

Syllabus

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5.0 Origin of Life

INTEXT QUESTION

Q.1 Can you recall ?

i. What is evolution?

Ans : Evolution is the gradual change occurring in living organisms over a long duration.

ii. Where was first life formed?

Ans : The first living material (protoplasm) was formed in the ocean, according to the theory of evolution.

iii. Why are many species of plants and animals getting (becoming) extinct?

Ans : Due to over exploitation of resources, deforestation, loss of habitat of animals due to deforestation, lack of food pollution, roaching/hunting of animals climate change, construction activities etc. many species of plants and animals are getting extinct.

iv. The Lamarck's theory of inheritance of acquired characters.

Ans :

i. Lamarck proposed that the activities of the organisms are responsible for their evolution.

Origin and Evolution of life

ii. This french naturalist proposed that each animal or plant undergo some changes in its life span and those changes are transferred to the next generation and such changes occur in next subsequent generations too.

iii. Jean-Baptiste Lamarck proposed that morphological changes occurring in living organisms are responsible for evolution and the reason behind those morphological changes is activities or laziness of that organism. He called this concept as principle of 'use or disuse of organs'.

iv. Further, he said that the neck of giraffe has become too long due to browsing on leaves of tall plants by extending their neck for several generation; similarly, shoulders of the ironsmith have become very strong due to frequent hammering movements.

v. What is Speciation?

Ans : Speciation is an evolutionary process by which a new species comes into being.

Q.2 Write a note on various theories and hypothesis that have been proposed to explain origin of life.

Ans : Various theories and hypotheses have been proposed to find the probable answer to this question.

i. Theory of special creation:

a. It is the oldest theory and is based on religious belief without any scientific proof.

b. It states that all living organisms are created by a super-natural power.

ii. Cosmozoic theory/Theory of Panspermia:

a. This theory advocates that life did not arise on the planet Earth.

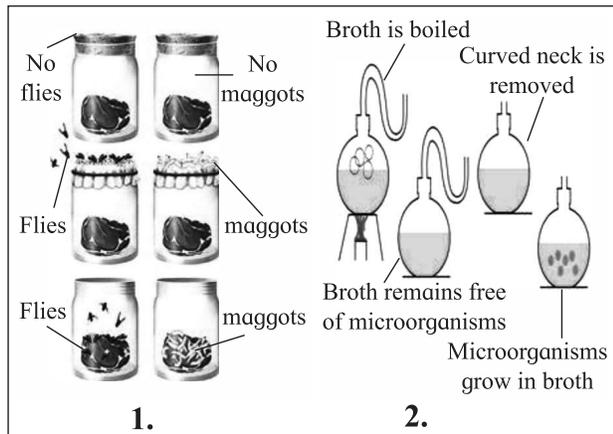
b. It may have descended to the earth from other planets in the form of spores or micro-organisms, called cosmozoa/panspermia.

- c. Recently, NASA has reported fossils of bacteria-like organisms on a piece of Martian rock recovered from Antarctica.
- iii. **Theory of spontaneous generation (Abiogenesis):**
- According to this theory, life originated from non-living material spontaneously.
 - This theory was disproved by Louis Pasteur.
- iv. **Theory of biogenesis:**
- According to this theory, living organisms are always produced from pre-existing living forms, by process called reproduction.
 - Theory of biogenesis however could not explain origin of first life on earth but could explain only the continuity of life.

INTEXT QUESTION

Q.3 Observe and discuss

- Redi Experiment**
- Louis Pasteur's Experiment**



Ans :

- Redi Experiment:**
 - In 1668, Francesco Redi, an Italian scientist, designed a scientific experiment to test the spontaneous creation of maggots by placing fresh meat in each of two different jars.
 - One jar was left open; the other was covered with a cloth. Days later, the open jar contained maggots, whereas the covered jar contained no maggots.
 - He did note that maggots were found on the exterior surface of the cloth that covered the jar.

- Redi successfully demonstrated that the maggots came from fly eggs and thereby helped to disprove spontaneous generation. He concluded that the maggots came from eggs laid on the meat by flies.
- Louis Pasteur's Experiment:**
 - Louis Pasteur expanded upon the investigations of predecessors, such as Francesco Redi.
 - Pasteur boiled a meat broth in a flask that had a long neck that curved downward, like a goose.
 - The idea was that the bend in the neck prevented falling particles from reaching the broth, while still allowing the free flow of air.
 - The flask remained free of growth for an extended period.
 - When the curved neck was removed, the broth quickly became clouded.
 - These experiments showed that living organisms that grew in such broths came from outside, as spores on dust, rather than spontaneously generated within the broth.
 - This was one of the last and most important experiments disproving the theory of spontaneous generation.

5.2 Chemical Evolution of Life

Q.4 Write a detailed note on Oparin and Haldane's theory of chemical Evolution of Life and enlists its steps.

Ans :

- Self assembly theory of origin of Life:**
 - According to this theory, life originated on earth by combinations of several chemicals through constant chemical reactions over a long period of time.
 - This theory is also called self assembly theory of origin of life or biochemical origin of life.
 - This theory was first formulated by Haeckel but later developed by the Russian scientist Alexander I.
 - Oparin (1924) and British biologist J.B.S. Haldane (1929).
- Steps of chemical evolution:**
The process of chemical evolution can be

divided into following steps:

i. **Origin of Earth and Primitive atmosphere:**

- a. The origin of universe was explained by the Big-Bang theory of Georges Lemaitre (1931).
- b. According to this theory the Universe originated about 20 billion years ago by a single huge titanic explosion.
- c. As the universe expanded, the temperature decreased and various galaxies of solid objects were formed.
- d. Milky Way is one such galaxy of which our solar system is one small part.
- e. Earth is one of the planets of solar system and originated about 4.6 billion year ago.
- f. When formed, it was a rotating cloud of hot gases and cosmic dust called Nebula.
- g. The condensation and cooling resulted in stratification with heavier elements like nickel and iron passing to the core and lighter ones like helium, hydrogen, nitrogen, oxygen, carbon, etc. remaining on the surface.
- h. They formed the atmosphere of the earth. The primitive atmosphere of the earth was quite different from the present one and it was of a reducing type, devoid of free oxygen.

ii. **Formation of ammonia, water and methane:**

- a. Primitive atmosphere was very hot.
- b. As it slowly cooled, the lighter elements started to react with each other.
- c. The early atmosphere was rich in hydrogen, carbon, nitrogen and sulphur of which hydrogen being more active, it reacted with other elements to form chemicals on earth like CH_4 , NH_3 , H_2O and H_2S .

iii. **Formation of simple organic molecules:**

- a. As temperature of the earth decreased, steam condensed into water that resulted in heavy rain fall and the earth gradually cooled.
- b. Rain water got accumulated on the land to form rivers, streams, lakes, seas and

oceans.

- c. The atmosphere then did not contain ozone layer and thus ultra-violet radiations reached the surface of earth directly.
- d. Under the influence of available energy sources such as ultra-violet rays, radiations, lightening and volcanic activities, the early molecules of hydrocarbons, ammonia, methane and water underwent reactions like condensation, polymerisation, oxidation and reduction.
- e. These reactions resulted in formation of simple molecules like monosaccharides, amino acids, purines, pyrimidines, fatty acids, glycerol, etc.
- f. All these simple organic molecules accumulated at the bottom of water bodies.
- g. Haldane described it as the “**hot dilute soup**” or “**primitive broth**”.
- h. It did not show any degradation due to absence of free oxygen and enzymes.

iv. **Formation of complex organic molecules:**

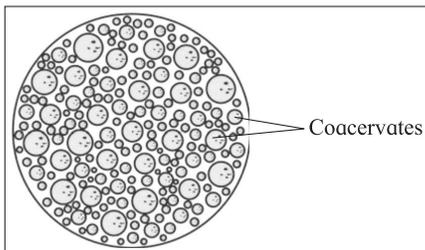
- a. The primitive broth was neutral and free from oxygen.
- b. Polymerisation took place and simple organic molecules aggregated to form new complex organic molecules like polysaccharides, fats, proteins, nucleosides and nucleotides.
- c. Polymerisation of amino acids formed **protoproteins** which later formed proteins.
- d. Formation of protein molecules is considered as landmark in the origin of life. Proteins (enzymes) accelerated the rate of other chemical reactions.

v. **Formation of Nucleic acids:**

- a. Nucleotides may have been formed by the reaction between phosphoric acid, sugar and nitrogenous bases (purines and pyrimidines).
- b. Number of nucleotides join together to form nucleic acids (RNA, DNA). Nucleic

acids acquired self-replicating ability which is a fundamental property of living form.

vi. **Formation of Protobionts or Procells:**



- Nucleic acids along with inorganic and organic molecules formed the first form of life called **protobionts**.
- Protobionts are the prebiotic chemical aggregates having some properties of living system.
- Protobionts are formed due to coacervation i.e. aggregation of organic molecules.
- Oparin (1924) called them coacervates and Sidney Fox called protenoids or microspheres.
- Coacervates are colloidal aggregations of hydrophobic proteins and lipids (lipoid bubbles).
- Coacervates grew in size by taking up material from surrounding aqueous medium.
- As they grew, they became thermodynamically unstable and split into smaller units, comparable to daughter cells of budding organisms.
- Microspheres are protenoids formed from colloidal hydrophilic complexes surrounded by water molecules.
- These bodies may have outer double-membrane, like primitive cell.
- Diffusion and osmosis may have occurred across the membrane.
- They were more stable than coacervates.
- Coacervates and microspheres were non-living colloidal aggregations of lipids and proteinoids respectively.
- They had some basic properties of living cells, such as growth and division.

