



Chapter # 24

Evolution



Q.1.(a) Write the Quranic Ayat which explains that God is the only creator.

وَهُوَ الَّذِي أَنْشَأَكُمْ مِنْ نَفْسٍ وَاحِدَةٍ

"And he is Who produced you from a single being" (Al-Quran 6:98)

Q.1.(b) What is the theory of special creation?

Ans. Evolution:

It is a process by which genetic changes take place in populations of animals and plants over million of years in response to environmental changes.

Theory of Special Creation:

The theory of special creation is that all living things came into existence in their present forms especially and specifically created by nature this theory was believed by creationists. Carolus Linnaeus believed on divine creation.

Aristotle Idea:

About evolution Aristotle believed that organisms ranged from simple to very complex structures. The other the reference to evolution is follows.

OTHER THEORIES

Scientist's Name	Life Span	Achievements
Linnaeus	1707-1778	Sought and found order in the diversity of life. He introduced binomial nomenclature for naming species.
Lamarck	1744-1829	Published his theory of evolution.
Malthus	1766-1834	Published Essay on the "Principle of Population".
Cuvier	1769-1832	Contributed much to the science of Palaeontology and explained Earth's history by catastrophism.
Lyell	1797-1875	Published Principles of Geology.
Darwin	1809-1882	1. Voyage of the <i>Beagle</i> 2. Began his note books on the origin of species. 3. Wrote his essay on the origin of species.
Mendel	1822-1884	Publishes papers on inheritance.
Wallace	1823-1913	Wallace sent his theory to Darwin.



Q.2. How do the evolution of eukaryotes take place from prokaryotes?

Ans. Many theories are given in this reference which are as follows.

Hydrothermalvent Hypothesis (evolution of Prokaryotes)

The first hypothesis in this reference is that life may have been originated in waters of deep oceans in underwater hot spring which is called **hydrothermal vents**. The energy and raw materials for early life forms have been provided by these vents.

Evidence

A group of bacteria called archae bacteria living now supports this hypothesis as they can tolerate the high temperatures up to 120°C.

Evolution of Photosynthetic Prokaryotes

The nutrients supply was very limited at that time so process of photosynthesis becomes a source of nutrient supply according to the need. For photosynthesis organisms used hydrogen sulfide as a source of hydrogen for reducing carbon dioxide to sugars.

Evolution of aerobic prokaryotes

After that water was used for this purpose. In the start there was not oxygen in the atmosphere but later on oxygen was liberated during photosynthetic reactions which started accumulating in the atmosphere. The oxygen changed the conditions of earth Ozone in the upper atmosphere began to filter ultraviolet radiations from sun.

Evolution of aerobic prokaryotes

This ozone layer was enough protective to make life possible. The oxygen invade the atmosphere and living organisms began to utilize this oxygen. The change from a reducing atmosphere to an oxidizing atmosphere means that life could no longer arise abiotically.

EVOLUTION OF EUKARYOTES

First Cell:

The first cell was simple like prokaryotic forms. The prokaryotes may have arisen more than 3.5 billion years ago. Eukaryotes first appeared about 1.5 billion years ago. There are following hypothesis.

1. Endosymbiont Hypothesis

Eukaryote might have evolved when large anaerobic amoeboid prokaryote ingested small aerobic bacteria and had stabilized them instead of digesting them. This idea is known as **endosymbiont hypothesis** which was first given by Lynn Margulis.

Formation of Mitochondria:

This theory also gave the idea of formation of mitochondria that aerobic bacteria developed into mitochondria which are sites of aerobic respiration and energy conversion of eukaryotic.

Formation of Flagella:

The flagella is a whip like structure which is mostly used for locomotion. It is thought that it may have arisen through ingestion of prokaryotes which is similar to spiral



shaped bacteria called spirochetes. Ingestion of prokaryotes which resembled present day cyanobacteria become a source of endosymbiotic development of chloroplasts in plants.

