# Origin and Evolution of Life

## EXERCISES [PAGES 117 - 118]

### Exercises | Q 1.01 | Page 117

**Multiple choice question.**

Who proposed that the first form of life could have come from per- existing nonliving organic molecules?

1. Alfred Wallace
2. **Oparin and Haldane**
3. Charles Darwin
4. Louis Pasteur

**Solution: Oparin and Haldane**

### Exercises | Q 1.02 | Page 117

**Multiple choice question.**

The sequence of origin of life may be-

1. Organic materials- inorganic materials – Eobiont- colloidal aggregates- cell.
2. **Inorganic materials – organic materials – colloidal aggregates – Eobiont- cell**
3. Organic materials- inorganic materials – colloidal aggregates - cell
4. Inorganic materials- organic materials – Eobiont- colloidal aggregates - cell

**Solution: Inorganic materials – organic materials – colloidal aggregates – Eobiont- cell**

### Exercises | Q 1.03 | Page 117

**Multiple choice question.**

In Hardy - Weinberg equation, the frequency of homozygous recessive individual is represented by:

1. $p^2$
2. pq
3. **$q^2$**
4. 2pq

**Solution: $q^2$**

**Exercises | Q 1.04 | Page 117**

**Multiple choice question.**

Select the analogous organs.

1. Forelimbs of whale and bat
2. **Flippers of dolphins and penguin**
3. Thorn and tendrils of Bougainvillea and Cucurbita.
4. Vertebrates hearts or brains.

**Solution: Flippers of dolphins and penguin**

**Exercises | Q 1.05 | Page 117**

**Multiple choice question.**

Archaeopteryx is known as missing link because it is a fossil and share characters of both

1. Fishes and amphibians
2. Annelida and arthropoda
3. **Birds and reptiles**
4. Chordates and nonchordates

**Solution: Birds and reptiles**

**Exercises | Q 1.06 | Page 117**

**Multiple choice question.**

Identify the WRONG statement regarding evolution.

1. Darwin's variations are small and directional
2. Mutations are random and nondirectional
3. Adaptive radiations leads to divergent evolution
4. **Mutations are non - random and directional**

**Solution: Mutations are non - random and directional**

**Exercises | Q 1.07 | Page 117**

**Multiple choice question.**

Gene frequency in a population remain constant due to –

1. Mutation

2. Migration
3. **Random mating**
4. Non- random mating

**Solution: Random mating**

**Exercises | Q 1.08 | Page 117**

**Multiple choice question.**

Which of the following characteristic is not shown by the ape?

1. Prognathous face
2. **Tail is present**
3. Chin is absent
4. Forelimbs are longer than hind limbs

**Solution: Tail is present**

**Exercises | Q 1.09 | Page 117**

**Multiple choice question.**

_____ can be considered as a connecting link between ape and man.

1. **Australopithecus**
2. Homo habilis
3. Homo erectus
4. Neanderthal man

**Solution: <u>Australopithecus</u>** can be considered as connecting link between ape and man.

**Exercises | Q 1.1 | Page 117**

**Multiple choice question.**

The cranial capacity of Neanderthal man was

1. 600 cc
2. 940 cc
3. **1400 cc**
4. 1600 cc

**Solution: 1400 cc**

## Exercises | Q 2.01 | Page 117

**Very short answer question.**

Define the Gene pool

**Solution:** The total genetic information encoded in the sum total of genes in a Mendelian population is called gene pool.

## Exercises | Q 2.01 | Page 117

**Very short answer question.**

Define the Gene frequency

**Solution:** The proportion of an allele in the gene pool, to the total number of alleles at a given locus, is called gene frequency.

## Exercises | Q 2.01 | Page 117

**Very short answer question.**

Define Organic evolution.

**Solution:** 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.

## Exercises | Q 2.01 | Page 117

**Very short answer question.**

Define Population.

**Solution:** According to this theory all individuals of the same species constitute a population.

## Exercises | Q 2.01 | Page 117

**Very short answer question.**

Define Speciation.

