

## CHAPTER 6 - EVOLUTION

### 1 Mark Questions

- 1 The first life on earth originated in \_\_\_\_\_ (**water**).
  - 2 \_\_\_\_\_ published the book "Origin of species by Natural Selection" in 1859. (**Charles Darwin**)
  - 3 Theory of mutation was the contribution by \_\_\_\_\_. (**Hugo de Vries**)
  - 4 The phenomenon of "Industrial Melanism" demonstrates \_\_\_\_\_. (**Natural selection**)
  - 5 Darwin's finches are an excellent example of \_\_\_\_\_. (**Adaptive radiation**)
  - 6 \_\_\_\_\_ proposed the Germplasm theory. (**August Weismann**)
  - 7 Evolutionary history of an organism is called \_\_\_\_\_. (**phylogeny**)
  - 8 The golden age of reptiles was \_\_\_\_\_. (**Mesozoic era**)
  - 9 \_\_\_\_\_ period was called "Age of fishes". (**Devonian**)
  - 10 Modern man belongs to \_\_\_\_\_ period. (**Quaternary**)
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### 2/3 Mark Questions

1. **Write short notes on Theory of Abiogenesis.**  
Living organisms originated from non-living organisms. It occurred through stepwise chemical and molecular evolution over millions of years.
2. **Write a brief account on scientific theory of Lamarck.**  
Organisms acquire new structures due to their adaptations to the changed environmental conditions. External conditions stimulate the somatic cells to produce certain secretions. They reach sex cells through blood and bring variations in the offspring.
3. **Write short notes on artificial selection?**  
It is the by-product of human's overexploitation of forests, fisheries and oceans. The long term use of pesticides, drugs and herbicides influences artificial selection. Man selected various types of dogs in 100 years.
4. **Trace the evolution of modern man.**  
*Homo sapiens* or modern human arose in Africa some 25,000 years ago and moved to other continents and developed into distinct races. They had a brain capacity of 1300 - 1600 cc. They started cultivating crops and domesticating animals.

**5. Describe probionts.**

These are sphere shaped droplets that enclose a watery solution in the primordial sea. These are abiotically produced organic molecules. They maintained a chemical environment different from surroundings. Probionts are precursor of prokaryotic cells.

**6. What is Evolution?**

The term is used to describe heritable changes in one or more characteristics of a population of species from one generation to the other.

**7. Give the meaning of Analogous organs?**

Organisms having different structural patterns but similar functions.

**8. What are molecular clocks?**

A slight change occurs over time in conserved molecules such as DNA, RNA and Protein. They are often called molecular clocks. They serve as molecular evidences of evolution.

**9. Write about use and disuse theory.**

Organs that are used often will increase in size and those that are not used will degenerate. Eg. Neck in Giraffe/ Limbs in snake.

**10. What do you meant by Struggle for existence?**

Organisms struggle for food, space and mate. As these become a limiting factor, competition exists among the members of the population.

**11. What does Gene mutation refers to?**

It refers to changes in the structure of the gene. It is also called point mutation. It alters the phenotypes of organisms. It produces variations in the offspring.

**12. What is Gene flow?**

Movement of genes between individuals in a population is called gene flow.

**13. What is Genetic Drift?**

Allele frequencies of a small population change over generation due to chance.

**14. Write short notes on Genetic recombination?**

This is due to crossing over of genes during meiosis. It brings about genetic variations in the same species. It leads to heritable variations.

**15. What is Connecting link?**

The organism which possesses the characters of two successive different groups is called connecting link. Eg: Peripatus (It is a connecting link between Annelida and Arthropoda).

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**5 Mark Questions**

**1. Explain actual remains.**

The original hard parts such as bones, shells are preserved as such in the earth's atmosphere. This is the most common method of fossilization .when Marine animals die their hard parts such as bones, shells etc., are covered with sediments and are protected from further deterioration. The salinity in ocean

prevents decay. The sediments become hardened to form definite layers or strata. For example, Woolly Mammoth that lived 22 thousand years ago were preserved in the frozen coast of Siberia.

