Evolution

This refers to the gradual process by which organisms change from simple to complex forms.

Origin of life

The exact origin of life is not known. However, some theories have been put forward to explain the origin of life.

Theories explaining the origin of life.

Steady state theory: This suggests that life has no origin and it has been existence since.

Spontaneous generation: This indicates that life arose from non-living matter on numerous occasions.

Cosmozoan theory: This suggests that life arrived on this planet from elsewhere.

Special creation: This indicates that life was created by a supernatural being at a particular time.

Biochemical evolution: This is the theory which is most accepted scientifically. It suggests that life arose according to chemical and physical laws which lead to formation of certain macromolecules which make up DNA and body cells.

Mechanism of evolution/Theories of organic evolution

The main idea of organic evolution is that populations of living things undergo changes over generations. Theories of organic evolution explain that the different species of organisms existing today arose from common ancestors which were originally primitive but gradually underwent changes along different evolutionary lines in different environments in

order to survive in those environments. The trend of evolution therefore, is gradual i.e. Changes from primitive forms of life to advanced forms of life.

There are two theories of organic evolution namely:

Lamarck's theory of evolution based on inheritance of acquired characters through use and disuse.

Darwin's theory of evolution based on natural selection.

Lamarck's theory evolution/Lamarckism-Inheritance of acquired characters

This theory was put forward by a French biologist Jean Baptiste Lamarck in 1809. His theory resolves itself into three factors namely:

Influence of the environment.

Use and disuse of parts of body

Inheritance of acquired characters.

Based on these propositions, Lamarck explained the long necks of modern giraffes in the following way:

Ancient giraffes were those living today. Lamarck argued that as the number of giraffes increased there was a shortage of food in form of tree leaves. This forced them to stretch their necks to reach for leaves on higher branches. The result of this was an elongation of the necks.

The offspring of these giraffes inherited the long necks, stretched even further and the process was repeated until the present long necks were developed.

There's evidence for the development of various parts of the body especially muscles when they are constantly put into use e.g. body builders.

However, his third proposition has been proved totally wrong by genetic evidence that acquired characters cannot be inherited. This theory is therefore not scientifically accurate.

The most accurate theory of evolution is Darwin's theory. It's explained by Charles Darwin using the theory of Natural Selection.

Definition of Natural Selection

This is the situation whereby organisms which are well adapted to the changes in the environment are naturally favoured and hence survive while the poorly adapted organisms are naturally selected against and hence die or fail to reproduce. The well adapted and naturally favoured organisms which survive the change in the environment give birth to offspring and pass on those adaptive characters to their offspring.

In case of such populations of offspring being isolated and exposed to further changes in the environments, they gradually undergo changes along different lines to fit or survive in the changing environment and give a rise to new organisms following observations, which he later accounted for.

Observation 1: Organisms of different species have the potential of giving birth to so many offspring but they are not over populated.

Observation 2: There is variation/differences existing among organisms of the same species.

Observation 3: Offspring tend to resemble their parents in some characters.

Explanation of Darwin's observation

Charles Darwin explained his observation by saying that, as the population of a particular species of organisms increases, the basic resources of the environment e.g. food, shelter etc become limited in amount or number and the organisms start competing for the few

available resources. And since not all the offspring survive, there must be a struggle for existence which causes some variations.

Since these organisms differ or vary, individuals with favourable variations and naturally favoured survive and pass on their favourable variations to successive generations.

Those organisms with unfavourable variations (poorly adapted to compete) and naturally not favoured are selected against and die or fail to reproduce. This regulates the population.

In case of any further change in the environment, the offspring which isolated, can individually and differently undergo gradual changes along their own lines and each one gives rise to new organisms which eventually forms a new species.

Examples of cases of natural selection

Resistance of bacteria to antibiotics e.g. microbes for gonorrhoea to penicillin

Resistance of insects to insecticide e.g. DDT on mosquitoes and houseflies

Existence of peppered moth called *Biston betularia* in Manchester, England.

The peppered moth exists in two forms i.e. the speckled white moth and the dark mutant form. Before 1945, the speckled white moth had the highest population in different cities of England e.g. Manchester, Birmingham etc yet the dark mutant moth could easily be spotted against such a bark ground and eaten by the birds. This caused the great decrease in the population of the dark mutant moth.