- These colloidal aggregations turned into first primitive living system called eobionts or protocell.

vii. **Formation of first cell:**

- When RNA or DNA system developed within protocells, they look like bacteria or viruses.
- They regulated various metabolic activities.
- First cell was anaerobic, heterotrophic and obtained energy by chemoheterotrophic processes.

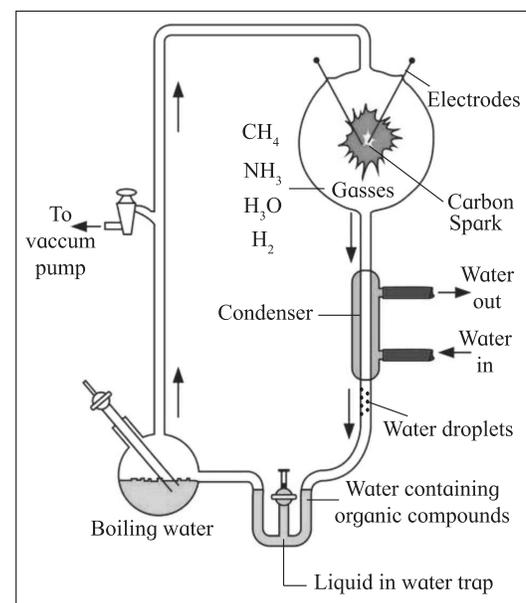
TEXTUAL QUESTION

★Q.5 **What is Coacervate?**

Ans : Coacervates are colloidal aggregations of hydrophobic proteins and lipids (lipoid bubbles).

★Q.6 **Describe the Urey and Miller's experiment.**

Ans :



- Stanley L. Miller and his teacher Harold C. Urey provided the first experimental evidence in support of chemical evolution theory of Oparin.
- They designed a glass-apparatus called spark-discharge apparatus.
- The apparatus was first sterilized and evacuated. Methane, ammonia and hydrogen gases were pumped in the proportion of 1:2:2

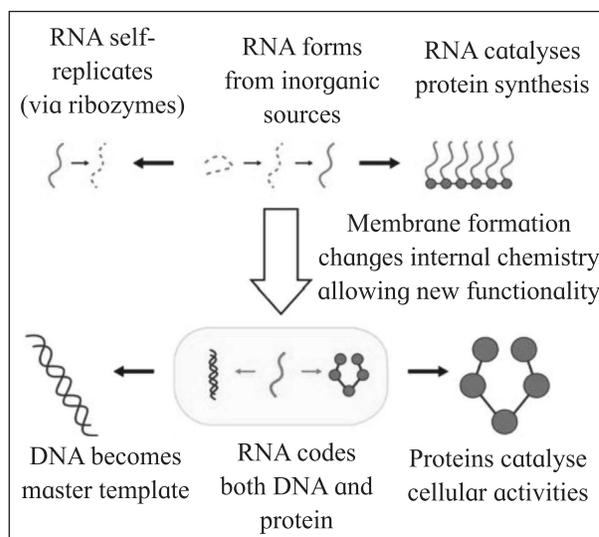
- into the glass chamber.
- iv. A tube carrying water vapour was also connected to the chamber.
 - v. Lightning effect was mimicked by electric discharge carbon arc spark in the chamber.
 - vi. Process of evaporation and precipitation was also simulated by the use of heating mantle and condenser respectively.
 - vii. The mixture of CH_4 , NH_3 , H_2 was exposed continuously to electric discharge for several days causing the gases to interact, after which these were condensed.
 - viii. They observed that the liquid collected in the U-tube turned brown.
 - ix. Chemical analysis of this liquid reported the presence of simple organic compounds.
 - x. Urea, amino acids, lactic acid, etc).
 - xi. This experiment strongly supports that the simple molecules present in the earth's early atmosphere combined to form the organic building blocks of life.

Q.7 Explain RNA world hypothesis.

Ans.

- i. It was in 1980 that Sidney Altman and Thomas Cech independently found out that RNAs can also act as biocatalysts.
- ii. These catalytic RNAs are called as Ribozymes.
- iii. For this discovery, Altman and Cech earned Nobel Prize in chemistry in 1989.
- iv. This discovery provided important support for RNA World hypothesis.
- v. The hypothesis suggests that early life must have been based exclusively on nucleic acids, most probably RNA.
- vi. It was first proposed by Carl Woese, Francis Crick and Leslie Orgel in 1960, long before discovery of ribozymes.
- vii. RNA is found abundantly in all living cells, it is structurally related to DNA and chains of RNA can evolve or undergo mutations, replicate and catalyse reactions are all facts supporting this hypothesis.
- viii. Biomolecules like Acetyl-Co-A have a nucleotide in their molecular structure.

- ix. Major evidence is existence of ribosome (the protein assembly unit) in the cell. In ribosomes, translation process is catalysed by RNA.
- x. These molecules might have undergone repeated replication and mutation forming varieties of RNA molecules with varying sizes and catalytic properties.
- xi. Eventually they might have developed their own protein coats and machinery to survive the assembly of primitive cell.
- xii. In due course, a double stranded stable structure, the DNA, might have been formed and thus continued the ongoing journey which resulted in rich biodiversity on earth.



5.3 Organic Evolution

★Q.8 Define Organic evolution.

Ans : Organic evolution can be defined as slow, gradual, continuous and irreversible changes through which the present day complex forms of the life developed (or evolved) from their simple pre-existing forms.

Q.9 Describe various theories of organic evolution.

Ans :

- i. Evolution (Latin word, e = from; volvere = to roll) means the act of unrolling or unfolding of nature. It brings about orderly changes from one form to another. These changes result in descendants becoming different from the ancestors.

- ii. According to Charles Darwin, evolution is 'descent with modification'.
- iii. Lamarck's theory proposed that, the trait are acquired due to internal force, changes in environment, new needs and the use and disuse of organs.
- iv. Lamarck's theory was disproved by a German biologist August Weismann, who cut the tails of many rats for several generations but could not find any change in size of tail even after 21 generations. He concluded that variations produced in somatic cells (somatoplasm) are not inherited while variations produced in germ cells (germplasm) are inherited to next generation and he proposed the theory of Germplasm.

5.4 Darwinism

Q.10 What is Darwinism? State the work that influenced Darwin to postulate this theory?

Ans :

- i. Darwinism is the theory of origin of species by Natural Selection.
- ii. Charles Darwin as a naturalist travelled extensively the world over from 27th December 1831 to October 1836 and returned to England.
- iii. Based on his collections of living and fossil material he published a book "The origin of species by Natural Selection" in 1859.
- iv. Before publishing his book, he was very much influenced by C. Lyell (Geologist) who pointed out that the natural forces that existed in the past are same as those existing at present.
- v. Darwin observed that the natural forces resulted in the changes in the earth's crust along South America.
- vi. He observed variety of strange plants and animal in Galapagos islands and other nearby islands in the Archipealago in terms of variations between the tortoises and finches. Similar observations were also made by Wallace.
- vii. He was also influenced by R. Malthus, an Economist, who worked on human population

mentioning that the reproductive potential of humans is greater than others. This resulted in multiplication of human population without corresponding increase in the food supply. This increase lead to competition and struggle for existence of human species.

- viii. He was also influenced by plant/animal breeders who by using artificial selection, altered the characteristic of cultivated plant and domestic animals.

Q.11 Describe the five main postulates of Darwinism?

Ans : Darwinism is based on five main postulates:

- i. **Overproduction (Prodigality of nature):**
 - a. It is the natural tendency to produce more number of progeny in geometric ratio, for perpetuation of the species.
 - b. He observed prodigality potential many species of plants and animals e.g. Salmon fish produces about 28 lakh eggs in a single season.
 - c. In a span of 750 years single pair of elephants would produce 19,000,000 elephants.
 - d. However the size of given species in a given area remains relatively constant because of fluctuations that occur seasonally.
- ii. **Struggle for existence:** Tendency of over production leads to the struggle for existence between the members of population for limited supply of food or to overcome adverse environmental conditions or for a space or to escape from enemies etc.
- iii. **Organic variations:**
 - a. The variations speak for all kinds of differences that occur in morphology, physiology, nutrition, habit behavioural patterns etc.
 - b. Darwin recognized these variations as raw material for evolution.
 - c. Variations were observed among members of the same species and even in different species.
- iv. **Natural selection:**
 - a. Organic variations can serve as evidence

- that for the some organisms have better adapted to survive under existing environmental conditions than the others.
- b. In the struggle for existence organisms with favourable variations are selected by the nature while those with unfavourable variations perish.
 - c. According to Darwin, the principle by which useful variations are preserved by nature, is called '**Natural Selection**'. H. Spencer named this process as '**survival of fittest**'.
- v. **Origin of new species (speciation):**
- a. As favourable variations are transmitted from generation to generation, successive generations become better adapted to environment.
 - b. Gradually these adaptation with few new modification become fixed in the life cycle and finally giving rise to a new species.