**Solution:** The process of formation of a new species from the pre-existing species is called speciation.

## Exercises | Q 2.02 | Page 118

**Very short answer question.**

What is adaptive radiation?

**Solution:**

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

### Exercises | Q 2.03 | Page 118

**Very short answer question.**

If variation occurs in a population by chance alone and not by natural selection and brings a change in frequencies of an allele. What is it called?

**Solution:**

If the variation in a population occurs by chance alone and not by natural selection and brings about a change in frequencies of an allele, it is called genetic drift.

### Exercises | Q 2.04 | Page 118

**Very short answer question.**

State the Hardy – Weinberg equilibrium.

**Solution:**

The Hardy-Weinberg equilibrium law states that ‘at the equilibrium point, both the gene (allele) frequency and genotypic frequency remain constant from generation to generation’.

### Exercises | Q 2.05 | Page 118

**Very short answer question.**

What are homologous organs?

**Solution:**

Homologous organs are those organs, which are structurally similar but perform different functions.

### Exercises | Q 2.06 | Page 118

**Very short answer question.**

What is vestigeal organ?

**Solution:**

Vestigeal organs or rudimentary organs are imperfectly developed and non-functional, degenerate structures that were functional in some related and other animals or in ancestors.

### Exercises | Q 2.07 | Page 118

**Very short answer question.**
What is the scientific name of the modern man?
**Solution:**

The scientific name of the modern man is Homo sapiens.

### Exercises | Q 2.08 | Page 118

**Very short answer question.**
What is coacervate?
**Solution:**

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

### Exercises | Q 2.09 | Page 118

**Very short answer question.**
Which period is known as “age of Reptilia”?
**Solution:**

Jurassic period is known as age of Reptilia.

### Exercises | Q 2.1 | Page 118

**Very short answer question.**
Name the ancestor of human which is described as a man with an ape brain.
**Solution:**

Australopithecus is the ancestor of humans which is described as a man with an ape brain.

## Exercises | Q 3.1 | Page 118

**Short answer question.**

Write a note on Genetic drift.

**Solution:**

1. Any alternation in allete frequency in the natural population by chance, is called genetic drift. e.g. Elimination of a particular allele from a population due to events like accidental death prior to mating of an organism.

2. The concept of genetic drift was first given Sewall Wright, and is hence also called as the Sewall Wright effect.

3. Genetic drifts are random or directionless.

4. The effect of genetic drift is more significant in small population than in large population.

5. Due to genetic drift, some alleles of a population are lost or reduced by chance and some others may be increased.

6. Sometimes, a few individuals become isolated from the large population and they produce a new population in a new geographical areas. The allele frequency of the new population becomes different. The original drifted population (i.e. colonizing ancestor/ pioneer) becomes ‘founders’ and the effect is called the founder effect.

7. A bottleneck 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.

## Exercises | Q 3.2 | Page 118

**Short answer question.**

Enlist the different factors that are responsible for changing gene frequency.

**Solution:**

The four major factors that are responsible for changing gene frequency are as follows:

**1. Gene flow (Migration):**

Gene flow is the 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). Thus, gene flow alters gene frequency causing evolutionary changes.

**2. 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 the elimination of particular alleles from a population. Smaller populations

have greater chances for genetic drift. Thus, genetic drift will result in the change in the gene frequency and has the potential to bring about evolutionary change.

**3. Natural selection:**

Natural selection is the process by which better adapted organisms grow and produce more offsprings in the population. It brings about evolutionary changes by favouring differential reproduction of genes that bring about changes in gene frequency from one generation to the next generation.