After 1945, there was an industrial revolution, which made the bark of trees appear black and also the death of lichens due to soot, dust fumes and toxic gases from the industries. Against such a dark background the white speckled form could easily be spotted and preyed

upon by the birds, which made its population decrease so greatly while the dark mutant moth could not easily be identified. This made its population increase.

Evidence for evolution

There is a lot of evidence h proposed to support the theory of evolution (i.e. to confirm that evolution took place. Such evidence includes:

Comparative anatomy

Embryology

Taxonomy (classification of organisms)

Palaeontology

Biochemistry

Geographical distribution of organisms.

1. Comparative anatomy

This involves comparing the structural make-up of different organisms. When different body structures are compared, it is observed that some organisms possess basically similar structures which are serving different functions. Such structures are known as homologous structures. In other words, homologous structures are basically similar structures of different organisms modified to serve different functions.

It is expected that the homologous structures were possessed by the ancestors from which modern organisms arose but each ancestor underwent adaptive radiation which made the structure to be modified differently and serve different functions. An example of a homologous structure is the pentadactyl limb.

A pentadactyl limb is the limb composed of five digits possessed by all vertebrates but was modified during evolution to serve different functions. When structures of organisms are

further compared, it is observed that some of them basically differ but serving similar functions. Such structures are known as analogous structures.

Analogous structures cannot serve as evidence for evolution because by the virtue of their being structurally different they do not originate from a common ancestor. They therefore arose due to convergent evolution, yet the homologous structure structures arose due to divergent evolution. Examples of analogous structure include; the wings of birds and wings of insects.

Adaptive radiation is the situation whereby ancestors undergo changes gradually along different evolutionary lines as they become isolated from the original stock and give rise to new and different organisms from the original stock which are well adapted to survive in that environment.

Vestigial structures

These are structures which once served a particular function but due to evolution in the changing environment, the structures become reduced in size and rendered useless e.g. the tail of man was reduced into a rudimentary structure of small bones called the COCCYX due to the evolutionary change underwent by man.

2. Embryology

This is the study of the growth and development of the embryo of different organisms. The embryos are compared in terms of their growth and developmental changes. It is observed that some organisms have similar developmental changes which reveals that these

organisms arose from common ancestors whose embryos also had the same developmental changes e.g. embryos of all vertebrates and some invertebrates have the following;

Post anal tail.

Three embryonic membranes i.e. chorion, amnion and allantois

A dorsal nerve tube

Gill clefts

A notochord etc.

All these show common ancestry of organisms with such changes.

3. Palaeontology

This is the study of fossils. Fossils are remains of organisms that lived in the past and now are represented as crystallized rock forms, or still exist in their original form within rocks. Fossils include entire organisms, hard skeletal structures, impressions, and imprints.

When the fossils were compared within the different rock layers ranging from the oldest to the young rock layer, it was observed that there is a great variety of more developed fossils than in the oldest rocks. This suggests progressive evolutionary changes of the organisms from the oldest primitive ancestors to the more developed organisms with time.

4. Taxonomy

Organisms are classified according to the similarities and differences among them. It is assumed that organisms in the same group of classification are closely related while those in

separate groups are distantly related. This indicates that those in the group have an evolutionary relationship i.e. they arise from a common ancestor.

In other words, the similarities and differences between organisms may be explained as a result of progressive adaptations by organisms within each group to particular environmental conditions over a period of time.

6. Biochemistry

This is the study of chemicals of life. When the different organisms are compared, referring to their chemicals of life, it is observed that different organisms have similar chemicals of life e.g. most cells have mitochondria, energy in form of ATP, DNA, hormones, and enzymes. Plant cells have chloroplasts, cell walls etc.

Possession of similar chemicals of life in different organisms suggests that such organisms arose from common ancestors which underwent evolutionary changes along different lines and gave rise to different organisms existing today.

7. Geographical distribution

Present day patterns of the distribution of plants and animals in certain parts of the world indicate an evolutionary process. This due to the fact that organisms which are found in different and isolated places look different e.g. Africa and South America have a similar climate but support different groups of animals and the individual species are different.

Africa has elephants, lions, zebras, camels, gorillas, chimpanzees etc., while South America has long tailed Monkeys, Llamas, puma, Jaguars. Australia has pouched mammals such the Kangaroos, koalas etc. It is believed that the first mammals evolved at some point in

Europe. As they increased in number, population pressure caused groups of mammal to disperse in different directions.

Once isolated, each group evolved independently of the others into different species. This suggests that special creation may not have taken place but organisms changed in form because of adaptation to different environments.