffled every generation. This does not itself change allele frequencies, but produces array of genetic combinations which natural selection can act upon.
- This is reason why genetic combination of offspring is different from parents and Recombination has got greatest role in Variation.
- This is the reason why no two individuals are alike because they develop from different zygotes, except identical twins which develop from same zygote



## Natural selection acts on variation

- The evolutionary factors discussed above, interact to produce variation and to distribute genes within and between populations.
- But it is natural selection, as explained by Darwin, that enables the population to adapt to changing environments.
- If as a result of genetic variation, some individuals are able to contribute more offspring to succeeding generation, this is natural selection. Infact natural selection is defined as ‘Differential net reproductive success’
- The result of natural selection is a change in allele frequency relative to specific environmental factors which is called as Adaptation.

## Modes of Selection on Variation

- Directional selection – unidirectional, for eg with mammoths, with earth cooling gradually over years, larger mammoths will be able to survive and hence larger mammoths are naturally selected over smaller ones.
- Stabilising selection – If environment is stable, extremes are selected against and phenotypes at the centre – ‘modal variations’ – are selected eg; medium sized turtles.
- Diversifying selection – Here extremes are selected and mean varieties are selected against – eg baboons – either small ones because they are less conspicuous or large ones because they can be active for defence.

## Unit of Selection and Unit of Evolution

- Selection acts on Individual. It is individuals who reproduce or do not reproduce and attempt to maximize their own reproduction.
- Individuals will attempt to maximize their own reproductive success even in face of dangers and impending extinction. Humans continue to reproduce even though we are facing the problem of exploding population.
- Evolution does not have any mechanism to guard against extinction. In fact in evolution, Extinction is the rule and not an exception. Of all the species that have evolved, only 0.1% are currently living on earth. The rest 99.9% have faced their inevitable evolutionary fate – Extinction.
- However, it is the entire population which is Unit of Evolution over generations.

## Evolution at Species level

- A species is defined as a group of interbreeding organisms that are reproductively isolated and therefore cannot successfully interbreed with other groups.
- If sustained over long period of time, gradual changes in the allele frequencies between member populations can lead to sufficient genetic differences such that fertile reproduction is no longer possible between populations, we can recognize a new form of species arising from splitting of existing species which is called '**Speciation**'.
- Pre-requisite for Speciation is reproductive isolation
  - ▣ Isolation may be geographic isolation, behavioural isolation and mechanical isolation.
- Isolation can also be pre-mating or pre-zygotic and post mating or post-zygotic



All the best

*Shabnam Yeasmin*

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