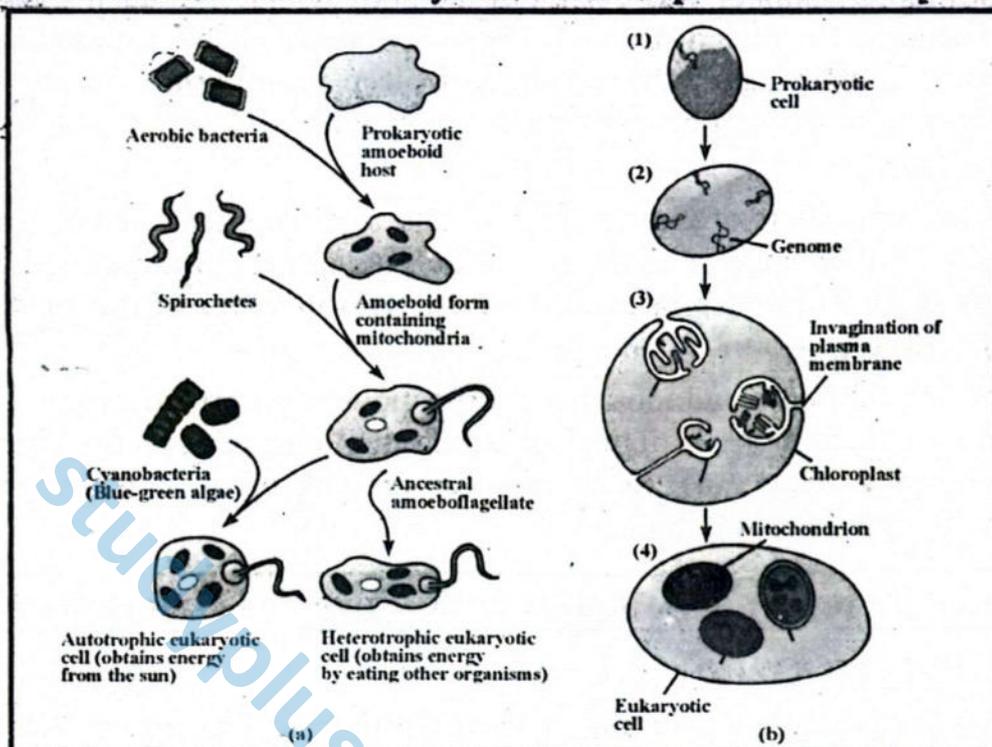


Fig. Two hypotheses on the evolution of the eukaryotic cell.

(a) **Endosymbiont hypothesis**, (b) **Membrane invagination hypothesis**. (1) A prokaryotic cell (2) Duplicates its genetic material (genome) (3) The plasma membrane then invaginates to form double membrane-bound organelles, and the individual genomes separate from each other (4) The nuclear genome eventually enlarges, while the other organelle genomes lose many of their genes, resulting in a eukaryotic cell.

2. Membrane Invagination Hypothesis

There is another hypothesis of evolution of eukaryotic cells. According to this hypothesis the prokaryotic cell membrane invaginated inward to enclose its copies of genetic material. Due to this invagination several double membrane bound entities or organelles were formed in a single cell. The entities evolved into mitochondria, nucleus and chloroplast of eukaryotes.

Further Evolution:

At first single celled eukaryotes were formed but with the passage of time multicellular organisms were formed in which various cells were specialized into tissues, which in turn formed organs of different function.

Q.3. Discuss the theory of Lamarck with reference to evolution of species?

Ans. LAMARCK:

Jean Baptist Lamarck was French naturalist. He presented his ideas about evolution in 1809. Lamarck was in charge of invertebrate collection at Natural History Museum in Paris. He presented a mechanism to explain how specific adaptations evolve. He discussed the following points.

1. Use and Disuse of Organs:

According to Lamarck those parts of the body which are much used to cope with environment become larger and stronger. Those organs which are not used deteriorate. To prove this point Lamarck gave the example of bicep in the arm of black smith as it is much used form hammering it become much developed.

Example of Giraffe

Another example is of giraffe. The ancestors of the giraffe fed on grasses so they had short neck. With change of environment the grasses become short and giraffe had to feed on leaves so giraffe stretch its neck to new lengths in search of leaves to eat.

2. Inheritance of Acquired Characters:

According to the second idea the modifications of an organism acquires during its life time can be passed along to its offspring e.g. the long neck of the giraffe. Lamarck reasoned, evolved gradually as the cumulative product of great many generations of ancestors stretching higher and higher.

Q.4. Explain the theory of natural selection given by Charles Darwin.

Ans. CHARLES DARWIN:

Charles Darwin was a naturalist who was born in Shrewsbury in Western England in 1809. During his voyage on Beagle to South American he, collected many specimens of South America which includes different animals and plants. He also made several observations.

Observations of Darwin

1. The fauna and flora of different regions of this South American continent were unique having South American stamp. They were quite different from the fauna and flora of Europe.
2. Darwin collected the fossils of South American which were entirely different to modern species but to some extent resemble the living plants and animals of South America.