**iv. Mutations:**

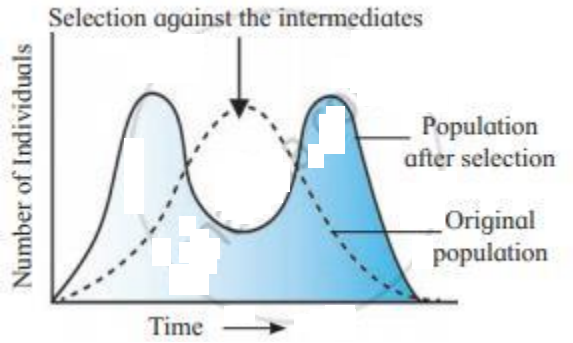
Sudden permanent heritable changes are called mutations. Mutation can occur in the gene, in the chromosome and in the chromosome number. Mutation that occurs within the single gene, is called point mutation or gene mutation or in a larger segment of genes by chromosomal aberrations. Both point mutations and chromosomal aberrations can alter gene frequency. Mutation leads to the change in the phenotype of the organism, causing variation.

## Exercises | Q 3.3 | Page 118

**Short answer question.**

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

**Solution:**




## Exercises | Q 3.4 | Page 118

**Short answer question.**

Give the significance of fossils.

**Solution:**

1. Fossils are the dead remains of plants and animals that lived in past in various geological layers.

2. The study of fossils provides the most convincing and direct evidence of evolution.

3. Study of fossils tells us that life forms were not the same millions of years ago (mya).

4. The geological time's scale is based on fossil records.

5. From the fossil records we can trace the complete evolutionary history of animals.

6. Study of fossils is an important aspect of evolution since it can be used in paleontology and anthropology for determining age of the fossils and deducing information about their ancestors.

## Exercises | Q 3.5 | Page 118

**Short answer question.**

Write the objections to Mutation theory of Hugo de Vries.

**Solution:**

Objections to Mutation Theory are as follows:

1. The large and discontinuous variations observed by Hugo de Vries were actually due to chromosomal aberrations. Gene mutations usually bring about only minor changes.

2. Rate of mutation is very slow as compared to the requirement of evolution.

3. Chromosomal aberrations have little significance in evolution as they are quite unstable.

## Exercises | Q 3.6 | Page 118

**Short answer question.**

What is disrruptive selection? Give example.

**Solution:**

1. Disruptive Natural selection is a selection in which more number of individuals acquire peripheral character value at both ends of the distribution curve.

2. In this selection, nature selects extreme phenotypes and eliminate intermediates.

3. This results in the formation of two peaks in the distribution of traits.

4. This kind of selection is rare.

5. It ensures the effect on the entire gene pool of a population, considering all mating types or systems.
e.g. Disruptive selection was observed in the different beak sizes of African seed cracker finches. The birds have different sizes of the beak and they feed on seeds. The available seeds were of two kinds i.e., small and large-sized seeds. Large beak sized birds feed on large seeds while small beak sized birds feed on small seeds and their number was increased. Intermediate beak sized birds were unable to feed on either type of seeds so their population decreased gradually and then were eliminated by natural selection.

## Exercises | Q 4 | Page 118

**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. Lamark | d. Theory of natural selection |

**Solution:**

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

## Exercises | Q 5.1 | Page 118

**Long answer question.**

Would you consider wings of butterfly and bat as homologous or analogous and why?

**Solution:**

The wings of butterfly and bat are analogous but not homologous.

Examples of analogous structures are as follows:

1. Wings of butterfly (insects) and of birds look superficially alike but they are not anatomically similar structures though they perform similar functions.

2. Eye of the octopus (mollusca) and of mammals. They differ in their retinal position, the structure of lens, and the origin of different eye parts.

3. The flippers of penguins (birds) and dolphins (mammals).

4. Sweet potato (root modification) and potato (stem modification) store food in form of starch.

## Exercises | Q 5.2 | Page 118

**Long answer question.**

What is adaptive radiation? Explain with suitable example.

**Solution:**

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

2. Darwin's Finches is one of the best examples of adaptive radiation. During his visit to Galapagos Islands, Charles Darwin also noticed a variety of small birds. These birds are now called Darwin's finches. Darwin concluded that the American mainland species of the bird was the original one from which they migrated to the different islands of Galapagos. These birds adapted to the different environmental conditions of these islands. From original seed-eating features, many other forms with altered beaks evolved into insectivorous features.