Q.12 State the Evidences of Darwinism.

Ans :

- i. **Evolution of long-necked giraffe:**
 - a. Evolution of long-necked giraffe to pluck and eat more leaves from tall trees and woody climbers.
 - b. This adaptation became fixed in the life for survival.
 - c. The Giraffe borne tall could survive in famine heat areas.
 - d. This adaptation was transmitted to their offspring.
 - e. This is how, present long-necked Giraffe came to existence.
- ii. **Evolution of Black coloured peppered moth:** Black colour peppered moths evolved gradually as new species.
- iii. **DDT resistance in mosquitoes:**
 - a. DDT resistance in mosquitoes-intensive DDT spraying destroyed all types of mosquitoes.
 - b. However some mosquitoes developed resistance to DDT and survived the on slaughter of DDT spray.

- c. Such resistant mosquitoes survived and reproduce giving rise to more resistant offspring.

Q.13 Enlist the drawbacks and objections to Darwnism.

Ans : Drawbacks and Objections to Darwnism are as follows:

- i. He considered minute fluctuating variation as principal factors which are not heritable and not part of evolution.
- ii. He also did not distinguish somatic and germinal variation and considered all variations are heritable.
- iii. He did not explain the 'arrival of the fittest'.
- iv. He also did not explain the cause, origin and inheritance of variations and of vestigial organs, nor he could explain the extinction of species.
- v. According to natural selection new species are formed by gradual accumulation of useful variations. If it is so, then their should be intermediate forms. But in most cases intermediate form were not recognised. Moreover, Darwinism also could not explain existence of neutral flowers and the sterility of hybrids.

5.5 Mutation Theory

Q.14 Explain Mutation theory in brief.

Ans :

- i. This theory was proposed by Hugo de Vries (1901), after the rediscovery of Mendel's work (1900).
- ii. He proposed this theory based on his observations on seven generations of the plant-evening primrose (*Oenothera Lamarckiana*).
- iii. He found that though most of the offsprings resembled their parents in many characters, some of the offsprings show the appearance of sudden or spontaneous variation clearly different from the phenotypic expression of the parent.
- iv. These sudden variations were called **mutations** or **discontinuous variations**.

- v. The variant offsprings produced variants and not normal plants i.e. these changes were inheritable.
- vi. He also observed that some variants also produced more variations.
- vii. He noted that these sudden changes are inheritable, and proposed the Mutation theory.

Q.15 Enlist the main features of the mutation theory.

Ans : The main features of mutation theory are as follows:

- i. Mutations are large, sudden and discontinuous variations in a population.
- ii. These changes are inheritable.
- iii. Mutations provide the raw material for organic evolution.
- iv. Mutation may be useful or harmful. Useful mutations are selected by nature.
- v. Accumulation of these mutations over a period of time leads to the origin and establishment of new species.
- vi. Harmful mutation may persist or get eliminated by nature.

TEXTUAL QUESTION

***Q.16 Write the objections to Mutation theory of Hugo de Vries.**

Ans : Objections to Mutation theory are as follows:

- i. The large and discontinuous variation observed by Hugo de Vries were actually due to chromosomal aberrations were as gene mutations usually bring about minor changes.
- ii. Rate of mutation is very slow as compared to the requirement of evolution.
- iii. Chromosomal aberrations have little significance in evolution as they are quite unstable.

Q.17 Differentiate between Darwinism and Mutation theory.

Ans :

	Darwinism	Mutation Theory
i.	Darwinism is based on the concept of natural selection.	Mutation theory is based on the concept of mutations.
ii.	Charles Darwin proposed this theory.	Hugo de Vries proposed this theory.
iii.	The theory states that evolution is caused by minor variation that one small and directional.	The theory states that evolution is caused by mutations which are random and directionless.
iv.	It was proposed based on observations - Prodigality of nature, struggle for existence, natural selection, origin of species and organic variations.	It was proposed based on observations on seven generations of plant - evening primrose.

5.6 Modern Synthetic Theory of Evolution

Q.18 Explain Modern synthetic theory in detail.

Ans :

- i. Modern Synthetic Theory of Evolution is the result of true synthesis of all biological discipline. Studies pertaining to genetical, ecological, anatomical, geographical, palaeontological etc. were pursued to explain mechanism of evolution. Also due importance was given to both mutations and natural selection.
- ii. R. Fischer, J.B.S. Haldane, T. Dobzhansky J. Huxley, E. Mayr, Simpson, Stebbins, Fisher, Sewall Wright, Medel, T.H. Morgan etc. are the main contributors of modern theory of evolution.
- iii. Modern synthetic theory comprises five main factors that are broadly divided into three main concepts like:
 - a. **genetic variations** caused due to various aspects of mutation, recombination and migration.
 - b. **natural selection** and
 - c. **isolation**, for explaining the evolution of species.

I. Genetic variations:

The change in gene and gene frequencies, is known as genetic variation. Genetic variations are caused by following factors:

1. Gene Mutation:

- Sudden permanent heritable change is called mutation.
- Mutation can occur in the gene, in the chromosome and in chromosome number.
- Mutation that occurs within the single gene, is called point mutation or gene mutation.
- This leads to the change in the phenotype of the organism, causing what is called variation.

2. Genetic recombination:

- In sexually reproducing organisms, during gamete formation, exchange of genetic material occurs between non-sister chromatids of homologous chromosomes.
- This is called **crossing over**.
- It produces new genetic combinations which result in variation.
- Fertilization between opposite mating gametes leads to various recombinations resulting into the phenotypic variations causing change in the frequencies of alleles.

3. Gene flow:

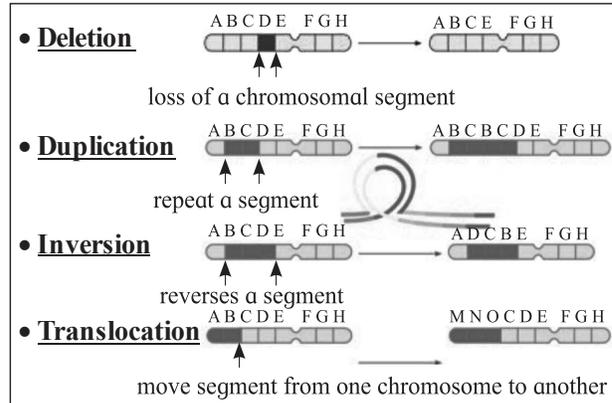
- Gene flow is movement of genes into or out of a population.
- Gene movement may be in the form of migration of organism, or gametes (dispersal of pollens) or segments of DNA (transformation).
- Gene flow also alters gene frequency causing evolutionary changes.

4. Genetic drift:

- Any random fluctuation (alteration) in allele frequency, occurring in the natural population by pure chance, is called genetic drift.
- For example, when the size of a population is severely reduced due to natural disasters like earthquakes, floods, fires, etc. cause elimination of particular

alleles from a population.

- Smaller populations have greater chances for genetic drift.
- It will result in the change in the gene frequency.
- Genetic drift is also an important factor for evolutionary change.



5. Chromosomal aberrations:

- The structural, morphological change in chromosome due to rearrangement, is called chromosomal aberrations.
- It changes the genes arrangement (order or sequence) that results in the variation.
- Chromosomal aberrations occur due to -
 - **Deletion:** Loss of genes from chromosome.
 - **Duplication:** Genes are repeated or doubled in number on chromosome.
 - **Inversion:** A particular segment of chromosome is broken and gets reattached to the same chromosome in an inverted position due to 180° twist. There is no loss or gain of gene complement of the chromosome.
 - **Translocation:** Transfer (transposition) of a part of chromosome or a set of genes to a non-homologous chromosome is called translocation. It is effected naturally by the transposons present in the cell.

II. Natural selection:

- According to Darwin, natural selection is the main driving force behind the evolution.
- This holds that genetic variations rise

within the population.

- c. The 'fittest' will be at the selective advantage and will be more likely to produce offsprings than the rest, as the 'fit' continues to enjoy greater survival and reproductivity, new species will eventually evolve.
- d. Alternatively, natural selection is the process by which better adapted organisms grow and produce more number of offsprings in the population.
- e. It brings about evolutionary changes by favouring differential reproduction of genes that bring about changes in gene frequency from one generation to next generation.
- f. Natural selection encourages those genes or traits that assure highest degree of adaptive efficiency between population and its environment.