Fauna of Galapagos Islands:

Galapagos islands were colonized by plants and animals that strayed from South American mainland and then diversified on different islands. Most of species found in the islands were not found any where in the world.

Darwin collected 13 types of finches on Galapagos island that was although quite similar seemed to be different species. Some were unique to individual islands while other species were distributed on two or more islands that were close together.

Conclusions

After this observation and returning from Great Britain he drew the following conclusions.



1. He perceived that origin of new species is closely related process to that of adaptation of the species to the environment, separated from original habitat by geographical barriers.
2. A new species would arise from an ancestral form by gradual accumulation, separated from original habitat by geographical barriers.
3. With the passage of time two populations have become so dissimilar that they are considered to be separated species.

This was happened in Galapagos island.

THEORY OF DARWIN:

After this detail study Darwin presented his theory. "**The Origin of Species**". Before this presentation Wallace presented his theory of natural selection which was same as that of Darwin. But in 1859 Darwin Published his theory. The main points of this theory was:

1. Decent with Modification:

Darwin believed in perceived unity in life. This means that all the organisms are related through descent from common ancestor that lived in remote past.

History of Life

According to Darwin history of life is like a tree i.e. all the organisms are related to each other like the multiple branching and re-branching from common trunk all the way to the tips of living twigs, which symbolize the current diversity of organisms. At each fork of evolutionary tree there is an ancestor common to all lines of evolution branching from that of fork.

2. Natural Selection and Adaptation:

Darwin was of the view that populations of individual species become better adapted to their local environments through natural selection. Darwin's theory of natural selection was based on following observation.

- (a) **Struggle for existence** : There is a struggle for existence between the individuals of a population as most of the species produce far more offspring than needed to maintain the population. In this way only a fraction of offspring survive in each generation.
- (b) **Basis for the Survival of Species**: Survival in the struggle for existence is not random but depend on the hereditary constitution of surviving individuals e.g. in many species the characters of individuals may differ in exact shape of body parts, existence to particular disease etc. These are the variations which are passed to next generation. Thus those individuals of the species all exist that environment whose hereditary characteristic fits best to that environment while others will not survive.
- (c) **Evolution of Species** : Darwin found that individuals with unequal ability of individuals to survive and reproduce will lead to gradual change in population. The favourable characteristics tend to be passed on to next generations. This leads to the evolution of a new species.



Q.5. What is Neo-Darwinism?

Ans. Neo-Darwinism is called modern theory of synthesis which is: 0

DEFINITION:

The integration of the principles of genetics and evolution is called modern theory of synthesis. In other words we can say that there is a great relationship between genes and natural selection.

Explanation:

After giving the theory of natural selection Darwin was unable to explain the mechanism of natural selection because Darwin did not know about genes.

After the Mendel's work on inheritance and with the discovery of genes it become very easy to explain the mechanism of natural selection. With the progress in population genetics in 1930's Mendelism and Darwinism were reconciled and genetic basis of variation and natural selection was worked out. Finally Ernst Mayr in 1940's gave the theory of modern synthesis. It is also called synthesis because it integrated *discoveries* and ideas from many different fields including paleontology, taxonomy, biogeography and population genetics.

EVIDENCES OF EVOLUTION

Q.6. Give the different evidence of evolution. Explain in detail.

Ans. Many of evidences given for the evolution are from.

1. Biogeography
2. Fossil record
3. Comparative Anatomy
4. Comparative Embryology
5. Molecular Biology

1. BIOGEOGRAPHY

It is the study of the distribution of living things on the earth. Biogeography of animals first suggested the idea of evolution.

Evidence:

It is found that the plants and animals of Galapagos islands were similar to the plants and animals to South American mainland. Thus the ancestors of those animals must have come from South America.

2. FOSSIL RECORD:

Fossil is any record of a dead organism. It may be nearly complete impressions of organisms or merely burrows, tracks, molecules or traces of their existence. It provides a visual record in a complete series showing the evolution of an organism. Most fossils are found in sedimentary rocks.

Evidences:

The succession of fossil forms is a strong evidence in favour of evolution. It gives following evidence.