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**2. Explain embryological evidences of evolution.**

Different vertebrates originated from a common ancestor. Eg Embryos of Fish, Chick, Salamander, Human and Tortoise. The embryos of different species show structural similarities. They all start from a single cell the egg and pass through different stages. Egg - zygote - blastula - gastrula. This indicates that all these animals originated from common ancestor.

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**3. Explain Darwin's Natural Selection Theory.**

Ans: Page 97 (6.5.2)

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**4. Explain about the objections to Darwinism.**

- i. Darwin failed to explain the mechanism of variation.
  - ii. Darwinism explained the survival of the fittest but not the arrival of the fittest.
  - iii. He focused on small fluctuating variations that are mostly non-heritable.
  - iv. He did not distinguish between somatic and germinal variations.
  - v. He could not explain the occurrence of vestigial organs, over specialisation of some organs like large tusks in extinct Mammoths, oversized antlers in the extinct Irish deer etc.,
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**5. Explain the different types of selection.**

A) Stabilizing selection

- In a stable environment the organisms with average phenotypes survive. The organisms with extreme phenotypes from both the ends are eliminated.
- This is also known as centripetal selection.
- It operates in stable environment.
- Phenotype stability is maintained.
- There is no speciation.

B) Directional selection

- It removes individuals from one end towards the other end of phenotype distribution.
- It happens in an environment where there is a gradual change. Eg: There is a size different between male and female sparrows. Both look alike externally, but differ in body weight. Females show directional selection in relation to body weight.

C) Disruptive selection (Centrifugal selection)

- The organisms of both extreme phenotypes are selected whereas the average phenotype organisms are eliminated.
- This occurs when homogenous environment changes to heterogeneous environment.

- This results in splitting of the population into subspecies or species.
- It is also called adaptive radiation. This is a rare form of selection. (Eg. Darwin's finches) (Page 101, Fig. 6.7)

### 5. Explain Hardy Weinberg Equilibrium concept.

The allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination and natural selection.

Evolution is a change in the allele frequencies in a population over time. Hence population in Hardy Weinberg is not evolving. A large population of beetles appear in two colours dark grey (black) and light grey and their colour is determined by 'A' gene. 'AA' and 'Aa' beetles are dark grey and 'aa' beetles are light grey. 'A' allele has frequency (p) of 0.3 and 'a' allele has a frequency (q) of 0.7 Then  $p+q=1$ .

If a population is in Hardy Weinberg equilibrium, the genotype frequency can be estimated by Hardy Weinberg equation

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

$$p = 0.3, q = 0.7$$

$$p^2 = (0.3)^2 = 0.09 = 9\% \text{ AA}$$

$$2pq = 2 (0.3) (0.7) = 0.42 = 42\% \text{ Aa}$$

$$q^2 = (0.7)^2 = 0.49 = 49\% \text{ aa}$$

Hence the beetle population appears to be in Hardy Weinberg equilibrium.

Factors affecting the Hardy Weinberg law are Gene flow, Mutation, Crossing over and Natural selection.

### 6. Explain the assumptions of Hardy-Weinberg equilibrium.

**No mutation** - No new alleles are generated by mutation nor the genes get duplicated or deleted.

**Random mating** - Every organism gets a chance to mate and the mating is random with each other with no preferences for a particular genotype.

**No gene flow** - Neither individuals nor their gametes enter (immigration) or exit (emigration) the population.

**Very large population size** - The population should be infinite in size.

**No natural selection**- All alleles are fit to survive and reproduce.

### 7. Differentiate convergent and divergent evolution.

Convergent Evolution	Divergent Evolution
Analogous structures bring about convergent evolution.	Homologous structures bring about divergent evolution.
Analogous structures have different structural patterns but similar function.	Homologous structures are similar in origin but perform different functions.
Ex: Eyes of octopus, mammals, flipper of penguin, dolphin.	Ex: Forelimbs of vertebrates have anatomical similarity.

## 8. What is fossilization? Explain the methods of fossilization.

It is the process by which plant and animal remains are preserved in sedimentary rocks. i) Actual remains, ii) Petrification and iii) Natural moulds and casts.