III. Isolation:

- a. Isolation is the separation of the population of a particular species into smaller units which prevents interbreeding between them.
- b. Some barrier which prevents gene flow or exchange of genes between isolated populations, is called isolating mechanism.
- c. Number of isolating mechanisms are operated in nature and therefore divergence and speciation may occur. The isolating mechanisms are of two types namely, geographical isolation and reproductive isolation.

1. Geographical Isolation:

- a. It is also called as physical isolation. It occurs when an original population is divided into two or more groups by geographical barriers such as river, ocean, mountain, glacier etc. These barriers prevent interbreeding between isolated groups.
- b. The separated groups are exposed to different kinds of environmental factors and they acquired new traits by mutations.

- c. The separated populations develop distinct gene pool and they do not interbreed.
- d. Thus, new species have been formed by geographical isolation. e.g. Darwin's Finches.

2. **Reproductive Isolation:** Reproductive isolations occurs due to change in genetic material, gene pool and structure of genital organs. It prevents interbreeding between population.

Types of Isolating Mechanisms :

- A. **Pre-mating or pre-zygotic isolating mechanism:** This mechanism prevent fertilization and zygote formation.

- a. **Habitat isolation or (Ecological isolation):** Members of a population living in the same geographic region but occupy separate habitats so that potential mates do not meet.

- b. **Seasonal or temporal isolation :** Members of a population living in the same geographic region but are sexually mature at different years or different times of the year.

- c. **Ethological isolation:** Due to specific mating behaviour the members of population do not mate.

- d. **Mechanical Isolation:** Members of two population have difference in the structure of reproductive organs.

- B. **Post-mating or Post-zygotic barriers:**

- a. **Gamete mortality:** Gametes have a limited life span. Due to one or the other reasons, if union of the two gametes does not occur in the given time, it results in the gamete mortality.

- b. **Zygote mortality:** Here, egg is fertilized but zygote dies due to one or the other reasons.

- c. **Hybrid sterility:** Hybrids develop to maturity but become sterile due to failure of proper gametogenesis (meiosis). e.g. Mule is an intergeneric hybrid which is sterile.

TEXTUAL QUESTION

★Q.19 If variation occurs in a population by chance alone and not by natural selection and brings change in frequencies of an allele what is called?

Ans : The variation in a population occurring by chance alone and not by natural selection and brings some change in frequencies of an allele, it is called are genetic drift.

★Q.20 By taking industrial melanism as one example. Explain the concept of natural selection.

Ans :

- i. Industrial melanism is one of the best example for natural selection.
- ii. In Great Britain, before industrilisation (1845) grey white winged moths (*Biston betularia*) were more in number than black-winged moth (*Biston carbonaria*).
- iii. These moths are nocturnal and during day time they rest on tree trunk.
- iv. White-winged moth can camouflaged (hide in the background) well with the lichen covered trees that helped them to escape from the predatory birds.
- v. On other hand, the black-winged moth resting on lichen covered tree trunks were easy victims for the predatory birds and their number was reduced.
- vi. During industrial revolution, large number of industries came up in Great Britain.
- vii. The industries released black sooty smoke that covered and killed the lichens growing on tree and turn the tree black due to pollution.
- viii. This change become an advantage to the black-winged moth that camoflaged well with the black tree trunks and their number increased while the white-winged moth become victims to predatory birds due to which their number reduced.
- ix. Thus natural selection has resulted in the establishment of a phenotypic traits in changing the environmental conditions.

★Q.21 What is isolation? Describe different types

of reproductive isolations.

Ans : Refer Q.18(III)

INTEXT QUESTION

Q.22 Can you tell?

i. What is variation?

Ans : Variation is the change in gene and gene frequencies.

ii. What is mutation?

Ans : Sudden permanent heritable change in the genetic material of an organism is called as mutation.

iii. What is gene frequency?

Ans : Ref. Q.23(iii)

iv. Why variations are occurs in population?

Ans : Ref. Q.18-(I)

Q.23 Define:

- i. Population
- ii. Gene pool
- iii. Gene frequency

Ans :

- i. **Population:** All individuals of the some species constitute a population.
- ii. **Gene pool:** The total genetic information encoded in sum total of genes in a Mendelian population is called **gene pool**.
- iii. **Gene frequency:** The proportion of an allele in the gene pool, to the total number of alleles at a given locus, is called **gene frequency**.

Q.24 Match the following.

	Column-I		Column – II
1	August Weismann	a.	Mutation theory
2	Hugo de vries	b.	Germplasm theory
3	Charl Darwin	c.	Theory of acquired characters
4	Lamarck	d.	Theory of natural selection

Ans : i-b, ii-a, iii-d, iv-c

5.7 Mechanism of Organic Evolution

TEXTUAL QUESTION

★Q.25 Write a note on Genetic drift.

Ans :

- i. Any alternation in allete frequency in the natural population by chance, is called **genetic**

drift.

- ii. Concept of genetic drift was first given Sewall wright, hence, called as Sewall wright effect.
- iii. For example, elimination of a particular allele from a population due to events like accidental death prior to mating of an organism.
- iv. Genetic drifts are random or directionless.
- v. The effect of genetic drift is more significant in small population than in large population.
- vi. Due to genetic drift, some alleles of a population are lost or reduced by chance and some others may be increased.
- vii. Some time, a few individuals become isolated from the large population and they produce new population in new geographical area. The allele frequency of new population become different. The original drifted population (i.e. colonizing ancestor/pioneer) becomes 'founders' and the effect is called founder effect.
- viii. A bottle neck effect is seen when much of a population is killed due to a natural disaster and only a few remaining individuals are left to begin a new population.

Q.26 What is natural selection?

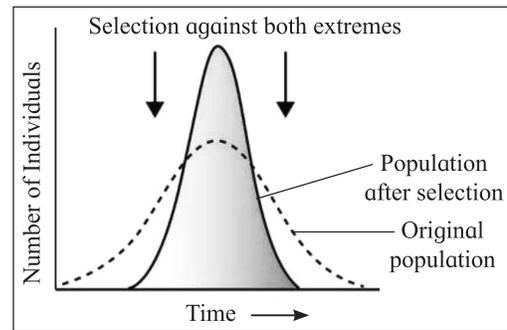
Ans : Natural selection is a process by which better adapted individuals with useful variations are selected by nature and leave greater or more number of progenies (Differential reproduction).

Q.27 Write a note on stabilizing selection.

Ans : Stabilizing selection or Balancing selection is represented by the graph.

- ii. Here more individuals of a population acquired a mean character value.
- iii. It tends to favour the intermediate forms and eliminate both the phenotypic extreme. For e.g. More number of infants with intermediate weight survive better as compare to those who are over-weight or under-weight.
- iv. It reduces variations.
- v. It does not lead to evolutionary change but tend to maintain phenotypic stability within population, therefore, it is described as stabilizing selection.

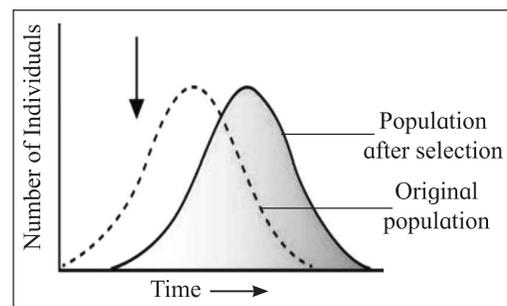
- vi. Genetically stabilizing selection represents a situation where a population is adapted to its environment.



Q.28 Write a note on directional selection.

Ans :

- i. In this type, more individuals acquired value other than the mean character value.
- ii. Natural selection acts to eliminate one of the extremes of the phenotypic range and favour the other. e.g. systematic elimination of homozygous recessives.
- iii. Directional selection operates for many generations, it results in an evolutionary trend within a population and shifting a peak in one direction.
- iv. e.g. Industrial melanism, DDT resistant mosquito etc.

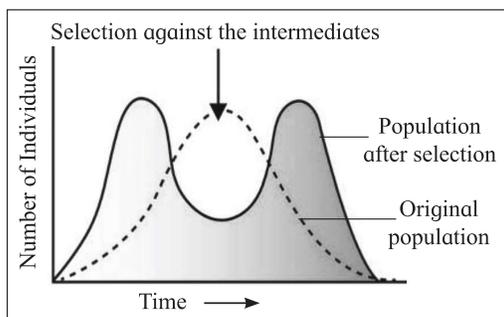


★Q.29 What is disruptive selection? Give example.

Ans :

- i. Here more number of individuals acquire peripheral character value at both ends of the distribution curve.
- ii. Nature select extreme phenotypes and eliminate intermediate. Hence two peaks are formed in distribution of traits.
- iii. This kind of selection is rare.
- iv. It ensures the effect on the entire genepool of a population, considering all mating types or

- systems.
- v. Example - It was observed in the different beak size of African seed cracker finches. The birds have different size of beak and they feed on seeds. The available seeds were of two kinds small and large sized seeds. Large beak sized birds feeds on large seeds while small beak sized birds feed on small seeds and their number was increased. Intermediate beak sized birds are unable to feed on either type of seeds so their population was decreased gradually and then eliminated by natural selection.