1. Evidences from biochemistry, biology and cell biology places prokaryotes as ancestors of all life and predicts that bacteria should precede all eukaryotic life in fossil record. Indeed the oldest known fossils are prokaryotes.
2. Another evidence is the chronological appearance of different classes of vertebrate animals in fossil record. Fossil record shows that fishes were the first vertebrates to appear in the world, the amphibians next, then the reptiles comes and then birds and mammals exist. This sequences is consistent with the history of vertebrate descent. The evolution of horse provides an example of such history.

3. COMPARATIVE ANATOMY:

It is a branch of biology in which structures of modern species are compared. Such studies are particularly useful where fossil record is poor. In the comparative study of anatomy it is necessary to distinguish structures that are homologous from those of that are analogous.

Homologous Structures:

Homologous structures are those that are functionally different but structurally alike e.g. forelimbs of man, bat, horse whale etc. are homologous and such evolution is called divergent evolution.

Analogous Structures:

These organs are functionally alike but structurally different e.g. wings of bat, birds and insects. Such evolution is called convergent evolution.

Comparative anatomy supports that evolution is a remodeling process in which ancestral structures that functioned in one capacity become modified as they take a new function.

Examples of Flower:

The flower parts of a flowering plant are homologous. They are considered to have evolved from leaves to form sepals, petals, stamens and carpels.

Oldest homologous Structures:

The oldest homologous structures are vestigial organs. The organs which become reduced during the evolution of species and even lose their function are called vestigial organs. Rudimentary structures that had important functions in ancestors are not important now. The examples of vestigial organs are appendix in carnivores ear muscles in man etc. Similarly the skeletons of whales and some snakes retain vestiges of pelvis and leg bones of walking ancestors.

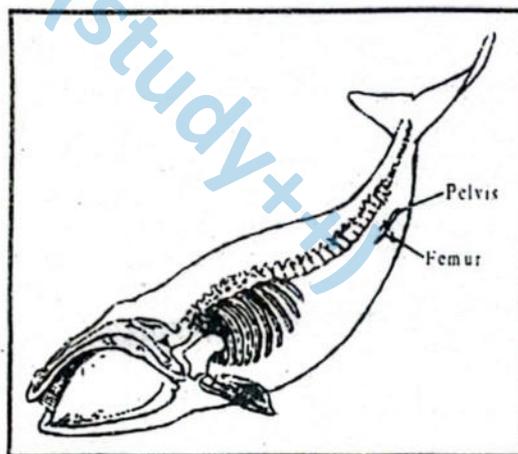


Fig. The whale retains pelvic and leg bones as useless vestiges.

4. COMPARATIVE EMBRYOLOGY:

In the embryonic development closely related species go through similar stages and comparison of this study is called comparative embryology.

Evidence:

Presence of gill pouches in vertebrate embryos. At embryonic stage of development similarities between fishes, frogs, snakes, birds, humans and all other vertebrates are very clear. As development progresses different vertebrates diverge more and more, taking on the different characters of their classes. In fish gill pouches develop into gills; in terrestrial vertebrates these embryonic structures become modified for other functions such as Eustachian tubes that connect the middle ear with the throat in humans.

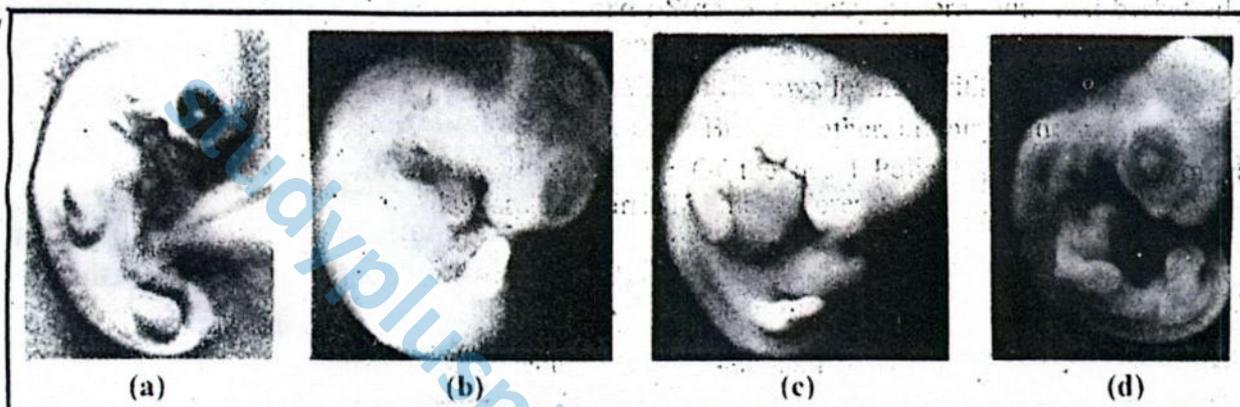


Fig. Homologies among vertebrates are clearly evident early in development, as the photos reveal. Embryo (a) turtle, (b) mouse, (c) human, (d) chick.