### i) Actual remains:

- The original hard parts such as bones, teeth or shells are preserved as such in the earth's atmosphere.
- This is the most common method of fossilization. When marine animals die, their hard parts such as bones, shells, etc., are covered with sediments and are protected from further deterioration.
- They get preserved as such as they are preserved in vast ocean; the salinity in them prevents decay.
- The sediments become hardened to form definite layers or strata.
- Eg., Woolly Mammoth that lived 22 thousand years ago in the frozen coast of Siberia, several human beings and animals living in the ancient city of Pompeii.

### ii) Petrification:

- When animals die the original portion of their body may be replaced molecule for molecule by minerals and the original substance being lost through disintegration.
- This method of fossilization is called petrification.
- The principle minerals involved in this type fossilization are iron pyrites, silica, calcium carbonate and bicarbonates of calcium and magnesium.

### iii) Natural moulds and casts:

- Even after disintegration, the body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones.
- Such impressions are called moulds.
- The cavities of the moulds may get filled up by hard minerals and get fossilized, which are called casts.

### Coprolites:

- Hardened faecal matter termed as coprolites occur as tiny pellets.
- Analysis of the coprolites enables us to understand the nature of diet the pre-historic animals thrived on.

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## 9. Describe Urey-Miller experiment.

- **Urey and Miller (1953)**, paved way for understanding the possible synthesis of organic compounds that led to the appearance of living organisms.
- In their experiment, a mixture of gases was allowed to circulate over electric discharge from a tungsten electrode.
- A small flask was kept boiling and the steam emanating from it was made to mix with the mixture of gases (ammonia, methane and hydrogen) in the large chamber that was connected to the boiling water.
- The steam condensed to form water which ran down the 'U' tube.
- Experiment was conducted continuously for a week and the liquid was analysed.
- Glycine, alanine, beta alanine and aspartic acid were identified.

- Thus Miller's experiments had an insight as to the possibility of abiogenetic synthesis of large amount of variety of organic compounds in nature from a mixture of sample gases in which the only source of carbon was methane.
- Later in similar experiments, formation of all types of amino acids, and nitrogen bases were noticed. (Page 93, Fig: 6.1).

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#### 10. Trace the evolutionary history of Homosapiens (Human)

Human Race	Characters
<b>Homosapiens</b> (25,000 years ago)	<ul style="list-style-type: none"> <li>• Modern man - Arose in Africa</li> <li>• Brain capacity is 1300 - 1600 cc</li> <li>• Started cultivating crops and domesticating animals</li> </ul>
<b>Cromagnon</b>	<ul style="list-style-type: none"> <li>• Ancestors of modern Europeans - France</li> <li>• Known for their painting, figures on floors, walls</li> </ul>
<b>Neandarthal</b> (34,000 to 1,00,000 years ago)	<ul style="list-style-type: none"> <li>• Used animal skin to protect their bodies</li> <li>• Buried their dead</li> <li>• Knew the use of fire</li> </ul>
<b>Homo erectus</b> (1.7 million years ago)	<ul style="list-style-type: none"> <li>• Human like appearance</li> <li>• Ate meat</li> <li>• Brain capacity was 900cc</li> </ul>
<b>Homo habilis</b> (2 million years ago)	<ul style="list-style-type: none"> <li>• Vegetarian, bipedal locomotion</li> <li>• Use tools of chipped stones</li> <li>• Brain capacity 650 - 800 cc</li> </ul>
<b>Australopithecus</b> (5 million years ago)	<ul style="list-style-type: none"> <li>• Lived in East African grassland</li> <li>• Ape like man, 1.5 meters tall, bipedal locomotion</li> <li>• Semi erect, omnivorous and cave dwellers</li> <li>• Brain capacity was 350 - 450 cc</li> </ul>
<b>Dryopithecus - Pre historic man</b> (14 million years ago)	<ul style="list-style-type: none"> <li>• Australopithecus, Sivapithecus and Ramapithecus evolved from this.</li> <li>• Body covered with hairs, vegetarian, walked like Gorillas.</li> </ul>