Q.30 Draw a graph show that natural selection leads to disruptive change.

Ans : Refer fig. Q.28.

Q.31 Write a note on the following :

- i. Isolation ii. Speciation**

Ans :

- i. **Isolation:** It is separation of a single interbreeding population into subunits. Isolation restricts gene flow between discrete (non continuous population due to different barriers like geographical barriers. (This part is already explained in detail earlier in this chapter).
- ii. **Speciation:** The sub units of single interbreeding population due to the geographical barriers like river, mountains, desert, sea etc. become isolated in such a way that their interbreeding is prevented. This will finally lead to origin of new species (i.e. speciation).

5.8 Hardy-Weinberg's principle

Q.32 Write a note on Hardy-Weinberg's equilibrium law.

Ans :

- i. Hardy-Weinberg's equilibrium states that 'at equilibrium point both the gene (allele) frequency and genotypic frequency remain constant from generation to generation'.
- ii. It occurs only in the diploid, sexually reproducing, large, free interbreeding population in which mating is random and no selection or other factors are present for changing the allele frequency. e.g. A single locus has two alleles (A and a).
- iii. The frequencies of these allele are p and q respectively. The allele frequency for any locus is always one. i.e. $P + Q = 1$.
- iv. The genotypic frequencies of both the alleles are represented by $(p + q)^2 = 1$. The binomial expansion of this is $P^2 + 2pq + q^2 = 1$ i.e. $AA = P^2$, $aa = q^2$ and for $2Aa = 2pq$.
- v. Hence $P^2 + 2pq + q^2 = 1$, This is a binomial expansion of $(p + q)^2$.
- vi. This can be explained by punnet square as follow.

		Hybrid A a	
		A (p)	a (q)
Hybrid Aa	A (p)	AA (p ²)	Aa (pq)
	a (q)	Aa (pq)	aa (q ²)

- Like allele frequency, the genotypic frequencies together are also equal to 1.
- vii. There are few factors such as gene migration (gene flow), genetic drift, mutation, genetic recombinations, natural selection, nonrandom mating, etc. which affect or change the Hardy-Weinberg equilibrium.
- viii. If these factors do not occur in the population, then population is genetically stable or non evolving population.

TEXTUAL

***Q.33 State the Hardy-Weinberg equilibrium.**

Ans : Hardy-Weinberg's equilibrium states that 'at equilibrium point both the gene (allele) frequency and genotypic frequency remain constant from generation to generation'.

INTEXT

Q.34 Can you tell?
In which condition the gene frequency of a population will remain constant.

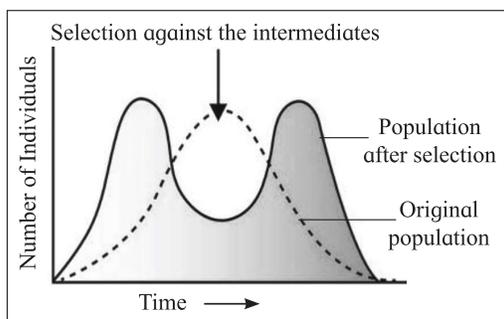
Ans : Gene frequency of a population remains constant when mating is random in a large populations with no disruptive circumstances like genetic drift, gene flow, mutation, genetic recombination, natural selection, etc.

5.9 Adaptive Radiation

TEXTUAL

★Q.35 What is adaptive radiation? Explain with suitable example.

Ans :



- i. The process of evolution which results in transformation of original species to many different varieties, is called, adaptive radiation.
- ii. Darwin's Finches is one of the best example of adaptive radiation.
- iii. During his visit to Galpagos Islands. Charls Darwin also noticed a variety of small birds. These birds are called Darwin's finches.
- iv. Darwin concluded that the American main land species of bird was the original one from which they migrated to the different islands of Galpagos.
- v. They adapted to the different environmental conditions of these islands.
- vi. From original seed eating features many other forms with altered beaks evolved into insectivorous features.
- vii. Another example of adaptive radiation is Australian Marsupials. In Australia, there are many marsupial mammals who evolved from

common ancestor.

★Q.36 What is adaptive radiation?

Ans : The process of evolution which results in transformation of original species to many different varieties is called adaptive radiation.

5.10 Evidences of organic evolution

Q.37 What does theory of organic evolution state also enlist the evidences for process of evolution.

Ans :

- i. The theory of organic evolution states that the present day complex organisms have originated from earlier simpler forms of life.
- ii. The process of evolution is supported by evidences provided by various branches of biology such as : Palaeontology, comparative anatomy, embryology and molecular biology.

Q.38 Can you recall?

i. What are fossils? Why should we study fossils?

Ans :

- i. The dead remains of plants and animals that lived in past in various geological layers are known as fossils.
- ii. Study of fossils provide evidence of evolution.
- iii. Study of fossils tell us about life forms seen millions of years ago (mya).
- iv. Geological time scale and evolutionary history is based on study of fossils.
- v. Study of fossil can be used in paleontology and antropology to obtain information of their ancestors and determining fossils age.

ii. How do we find age of fossils?

Ans :

- i. Age of fossils can be found out by relative dating and absolute dating.
- ii. Relative dating is the science determining the relative order of past events without necessarily determining their absolute age.
- iii. The approximate age of fossile can be determined by comparing it to similar rocks and fossils of known ages.
- iv. In absolute dating the precise age of the fossil

can be determined by carbon dating method.

Refer to Q.52

iii. Where do we find fossils?

Ans : Sedimentary rocks, amber (yellowish fossils resin), ice, peat bogs etc. are where fossils are mostly found.

Q.39 What is Palaeontology? State the significance of palaeontology.

Ans :

- i. The study of ancient life with help of fossils is called palaeontology.
- ii. **Significance of Palaeontology:**
 - a. It is useful in reconstruction of phylogeny.
 - b. It helps in studying various forms and structures of extinct animals.
 - c. It provides record of missing link between two groups of organisms.
 - d. It helps in the study of habits of extinct organisms.
 - e. Palaeontology provides the following types of evidences.

Q.40 Explain the different types of fossils?

Ans : The types of fossils are as follows:

- i. **Actual remains:**
 - a. These are most common type of fossils.
 - b. The plants, animals and human bodies got embedded in permafrost of arctic or alpine snow remain preserved in the actual state, e.g. Woolly Mammoth in Siberia.
 - c. Amber or hardened resin contains preserved bodies of many insects and arthropods.
- ii. **Moulds:**
 - a. These are the hardened encasements formed in the outer parts of organic remains which later decayed leaving cavities.
 - b. Body parts of plants or animals later decays but the impression still remains and becomes permanent.
 - c. For example Foot – prints are formed in this manner.
- iii. **Cast:** They are hardened pieces of mineral matter deposited in the cavities of moulds.
- iv. **Compressions:** Internal structure is absent but

a thin carbon film indicates the outline of external features.

Q.41 Give the significance of fossils.

Ans :

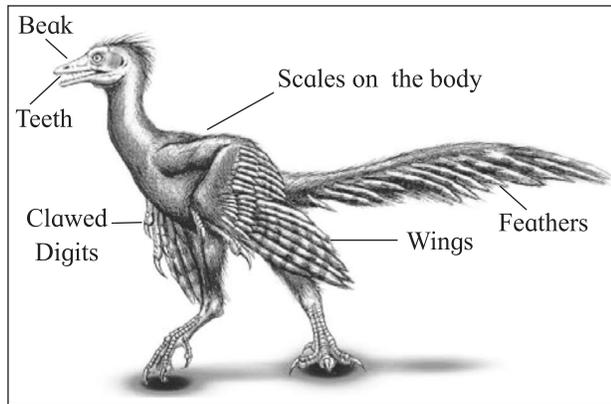
- i. Age of fossils can be found out by relative dating and absolute dating
- ii. Relative dating is the science determining the relative order of past events without necessarily determining their absolute age.
- iii. The approximate age of fossil can be determined by comparing it to similar rocks and fossils of known ages.
- iv. In absolute dating the precise age of the fossil can be determined by carbon dating method.
- v. Study of fossil can be used in paleontology and anthropology to obtain information of their ancestors and determining fossils age.

Q.42 Explain, Archaeopteryx is called the connecting link between reptiles and aves.

Ans :

- i. It is fossilized crow size toothed bird found from jurassic rocks in Germany.
- ii. It is known as missing link between reptiles and birds because it shows characters of both.
- iii. **Reptilian characters:**
 - a. Presence of long tail, claws and scales on the body.
 - b. Single headed ribs.
 - c. Abdominal ribs are present which look like ribs of crocodile.
 - d. Jaws with homodont teeth.
 - e. Sternum without keel.
 - f. Bones are solid (nonpneumatic).
 - g. Hind limbs had four clawed digits.
- iv. **Avian characters:**
 - a. Feathery exoskeleton.
 - b. Forelimbs are modified into wings.
 - c. Jaws are modified into beak.
 - d. Skull bone is completely fused.
 - e. Large rounded cranium.
 - f. Cranium with large orbits and a single condyle.
 - g. Limb bones are bird like.
 - h. Hind limbs with four toes first toe is opposable.
- v. Thus from the above study it is very clear that

birds evolved from reptiles. Huxley justified this by calling **birds as glorified reptiles.**



Q.43 Activity

Complete the following chart.