5. MOLECULAR BIOLOGY:

The evidences are form in the structure of DNA and proteins, in their genes and gene products. If two species have genes and proteins with sequences of monomer that match closely, the sequences must have been copied from a common ancestor.

Example:

A common genetic code bring evidence that all life are related with each other. Thus molecular biology give the evidence of evolution as the basis of unity and diversity. It is found that some proteins are common in human and bacteria e.g., cytochrome respiratory protein is found in all aerobic species.

Q.7. Differentiate between natural selection and artificial selection.

Ans. NATURAL SELECTION:

The natural selection is that selection in which nature selects the species. It occurs by an interaction between environment and variability inherit in any population.

Characteristic Natural Selection

It can enhance or decrease the heritable variations. The natural selection is regional and timely and factors affecting the environment vary from place to place and from time to time.

Example : An example of natural selection is evolution of antibiotic resistance in bacteria.

Artificial Selection:

Artificial selection means breeding of domesticated plants and animals. Humans have modified other species over many generation by selecting individuals by desired traits as breeding stock. The plants and animals we grow for food have very little resemblance of their wild ancestors. From the changes achieved by artificial selection in a very short period of time, Darwin found that natural selection operating in very vast spans of time could account for entire diversity of life.

Q.8. What is population? How the gene frequency of population is determined?

Ans. POPULATION:

A population is a group of individuals belonging to same species living in the same area.

Species:

Species is a group of populations that have that potential to interbreed in nature.

Isolated population:

A population isolated from other individual of the same species, exchanging genetic materials rarely is called isolated population.

Each species live in specific geographical range with in which individuals are not spread evenly but are aggregated in localized populations. The species cannot frequently in exchange genetic material because they may be isolated from others of same species. Such type of isolations are found in those populations that are separated by islands, mountain ranges, unconnected lakes etc.

A individuals of same populations are concentrated in centers so they can interbreed easily with each other. Therefore they are closely related to each other.

GENE POOL:

The total aggregate of genes in a population at any one time is called populations gene pool.

It contains all alleles at all gene loci in individuals of population. For diploid species each locus representative in genome of an individual, which may be homozygous or heterozygous.

Fixed:

If all the members of population are homozygous for same allele then that allele is called fixed.

Oftenly, there are two or more alleles for gene having relative frequency in gene pool. We can understand this with an example of wild flower population with two variants contrasting flower color.

Example:

There are two varieties. One is of pink flower which is dominant having symbol of A. The other variety is of white flower which is recessive denoted by a.



Gene Frequency:

To find the gene frequency of A we imagine that there are 500 plants.

On crossing both plants we get result of AA, Aa and aa plants. Thus the number of these plants will be (white flowers) aa = 20.

Pink homozygous AA = 320

Pink Heterozygous Aa = 160

As they are diploid plants the total gene copies of flower colour in population is 1000.

Therefore:

Number of genes for AA = $320 \times 2 = 640$ (2 denotes for A + A)

Number of genes Aa plant = $160 \times 1 = 160$ (1 for A only)

Total number of genes for A = $640 + 160 = 800$.

Thus frequency of A allele in gene pool is 80% or 0.8 and for a allele is 20% or 0.2. Similarly gene frequency of AA is 0.64 ($320/500$) Aa = 0.32 ($160/500$) and aa = 0.04 ($20/500$).

Q.9. What is Hardy Weinberg Theorem?

Ans. STATEMENT:

The theorem states that frequencies of alleles and genotypes in a population's gene pool remain constant over the generation unless acted upon by agents other than sexual recombination.

Importance of the Theorem

This theorem was made by two scientists Hardy and Weinberg in 1908.

Hardy Weinberg theorem explains the frequencies of genotypes of non-evolving population. According to this theorem shuffling of alleles due to meiosis and random fertilization have no effect on overall genetic structure of a population.

Hardy Weinberg Equation

The Hardy - Weinberg equation is used for calculating the frequencies of alleles and genotypes in populations at equilibrium. For example, a gene locus has only two alleles in a population.