3. Another example of adaptive radiation is Australian Marsupials. In Australia, there are many marsupial mammals who evolved from a common ancestor.

## Exercises | Q 5.3 | Page 118

**Long answer question.**

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

**Solution:**

1. Natural selection encourages those genes or traits that assure the highest degree of adaptive efficiency between the population and its environment.

2. Industrial melanism is one of the best examples of natural selection.

3. In Great Britain, before industrialization (1845) grey white-winged moths (Biston betularia) were more in number than black-winged moth (Biston carbonara).

4. These moths are nocturnal and during the day time they rest on a tree trunk.

5. White-winged moths were camouflaged (hide in the background) well with the lichen-covered trees that helped them to escape from the predatory birds.

6. However, the black-winged moth resting on lichen-covered tree trunks were easy victims for the predatory birds and their number was reduced.

7. During the industrial revolution, large number of industries came up in Great Britain.

8. The industries released black sooty smoke that covered and killed the lichens growing on a tree and turn the tree black due to pollution.

9. This change became an advantage to the black-winged moths that camouflaged well with the black tree trunks and their number increased

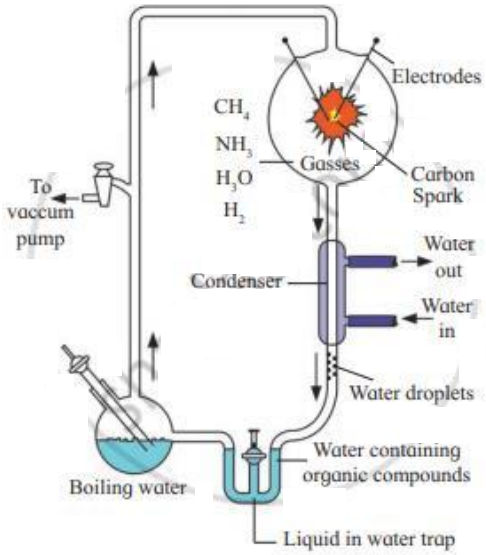
10. The white-winged moths however became victims to predatory birds due to which their number reduced. Thus, natural selection has resulted in the establishment of a phenotypic trait in the changing environmental conditions.

## Exercises | Q 5.4 | Page 118

**Long answer question.**

Describe the Urey and Miller experiment.

**Solution:**




Stanley L. Miller and his teacher Harold C. Urey provided the first experimental evidence in support of chemical evolution theory of Oparin.

**1. Apparatus and Procedure:**

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. A tube carrying water vapour was also connected to the chamber. The lightning effect was mimicked by the action of electric discharge in the chamber.
The process of evaporation and precipitation was also stimulated by the use of heating mantle and condenser respectively.
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.

**2. Observation:**

It was observed that the liquid collected in the U-tube turned brown.

**3. Results and Conclusions:**

Chemical analysis of this liquid reported the presence of simple organic compounds. (urea, amino acids, lactic acid, etc.). This experiment strongly supports that the simple molecules present in the Earth's early atmosphere combined to form the organic building blocks of life.

## Exercises | Q 5.5 | Page 118

**Long answer question.**

What is isolation? Describe the different types of reproductive isolations.

**Solution:**

Isolation is the separation of the population of a particular species into smaller units which prevents interbreeding between them. A barrier that prevents gene flow or exchange of genes between isolated populations, is called isolating mechanism. A 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:**

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 rivers, oceans, mountains, glaciers, etc. These barriers prevent interbreeding between isolated groups.

The separated groups are exposed to different kinds of environmental factors and they acquired new traits by mutations. The separated populations develop distinct gene pool and they do not interbreed. Thus, new species have been formed by geographical isolation. e.g. Darwin's Finches.