Ans :

	Animals	Connecting link between
i.	Balangoglossus	
ii.		Annelida and arthropoda
iii.	Lung fishes	
iv.		Reptiles and Mammals
v.	Seymouria	
vi.	Ichthyostega	Fishes and amphibia

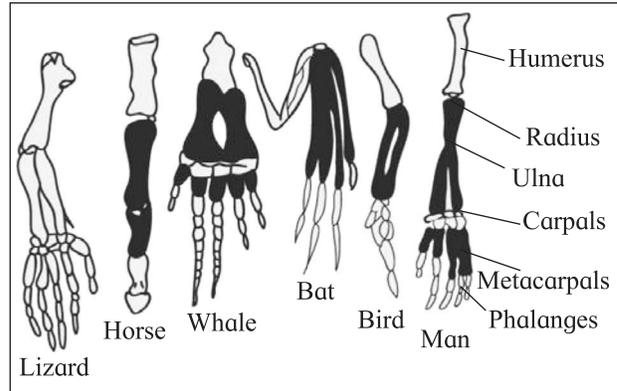
	Animals	Connecting link between
i.	Balangoglossus	<i>Chordates and Non-chordates</i>
ii.	<i>Peripatus</i>	Annelida and arthropoda
iii.	Lung fishes	<i>Fishes and Amphibians</i>
iv.	<i>Platypus</i>	Reptiles and Mammals
v.	Seymouria	<i>Amphibians and Reptiles</i>
vi.	<i>Ichthyostega</i>	Fishes and amphibia

Q.44 Write a note on homologous organs.

Ans :

- i. Homologous organs are those organs, which are structurally similar but perform different functions.
- ii. For example:
 - a. Forelimbs of vertebrates such as lizzard, bird, bat, horse, whale and man, all of them have humerus, radius-ulna, carpals, metacarpals and phalanges in their forelimbs. Forelimbs of these vertebrates are structurally similar but perform different functions.

- b. Vertebrate heart and brain.
- c. In plants, thorns of Bougainvillea and tendrils of cucurbita represent homology.
- iii. The structural similarities between the homologous organs indicates that they have a common ancestry.
- iv. Differences in homologous organs are examples of divergent evolution or adaptive radiation.



INTEXT

Q.45 Can you tell?

**What are hemologus organs or
★What are homologous organs.**

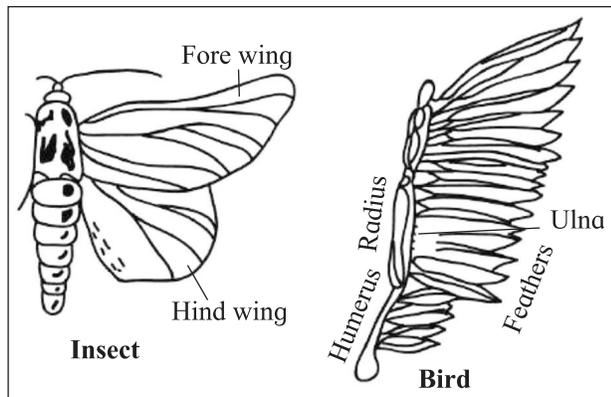
Ans : Refer Q.43.

Q.46 Write a note on analogous organs and state its examples.

Ans :

- i. Analogous organs are those which are structurally dissimilar but functionally similar.
- ii. These organs have external superficial similarity due to similar functions but they are different anatomically.
- iii. Analogous organs leads to convergent evolution i.e. different organisms shows same superficial structural similarities due to similar functions or habitat.
- iv. These organs do not help to trace the common ancestry.
- v. Thus analogous organs do not have significant role in evolution.
- vi. For e.g. wings of butterfly (insects) and of birds look superficially alike but they are no anatomically similar structures though they perform similar functions.

- vii. Other examples of analogous organs.
1. Eye of the octopus (mollusca) and of mammals. They differ in their retinal position, structure of lens and origin of different eye parts.
 2. The flippers of penguins (birds) and dolphins (mammals).
 3. Sweet potato (root modification) and potato (stem modification) store food in form of starch.



★ Q.47 Would you consider usings of butterfly and bat as homologous or analogous and why?

Ans : Wings of butterfly and bat are analogous but not homologous.

Refer Q.45 (vi).

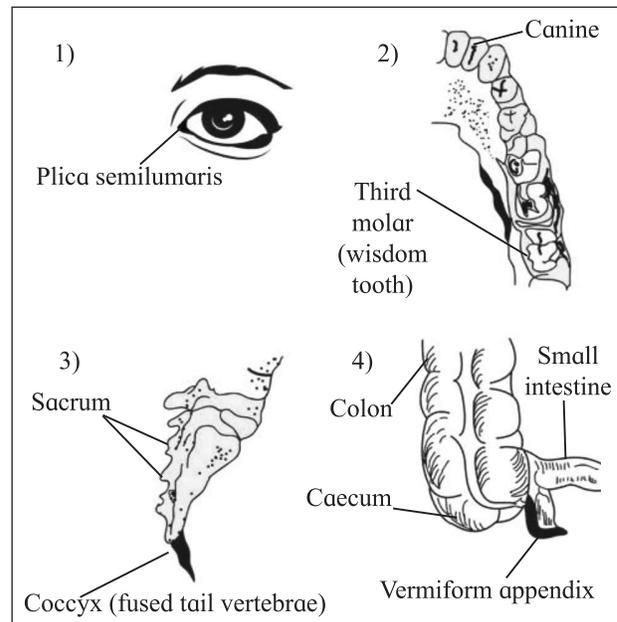
Q.48 Write a detailed note on Vestigial organs.

Ans :

- Vestigial organs or Rudimentary organs are imperfectly developed and non-functional, degenerate structures which were functional in some related and other animals or in ancestors.
- The vestigial organs are no longer required by the organism but indicate the relationship with those organisms where these organs are fully developed.
- Examples : Human beings show some vestigial organs like -
 - a. Presence of vestigial nictitating membranes.
 - b. Presence of wisdom teeth (third molars).
 - c. Coccyx (tail bone): It is greatly reduced in man since the tail is of no use due to erect posture.
 - d. Vermiform appendix and the caecum. It

is functional in herbivorous mammals for digestion of cellulose. In man due to eating of cooked food it has lost its function.

- iv. Presence of these vestigial organs provide evidence that man has (evolved) descended from simple primates.



Q.49 What is Vestigial organ?

Ans : Vestigial organs or Rudimentary organs are imperfectly developed and non-functional, degenerate structures which were functional in some related and other animals or in ancestors.

Q.50 Can you tell?

i. What is embryology.

Ans : Embryology is a branch of biology that deals with the study of different stages of development of an embryo.

ii. Can you recall?

Give examples of embryological evidences studied in lower classes.

Ans :

- Embryological evidences arise from comparative study of embryological development stages of various vertebrates.
- Embryos of different vertebrates appear similar during the initial stages of development and these similarities gradually

- decrease as the embryo develops.
- iii. Examples of embryological evidence include similarities in embryological developmental stages of vertebrates like fish, salamander, tortoise, chicken, pig, cow, rabbit and man.

Q.51 Write a note on molecular evidences of evolution.

Ans :

- i. Cell is the basic structural and functional unit of life in all organisms.
- ii. Similarities in proteins and genetic material performing a similar function among diverse organisms gives evidence of a common ancestry.
- iii. Basic metabolic activities also occur in a similar manner in all organisms.
- iv. ATP is the energy source in all living organisms.

Q.52 Can you tell? What is carbon dating and how does it work?

Ans :

- i. Carbon dating is a method used to calculate the time passed since the death of a plant or animal.
- ii. The carbon consumption of animals and plants steps after death and since then, only the decaying process of C-14 occurs continuously.
- iii. In case of dead bodies of plants and animals instead of remaining constant, the ratio between C-14 and C-12 changes continuously as C-12 is non-radio active.

5.11 Speciation

TEXTUAL

★ Q.53 Define Speciation.

Ans : The process of formation of a new species from the per-existing species is called speciation.

Q.54 Define Species.

Ans : Species is a group of similar organisms that can interbreed and produce a fertile offspring in nature.

Q.55 What are different modes of speciation.