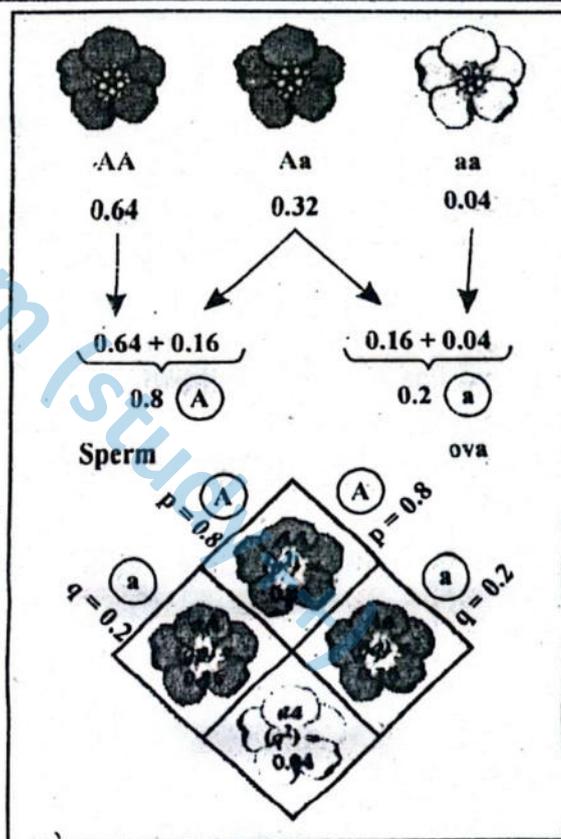


Fig. The Hardy-Weinberg theorem. The genetic structure of a non-evolving population remains constant over the generations. Sexual recombination alone will not alter the relative frequencies of alleles or genotypes. (p = frequency of A; q = frequency of a).

1. Measurement of Allelic Frequency

Population geneticists use the letter P to represent the frequency of one allele and letter q to represent the frequency of one allele and letter q to represent the frequency of the other allele.

A wild flower population has

$$p = 0.8$$

$$q = 0.2$$

Note that $p + q = 1$, the combined frequencies of all possible alleles must be equal to 100% of the genes for that locus in the population. If there are only two alleles and we know the frequency of one, the frequency of other can be calculated

$$\text{If } p + q = 1, \text{ then } 1 - p = q \text{ or } 1 - q = p$$

2. Measurement of Gene Frequency

In the wild flower population the frequency of dominant allele.	$p = 0.8$
The frequency of recessive allele.	$q = 0.2$
The gametes combine their alleles to form zygotes. The probability of producing an AA genotype then probability of an A sperm fertilizing an A ovum to produce an AA zygote is	$p^2 = 0.64$
The frequency of individuals homozygous for the other allele (aa) population is	$q^2 = 0.2 \times 0.2$ $= 0.04$
There are two ways in which an (Aa) genotype can arise. It depends on which parent contributes the dominant allele. Therefore, the frequency heterozygous individuals in the population is	$2pq$ $= 2 \times 0.8 \times 0.2$ $= 0.32$
We have calculated frequencies of all possible genotypes correctly, they should add to give.	1

$$p^2 + 2pq + q^2 = 1$$

(frequency of AA) (frequency of Aa + AA) (frequency of aa)

Binomial Expression

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

Q.10. Explain the different factors which affect the gene frequency.

Ans. Factors affecting gene frequency

Many factors can change the frequency of gene. Out of these five affect the proportion of homozygotes and heterozygotes which produce significant deviation from the proportion claimed by Hardy Weingberg. These are



Factor

(i) Mutation

“A spontaneous change in part of DNA is called mutation”.

It is the ultimate source of all changes; individuals mutations occur so rarely that mutation alone does not change frequency much.

(ii) Migration

“The movement of an organism from one population to the other is called migration”.

A very potent agent of change, migration locally acts to prevent evolutionary changes by preventing populations that exchange members from diverging from one another. Emigration and immigration of members of a population, cause disturbance in the gene pool.

(iii) Genetic Drift

“The change in frequency of alleles at a locus that occurs by chance is called genetic drift”. In small populations, such as fluctuations may lead to the loss of particular alleles. This may occur in a small population when a few individuals fail to reproduce and then genes are lost from population.

(iv) Non Random Mating

“Individuals with certain genotypes mate with one another more commonly than expected random mating. This is called non-random mating”.

Inbreeding is the most common form; does not alter allele frequency, but lessens the proportion of heterozygote individuals.