**2. Reproductive Isolation:**

Reproductive isolation occurs due to change in genetic material, gene pool and structure of genital organs. It prevents interbreeding between populations. Types of Isolating Mechanisms:

**a. Pre-mating or pre-zygotic isolating mechanism:**

This mechanism prevents fertilization and zygote formation.

i. Habitat isolation or (Ecological isolation): Members of a population living in the same geographic region but occupying separate habitats in such a way that potential mate do not meet.

ii. 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.

iii. Ethological isolation: Due to specific mating behavior the members of the population do not mate.

iv. Mechanical Isolation: Members of two populations have a difference in the structure of reproductive organs.

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

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

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

iii. Hybrid sterility: Hybrids develop to maturity but become sterile due to the failure of proper gametogenesis (meiosis).
e.g. Mule is an inter-generic hybrid that is sterile.

## Exercises | Q 5.6 | Page 118

**Long answer question.**

What are genetic variations? Explain the different factors responsible for genetic variations.

**Solution:**

Genetic variations: They are caused due to various aspects of mutation, recombination and migration. The change in gene and gene frequencies is known as genetic variation. Genetic variations are caused by the following factors:

**a. Gene Mutation:**
Sudden permanent heritable change is called a mutation. Mutation can occur in the gene, in the chromosome, and in the chromosome number. The mutation that occurs within the single gene is called point mutation or gene mutation.
Mutation leads to the change in the phenotype of the organism, causing variation.

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

**c. Gene flow:**
Gene flow is the 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.

**d. Genetic drift:**
Any random fluctuation (alteration) in allele frequency, occurring in the natural population by pure chance, is called genetic drift.
e.g. When the size of a population is severely reduced due to natural disasters like earthquakes, floods, fires, etc., it causes the elimination of particular alleles from a population. Smaller populations have greater chances for genetic drift. It will result in a

change in the gene frequency. Genetic drift is also an important factor for evolutionary change.

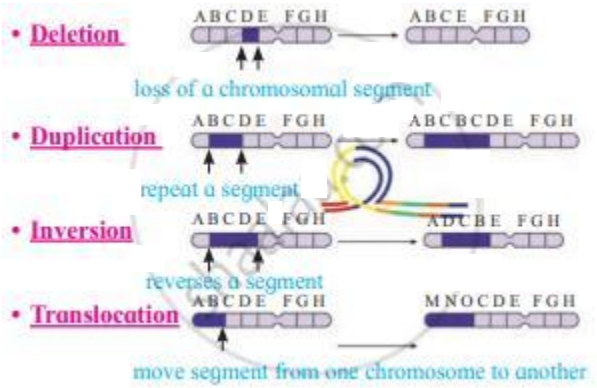
**e. Chromosomal aberrations:**
The structural and morphological change in chromosome due to rearrangement is called chromosomal aberrations. It changes the arrangement of the genes (order or sequence) that results in the variation.
Chromosomal aberrations occur due to the following reasons:

**1. Deletion:** Loss of genes from the chromosome.

**2. Duplication:** Genes are repeated or doubled in number on the chromosome.

**3. Inversion:** A particular segment of the chromosome is broken and gets reattached to the same chromosome in an inverted position due to 180° twists. There is no loss or gain of the gene complement of the chromosome.

**4. Translocation:** Transfer (transposition) of a part of a chromosome or a set of genes to a non-homologous chromosome is called translocation. It is affected naturally by the transposons present in the cell.




## Exercises | Q 6 | Page 118

**Long answer question.**

Complete the chart.

| Era | Dominating group of animal |
|---|---|
| 1. Cenozoic | _____ |
| 2. _____ | Reptiles |
| 3. Palaeozic | _____ |
| 4. _____ | Invertebrates |

**Solution:**

| Era | Dominating group of animal |
|---|---|

| | |
|---|---|
| 1. Cenozoic | **Mammals** |
| 2. **Mesozoic** | Reptiles |
| 3. Palaeozic | **Amphibians** |
| 4. **Palaeozoic** | Invertebrates |