Ans : Following are modes of speciation:

1. Intraspecific Speciation:

i. Allopatric speciation:

- a. Formation of a new species due to separation of a segment of population from the original population by distanced or a geographical barrier cutting across the species range. e.g. creeping glaciers, development of mountains.
- b. Migration of individual also causes allopatric speciation.
- c. The mode of evolution here is called adaptive radiation e.g. 14 different species of finches in Galapagos islands and several marsupial species in the Australian continent.

ii. Sympatric speciation:

- a. Formation of species within single population without geographical isolation.
- b. These are formed due to reproductive isolation. e.g. *Cichlid* fishes in Lake Victoria.
- c. Mutations are helpful in sympatric speciation.

2. Interspecific Speciation :

i. Hybridisation :

- a. Two different species on crossing may give rise to a new species. e.g. Mule is a hybrid produced by interbreeding between a male donkey and a female horse.
- b. Hinny is offspring of male horse and female donkey.

5.12 Geological time scale

Q.56 What is geological time scale.

Enlist the major geological events that occurred in the pas.

Ans :

- i. Geological time scale is used to understand the sequence of events that to place on the earth in different ages over a period of time.
- ii. It is divided into six major 'Eras' Eras ended with major environmental changes on earth resulting into extinction and emergence of

- new species.
- iii. The eras are further divided into periods and epochs based on minor but landmark events in each era.
 - iv. The first life appeared on the earth some 2000 million years ago. It took billions of years for this process to take place. Once formed the living forms diversified into various groups.
 - v. Life began in the sea water and plants were the first living beings to adapt to terrestrial life.
 - vi. Fishes evolved and diversified. The lobe fin group of fishes too got diversified. Some developed stout and strong fins and could go to land and come back to water.
 - vii. The coelocanth was considered a **living fossils**.
 - viii. Reptiles evolved from amphibians. They are the first true land vertebrates.
 - ix. 200 million years ago (mya) some reptiles moved back to aquatic mode of life and gained fish like form as seen in *Ichthyosaurs*.
 - x. The giant reptiles like Dinosaurs dominated the earth around 65 mya but are now extinct.
 - xi. Decline of giant reptiles marked the beginning of dominance of mammals. These viviporous organisms were more intelligent. They could avoid danger.
 - xii. Early mammals were small shrew like organisms, but this group **diversified**.
 - xiii. Whales, dolphins, seals and sea cow live in water, bats are the flying mammals, Kangaroo rats are fossorial, lemurs are arboreal.
 - xiv. Major physical disturbances led to phenomenon like the **continental drift** i.e. continents moved from their original place.
 - xv. As a consequence when south America joined north America, ancestral forms of horse, hippos, rabbits, etc. native to south America were dominated by north American animals.
 - xvi. At the same time, marsupial diversified into different habitats in Australia. These survived due to lack of competition.

INTEXT QUESTION

Q.57 Dinosaurs become around 65 million years

ago! Why it must have happened? Can we give affirmative reason for this extinction? At around the same time giant ferns were present on earth. However, they also become extinct and got converted to fossil fuels. How this must have happened?

Ans :

- i. There are various theories for dinosaurs extinction.
- ii. **Extinction of giant ferns:**
 - a. At the end of the Triassic around 201 million years ago, three out of four species of ferns on Earth disappeared. Until now, scientists believed the cause of the catastrophe to be the onset of large-scale volcanism resulting in abrupt climate change. However recently, an international research team has found a contributing cause: poisoning by mercury emitted by the volcanoes.
 - b. Be careful study of fern spores in sediments from the mass extinction, it was evident that these ferns were negatively affected by the mercury levels. Since mercury is accumulated in the food chain, it seems likely that other species have suffered as well.
 - c. Studies suggest that the end-Triassic mass extinction was not just caused by greenhouse gases from volcanoes causing global climate change, but that they also emitted toxins such as mercury.

TEXTUAL

***Q.58 Which period is known as “age of Reptilia”.**

Ans : Jurassic period is known as age of Reptilia.

Q.59 Write a note on events that occurred in plant and animals life in Mesozoic era.

Ans :

- i. **Plant life :**
 - a. **Triassic period:** Dominance of gymnosperms extinction of seed ferns.
 - b. **Jurassic Period:** Origin of angiosperms Dominance of lycophytes, ferns, conifers, cycads.
 - c. **Cretaceous Period:** Decline of ferns-sphenopsids (horsetails) and

Gymnosperms Ginkos, Gnetales. 1st appearance of flowering plants.

- ii. **Animal life:**
- Triassic period:** Appearance and rise of dinosaurs. Extinction of primitive amphibians. Diversification of reptiles. Rise of oviparous mammals. Therapsids, diversification of flies.
 - Jurassic Period:** Age of reptiles. Dinosaurs dominant, Appearance of toothed birds (Archaeopteryx) Rise of marsupials.
 - Cretaceous Period:** Extinction of Dinosaurs and toothed birds. Appearance of placental mammals and first modern birds.

Q.60 Complete the chart.

	Era	Dominating group of animal
i.	Cenozoic	
ii.		Reptiles
iii.	Palaeozoic	
iv.		Invertebrates

Ans :

	Era	Dominating group of animal
i.	Cenozoic	Mammals
ii.	Mesozoic	Reptiles
iii.	Palaeozoic	Amphibians
iv.	Palaeozoic	Invertebrates

Q.61 Internet my friend.

You may gather information out of curiosity about geological events occurred in the past.

Ans : Refer to Q.

5.13 Human Evolution

Q.62 Write a short note on the following:

- Dryopithecus
- Ramapithecus
- Australopithecus
- Homo habilis
- Homo erectus
- Neanderthal man
- Homo-sapiens

Ans :

- Dryopithecus:**
 - It has Ape like appearance.

- The site of fossil record of Dryopithecus is Lake victoria of Africa, Haritalyanga, Himachal Pradesh.
- It lived in Miocene epoch 20-25 mya.
- They had semi erect posture.
- Their special features are close similarity to chimpanzee.

ii. **Ramapithecus:**

- It has Man like appearance.
- The site of fossil record of Ramapithecus is Shivalik Hills in Indian and even in Kenya.
- It lived in Miocene and early pliocene epoch 14-12 mya.
- They had erect posture.

iii. **Australopithecus:**

- It has connecting link between Ape and man appearance.
- The site of fossil record of Australopithecus is Toug in South Africa, Ethiopia, Tanzania.
- It lived in late pliocene or early pleistocene epoch about 4-1.8 mya.
- They were not taller than 4 feet, jaws larger, prognathus face, chin absent, lumbar curvature present.
- They had upright posture.
- They had a cranial capacity of 450 to 600 cc.
- Their special features are man with ape brain.

iv. **Homo habilis:**

- It has handy man like appearance.
- The site of fossil record of Homo habilis is Tanzania in Africa.
- It lived in late pliocene or early pleistocene 2.5 to 1.4 mya.
- They were lower jaw, lightly built, dentition more like modern man, smaller molars.
- They had erect posture.
- They had a cranial capacity of 650 to 800 cc.
- Their special features are probably did not eat meat, made tools from stones, nicknamed handy man.

- v. **Homo erectus:**
- It has Ape man like appearance.
 - The site of fossil record of Homo erectus is Java and peking
 - It lived in middle of pleistocene epoch 1.5 mya ago.
 - They were 5 feet in height prognathus face massive jaws, Huge teeth, chin absent, Bony eye brow ridges present.
 - They had erect posture.
 - They had a cranial capacity of 900 cc.
 - Their special features are probably ate meat omnivorous might have used fire.

- vi. **Neanderthal man:**
- It has advanced prehistoric man appearance.
 - The site of fossil record of Neanderthal man is Neanderthal valley, Germany.
 - It lived in Late pleistocene epoch 100000 to 40000 years ago.
 - They were heavy built short prominent brow ridges low forehead, deep jaws, chin absent, outwardly curved thigh bones.
 - They had erect posture.
 - They had a cranial capacity of 1400 cc.
 - Their special features are used hide, buried their dead, constructed flint tools.

- vii. **Homo-sapiens:**
- It has modern man appearance.
 - The site of fossil record of Homo-sapiens is Africa.
 - They had erect posture.
 - They had a cranial capacity of 1450 cc.
 - Their special features are developed distinct races. Developed cave art about 18000 years ago.

Q.63 Use your brain power.
Since your earlier school days, you have been solving mysteries/puzzles labelled as use your brain power. Did you ever wonder why human brain has such a capacity? Why and how we evolved along these lines? What is the extent of similarity between humans, chimpanzees and monkeys?

Ans :

- As early humans faced new environmental challenges and evolved bigger bodies, they evolved large and more complex brains.
- The large and complex brains could process and store a lot of information which was an advantage to early humans in their social interactions and encounters with unfamiliar habitats.
- It is believed that over the course of human evolution, brain size tripled.
- The modern human brain is the largest and most complex of any living primate.
- From 6-2 million years ago, early humans began to walk upright and make simple tools. During this period the brain size increased, but only slightly.
- Further, from 2 million-800,000 years ago, early humans spread around the globe, encountering many new environments on different continents. These challenges, along with an increase in body size, led to a gradual increase in brain size.
- However, from 800,000-200,000 years ago human brain size evolved most rapidly during a time of dramatic climate change. Larger, more complex brains enabled early humans of this time period to interact with each other and with their surroundings in new and different ways. As the environment became more unpredictable, larger brains helped in survival of humans.
- There is a difference of only 2.5% between DNA of chimpanzee and man while between monkey and man it is 10%.