Non Random Mating Causes: The frequencies of particular genotypes to differ greatly from those predicted by the Hardy Weinberg principle.

(v) Selection

Some individuals leave behind more progeny than others, and the rate at which they do so is affected by their inherited characteristics. This is called selection. Selection can be artificial selection or natural selection. In artificial selection, the breeders select for the desired characters. In natural selection, the environment plays this role, thus affecting the proportions of gene in a population.

Q.11. What are the endangered species? What measures could be adapted for their preservation?

Ans. Definition

The endangered species are those species which are in imminent danger of extinction through its range where it lives.

CAUSES OF EXTINCTION:

The plant and animals are in great danger becoming extinct. There are several factors for their extinction.



1. Habitat Destruction:

The living place of many species are destroyed.

(i) Tropical rain forest:

These forests had reduced to 44% of their original extent.

(ii) Ecuador:

In Ecuador forest coverage has been reduced by 95% this decrease in habitat has resulted in tens of thousands of extinction.

(iii) Other Habitats:

These are grassland, marshes deserts and coral reefs. The habitats other than this are also being threatened. Deserts, sub-mountainous tract and wet lands are habitat in peril. We must protect them.

2. Climate change
3. Pollution
4. Invasions from foreign species
5. Hunting

Extinct Species of Pakistan

In Pakistan the species which are extinct are cheetah, tiger, Asian lion, Indian rhino, Cheer pheasant, crocodile, gavia. Those species which are near to extinction are. Indus dolphin, Black buck, common leopard, Great Indian bustard, Henbane bustard, white headed duck and marbled teal.

Endangered species of plants have been recorded to more than 500.

Preservation Measures:

Preservation of endangered species need a conservation plan which should have.

1. A global system of national parks to protect large tracts of land and wild life corridors that allow movement between natural areas.
2. The endangered species should be place in zoos and botanical gardens so that they are saved.
3. Many of the landscapes should be protected so that they become multiple areas which allow controlled private activity but also retain value as wildlife habitat.

Endangered Species in Pakistan

Extinct Species

Cheetah, Tiger, Asian lion, Indian rhino, cheer pheasant, crocodile, gavia have been declared extinct in Pakistan.

Endangered Species

Indus dolphin, Blackbuck, Common leopard, Great Indian bustard, Houbara bustard, White-headed duck and Marbled teal are near to extinct. More than 500 species of plants are endangered species.



◀ SOLVED EXERCISE ▶

Q.1: Fill in the blank with appropriate words.

- (i) Archaeobacteria can tolerate high temperatures up to _____.
- (ii) The first eukaryotes appeared about _____ years ago.
- (iii) _____ presented the theory of the origin of species by means of Natural Selection.
- (iv) _____ developed a theory of natural selection essentially identical to Darwin's.
- (v) _____ are considered to be the ancestors of all life.
- (vi) A respiratory protein called _____ is found in all aerobic organisms.
- (vii) Total aggregate of genes in a population at any time is called its _____.
- (viii) Hardy Weinberg theorem describes a _____ population.
- (ix) _____ is a series of changes in the genetic composition of a population over time.
- (x) Level of classification between species and family is called _____.
- (xi) Hardy Weinberg equation is binomial expansion of _____.
- (xii) An _____ species is in imminent danger of extinction throughout its range.
- (xiii) A _____ is a localized group of individuals belonging to the same species.
- (xiv) The first photosynthetic organisms used _____ as source of hydrogen for reducing carbon dioxide to sugars.
- (xv) _____ published an essay on 'The Principle of Population'.

- Ans:**
- | | | |
|---------------------|------------------------------------|------------------|
| (i) 120°C | (ii) 1.5 billion | (iii) Darwin |
| (iv) Alfred Wallace | (v) prokaryotes | (vi) haemoglobin |
| (vii) gene pool | (viii) non evolving | (ix) evolution |
| (x) genus | (xi) $(p + q)^2 = p^2 + 2pq + q^2$ | (xii) endangered |
| (xiii) population | (xiv) hydrogen sulphide | (xv) Malthus |

Q.2. Each question has four options. Encircle the correct answer.