Q.64 Use your brain power.
Even though the cranium of elephant is larger than that of man, humans are considered more intelligent than elephant. Why is it so?

Ans :

- On an average elephants 'brains are three times larger than humans' brains and has much more neurons than humans do.
- However, size of cranium does not determine intelligence. Intelligence is mainly based on

- where the neurons are located.
- iii. Different parts of the brain have different concentrations of neurons.
 - iv. Despite having three times as many neurons, elephants only have a third as many neurons in their cerebral cortex.
 - v. Cerebrum is associated with higher cognitive functions and intelligence.
 - vi. The neurons in an elephants 'brain are concentrated in other areas, like the cerebellum which are linked to motor skills and sensory input.

Thus, even though the cranium of the elephant is larger than that of man, humans are considered more intelligent than elephants.

Q.65 Internet my friend.

- i. **Recently a fossil park has been established in Gadchiroli district of Maharashtra state. Find more information about Wadadham fossil park.**

Ans : The Wadadham Fossil Park is situated nearby a village Wadadham, Sironcha Taluka in Gadchiroli district of Maharashtra State.

This park is located 189 km towards the south from the district headquarter at Gadchiroli and 19 km from Sironcha.

A group of amateur archaeologists have unearthed fossils in the Sironcha in Gadchiroli district of Maharashtra's Vidarbha.

They claimed that these fossils date back millions of years and are believed to be of dinosaurs.

Sironcha is among the five places in the country where dinosaur fossils have been found in large numbers.

The Wadadham fossil park houses the fossils of flora that existed in the late Jurassic period, when Sauropods existed in the Indian subcontinent.

- ii. **Find out information about caves in India. One such place is in Madhya Pradesh. It is at Bhimbetka rock shelter in Raisen district. Here we can see cave paintings by prehistoric humans.**

Ans : Some of the vaces in India are as follows:

- i. **Ajanta Caves:** Ajanta caves is located approximately 100 km from Aurangabad. The paintings in the cave largely owe their existence to Mahayana sect of Buddhism. The life of Buddha is depicted in the form of portraits and illustrations.
- ii. **Ellora Caves:** These caves are situated around 18 miles from Aurangabad in Chamadari Hills. The paintings, present in these caves depict the supremacy of Lord Vishnu and Goddess Lakshmi.
- iii. **Elephanta Caves:** These caves are located in the Elephanta Islands of Maharashtra. These paintings were made around 8th century. Other notable caves with paintings located in Maharashtra are **Bhaja** caves, **Kanheri** caves, **Karsamble** caves and **Kuda** caves.
- iv. **Bhimbetka Cave:** This cave is located in Bhopal. The paintings of this cave represent wild animals like elephant, tiger, wild boar, bison, monkey, rhinoceros and others.
- v. **Lenyadri Caves:** Out of 40 different caves of this cave group, several caves have unique Buddhist paintings. These caves of Maharashtra served as thriving Buddhist temples upto 3rd century BC.
- vi. **Armamalai Caves:** These caves are located in the Vellore region of Tamil Nadu. This Jain cave temple of 8th century holds rock art, Jain paintings, remains of saints and others. Jain monks who stayed in the cave created these paintings, which are quite similar to Sittanavasal caves.
- vii. **Badami Caves:** These caves are located in Karnataka and belong to 6th century BC. The mural paintings of these caves were inspired by mythologies of Hindu religion. These are also paintings of other religions like Buddhism and Jainism.
- viii. **Adamgarh Hills:** This hill is located in Hoshangabad of Madhya Pradesh. The caves in these hills have a very ancient style of cave painting dating back to Paleolithic period. Madhya Pradesh was a favourable location for human habitation and hence there are

numerous paintings on the cave walls, which were symbol of their daily life style.

- ix. **Jogimara Caves:** Located in Chhattisgarh these caves possess one of the oldest cave paintings made in 1st century B.C. You can find paintings of non-religious elements like dancing humans, nature elements and others.

TEXTUAL QUESTION

Q.66 Think about it.

Human being is said to be most evolved, intelligent living being. Yet we are not self-sufficient. Think of various aspects for which we depend on other living beings for our survival.

Ans : Human beings depends on other living beings for various things for survival. Some of them are as follows:

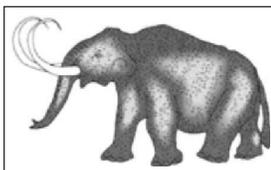
- i. Humans depend on plants and animals for their food.
- ii. Plants, microbes and animals are used as raw material/sources for medicines.
- iii. Diversity of plants and animals are used for industrial fibres, gums, spices, dyes, resins, oils, lumber, cellulose and wood biomass.
- iv. Animals are used in medical research, genetic research, drug safety testing, etc.
- v. Microbes are used in fermentation and production of food and beverages.
- vi. Animals are domesticated to carry loads, supply milk and for farm use.

Q.67 Activity

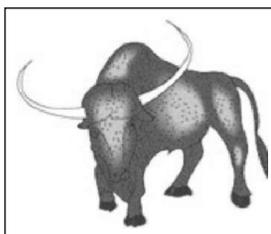
Collect the information about the organisms depicted in the following diagrams and write on the same.

i.

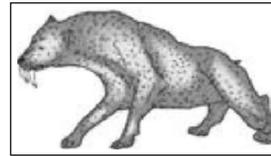
a.



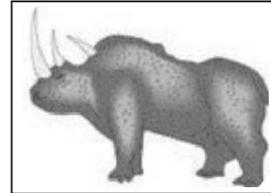
b.



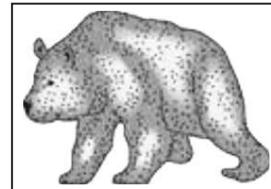
c.



d.



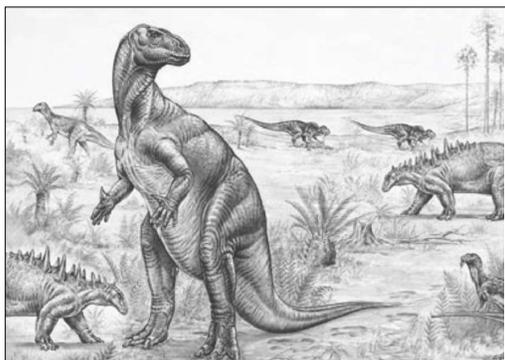
e.



Ans :

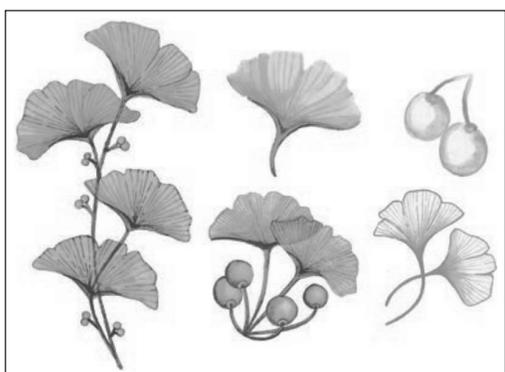
- a. **Mammoth:** This is the huge ancestor of the woolly coat elephant. A mammoth is any species of the extinct elephantid genus *Mammuthus* from the Pleistocene epoch.
- ii. **Long horned bison:** *Bison latifrons* (also known as the giant bison or long-horned bison) is an extinct species of bison that lived in North America during the Pleistocene epoch. This species of bison was the largest and heaviest to ever live in North America.
- iii. **Sabre-toothed tiger:** This was a large toothed predator. Sabre-toothed tiger (*Machairodontinae*) and modern house cats (*Felis catus*) shared a common ancestor. It was one of the best-recognized large mammals of the Pleistocene epoch.
- iv. **Woolly rhinoceros:** The woolly rhinoceros (*Coelodonta antiquitatis*) is an extinct species of rhinoceros that was common throughout Europe and northern Asia during the Pleistocene epoch and survived until the end of the last glacial period.
- v. **Giant short faced bear:** The giant short faced bear (*Arctodus Simus*) was among the most terrifying predators ever to appear on the North American continent. It lived at a time when the dire wolf, the American lion and the saber-toothed cat known as Smilodon prowled the landscape.

ii.



Ans : This picture represents dinosaurs that dominated the earth during the Jurassic period i.e. 135 to 165 mya. These dinosaurs became extinct during Cretaceous period of the Mesozoic era, about 65 million years ago.

iii.



Ans : This picture represents the leaves of *Ginkgo biloba* tree.

Ginkgo biloba evolved from the descendant of the plants of the Permian period in the Paleozoic era.

They are the only living representatives of the division Ginkgophyta.

There was a decline in the number of Ginkgo plants during the cretaceous period of the Mesozoic era.

□□□