- (i) **The gill pouches of mammals and birds are.**
- (a) Support for "ontogeny recapitulates phylogeny"
- (b) Homologous structures
- (c) Used by the embryos to breathe
- (d) Evidence for the degeneration of unused body parts
- (ii) **Darwin's theory, as presented in The Origin of Species, mainly concerned**
- (a) How new species arise
- (b) The origin of life
- (c) How adaptations evolve
- (d) How extinctions occur
- (e) The genetics of evolution



- (iii) **The smallest biological unit that can evolve over time is**
- (a) A particular cell (b) An individual organism
(c) A population (d) A species
(e) An ecosystem
- (iv) **A gene pool consists of**
- (a) All the alleles exposed to natural selection
(b) The total of all alleles present in a population
(c) The entire genome of a reproducing individual
(d) The frequencies of the alleles for a gene locus within a population
(e) All the gametes in a population
- (v) **In a population with two alleles for a particular locus, B and b, the allele frequency of B is 0.7. What would be the frequency of heterozygote if the population is in Hardy-Weinberg equilibrium?**
- (a) 0.7 (b) 0.42
(c) 0.49 (d) 0.09
(e) 0.21
- (vi) **In a population that is in Hardy-Weinberg equilibrium, 16% of the individuals show the recessive trait. What is the frequency of the dominant allele in the population?**
- (a) 0.84 (b) 0.36
(c) 0.6 (d) 0.4
(e) 0.48
- (vii) **Selection acts directly on**
- (a) Phenotype (b) Genotype
(c) The entire genome (d) Each allele
(e) The entire gene pool
- Ans. (i) (d) (ii) (a) (iii) (d) (iv) (b)
(v) (b) (vi) (a) (vii) (b)

Q.3. Short questions.

(i) **What are hydrothermal vents?**

Ans. Life may have been originated in waters of deep oceans in underwater hot spring which is called hydrothermal vents.

(ii) **State Endosymbiont hypothesis.**

Ans. Eukaryote might have evolved when large anaerobic amoeboid prokaryote ingested small aerobic bacteria and had stabilized them instead of digesting them. This idea is known as endosymbiont hypothesis.

(iii) **Define population genetics.**

Ans. The total aggregate of genes in a population at any one time is called populations - gene pool and such study is called population genetics.



(iv) How does fossil record provide evidence of evolution?

Ans. Fossil is any record of a dead organism.

1. Evidences from biochemistry, biology and cell biology places prokaryotes as ancestors of all life and predicts that bacteria should precede all eukaryotic life in fossil record. Indeed the oldest known fossils are prokaryotes.
2. Another evidence is the chronological appearance of different classes of vertebrate animals in fossil record. Fossil record shows that fishes were the first vertebrates to appear in the world, the amphibians next, then the reptiles comes and then birds and mammals exist. This sequences is consistent with the history of vertebrate descent. The evolution of horse provides an example of such history.

(v) Explain the term homology with a suitable example.

Ans. Similarity in characteristics resulting from common ancestry is known as homology. e.g. forelimbs of man, bat, horse whale etc. are homologous and such evolution is called divergent evolution.

(vi) What are vestigial organs? Give two examples.

Ans. The oldest homologous structures are vestigial organs, rudimentary structures that had important functions in ancestors are not important now. The examples of vestigial organs are appendix in carnivores, ear muscles in man etc.

(vii) How are evolutionary relationships reflected in DNA and proteins?

Ans. The evidences are form in the structure of DNA and proteins, in their genes and gene products. If two species have genes and proteins with sequences of monomer that match closely, the sequences must have been copied from a common ancestor. A common genetic code bring evidence that all life are related with each other. Thus molecular biology give the evidence of evolution as the basis of unity and diversity.

(viii) State Hardy Weinberg theorem.

Ans. The theorem states that frequencies of alleles and genotypes in a populations gene pool remain constant over the generation unless acted upon by agents other that sexual recombination.

(ix) What is the difference between endangered species and threatened species?

Ans. The endangered species are those species which are in imminent danger of extinction through its range where it lives. While threatened species are those species which are near to be come endangered.

(x) Name any five species, declared extinct in Pakistan.

Ans. In Pakistan the species which are extinct are cheetah, tiger, Asian lion, Indian rhino, Cheer pheasant.



Q. 4. Extensive Questions.

(i) What are the endangered species? What measures could be adapted for their preservation?

Ans. Please see Q. No. 10

(ii) State and explain Hardy Weinberg theorem.

Ans. Please see Q. No. 9

(iii) Describe evidences of evolution from any five branches of biology.

Ans. Please see Q. No. 6

(iv) How did evolution proceed from prokaryotes to eukaryotes?

Ans. Please see Q. No. 2

(v) Analyze the Darwin's theory of natural selection as mechanism of evolution.

Ans. Please see Q. No. 4

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