THE VILLAGE
INTERNATIONAL SCHOOL
"We Nurture Dreams"

CHAPTER 7
EVOLUTION – QB 2

1. State Hardy–Weinberg principle of genetic equilibrium. Knowing that genetic drift disturbs this equilibrium, mention what does this disturbance in genetic equilibrium leads to.
   Ans. Hardy–Weinberg principle states that gene pool remains constant, i.e., the allele frequencies in a population are stable and remains constant from generation to generation. Genetic drift refers to change in allele frequencies of a population occurring by chance. The change in allele frequency may be so different that the population becomes a different species. This effect is called founder effect.

2. What are analogous structures? How are they different from homologous structures? Provide one example for each.

S.No.	Homology	Analogy
(*i*)	Organisms having the same structure developed along different directions due to adaptations/ different functions.	Different structures having the same function (in different organisms).
(*ii*)	Result of divergent evolution.	Result of convergent evolution.
(*iii*)	Indicates common ancestry.	Does not indicate common ancestry.
(*iv*)	Anatomically same structures.	Anatomically different structures.
(*v*)	**Example:** Forelimbs of whale—bats—cheetah—human/ Thorns of *Bougainvillea* and tendrils of *cucurbits*	**Example:** Wings of butterfly and birds, Sweet potato and potato

3. What is adaptive radiation? (b) Explain with the help of a suitable example where adaptive radiation has occurred to represent convergent evolution. OR What is adaptive radiation? When can adaptive radiation be referred to as convergent evolution? Give an example.
   Ans. (a) The process of evolution of different species in a given geographical area starting from a point and radiating to other areas of geography (habitats) is called adaptive radiation (b) When more than one adaptive radiation occurs in an isolated geographical area (representing different habitats), it can be called as convergent evolution. For example, similarity between some individual members of placental mammals and marsupial mammals argues strongly that they are the result of convergent evolution. These animals have similar forms because of evolution in different, isolated areas because of similar selective pressures in similar environments. This means marsupials in Australia resemble placental mammals in the rest of the world. They evolved in isolation after Australia separated from other continents.

4. Explain adaptive radiation with the help of a suitable example. (b) Cite an example where more than one adaptive radiations have occurred in an isolated geographical area. Name the type of evolution your example depicts and state why it is so named.
   Ans. (a) Adaptive radiation can be observed in black birds of Galapagos islands, which are also called Darwin's finches. These birds evolved on the island itself from the original seed eating features. Many forms with offered beaks arose which enabled them to become insectivorous and vegetarian in different habitats of the island. (b) More than one adaptive radiation have occurred in Australian marsupials and placental mammals. The example depicts convergent evolution. It is named so, because more than one adaptive radiation occurred in isolated geographical area.

5. Evolution is a change in gene frequencies in a population in response to changes in the environment in a time scale of years and not centuries. Justify this statement with reference to DDT. How does the theory of Hugo de Vries support this?
   Ans. When DDT was used for the first time, maximum mosquitoes died but few survived due to variation in a population. These mosquitoes showed resistance to DDT and survived to reproduce successfully in the presence of DDT and gradually such mosquito population became DDT resistant within a time span of few years. According to Hugo de Vries, evolution is caused by sudden large differences in the population and not minor variations.

6. According to Darwinian theory of natural selection the rate of appearance of new forms is linked to the life-cycle or the life-span of an organism. Explain with the help of an example.
   Ans. A colony of bacteria (say A) growing in a given medium has built in variation in terms of ability to utilise a feed component, a change in the medium composition would bring out only that part of the population(say B) that can survive under the new conditions. In due course of time this variant population outgrows the others and appears as new species, thus organisms with shorter life-cycle or life-span will undergo evolution faster. For the same thing to happen in fish or fowl it would take millions of years as life spans of these animals are in years,

7. How does industrial melanism support Darwin's theory of Natural Selection? Explain.
   Ans. Before industrial evolution the environment was unpolluted. The lichens on the barks of trees were pale. The white-winged moths could easily camouflage, while the dark-winged were spotted out by the birds for food. Hence, they could not survive. After industrial revolution the lichens became dark (due to soot deposit). This favoured the dark-winged moths while the white-winged were picked by birds. The population of the former which was naturally selected increased.

8. $p2 + 2pq + q2 = 1$. Explain this algebraic equation on the basis of Hardy Weinberg's principle.

Ans. In a diploid if p represents the frequency of allele A and q represents the allele frequency of a, then frequency of AA individuals in a population is p2 . Similarly of aa is q2 and of Aa is 2pq. Hence p2 + 2pq + q2 = 1. This is a binomial expansion of (p+q) 2 . According to Hardy–Weinberg principle, total genes and their alleles in a population or gene pool remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1 [p+q = 1/(p+q) 2 = 1].

9. How does the Hardy–Weinberg's expression (p2 + 2pq + q2 = 1) explain that genetic equilibrium is maintained in a population? (b) List any two factors that can disturb the genetic equilibrium.
   Ans. (a) (i) Sum total of all the allele frequencies is 1: Let there be two alleles A and a in a population. The frequencies of alleles A and a are p and q, respectively. The frequency of AA individual in a population is p2 and it can be explained that the probability that an allele A with a frequency of P appear on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e., p2 . Similarly, the frequency aa is q2 and that of Aa is 2pq. p2 + 2pq + q2 = 1, where p2 represents the frequency of homozygous dominant genotype, 2pq represents the frequency of the heterozygous genotype and represents the frequency of the homozygous recessive. (ii) Genetic equilibrium states the status of evolution. If there is some fluctuation or disturbance in genetic equilibrium or Hardy–Weinberg equilibrium, i.e., change of frequencies of alleles in a population then it can predicted that evolution is in progress. (b) Factors that affect Hardy–Weinberg equilibrium: (i) Gene migration or gene flow (ii) Genetic drift (iii) Mutation

10. What is disturbance in Hardy-Weinberg genetic equilibrium indicative of? Explain how it is caused.
    Ans. Disturbance in Hardy-Weinberg equilibrium is an indicator of change of frequency of allele in a population, resulting in evolution. It is caused by any of the following factors: (i) Genetic drift (ii) Gene flow or gene migration (iii) Mutation (iv) Genetic recombination (v) Natural selection
11. Rearrange Ramapithecus, Australopithecus and Homo habilis in the order of their evolution on the Earth. Comment on their evolutionary characteristics.
    Ans. The order of evolution on the earth is: Ramapithecus → Australopithecus → Homo habilis Ramapithecus were hairy and walked–like gorilla and chimpanzees. They were more man like. Australopithecus hunted with stone weapons and ate fruit. Homo habilis had a brain capacity 650-800 cc and probably did not eat meat.

12. Write the characteristics of Ramapithecus, Dryopithecus, and Neanderthal man.
Ans. Ramapithecus: hairy, walked–like gorillas and chimpanzees, more man like. Dryopithecus: hairy, walked–like gorillas and chimpanzees, more ape-like. Neanderthal man: brain size is 1400 cc, used hides to protect their body, buried their dead

13. Name the ancestors of progymnosperm. (b) Name the ancestors of herbaceous and arborescent lycopod. (c) Name the ancestors of cycads.

Ans. (a) Psilophyton (b) Zosterophyllum (c) Progymnosperm

14. (a) What was proposed by Oparin and Haldane on origin of life? How did S.L. Miller's experiment support their proposal? (b) Which human chromosome has (i) maximum number of genes, and which one has (ii) fewest genes? (c) Write the scientific importance of single nucleotide polymorphism identified in human genome.
Ans. (a) Theory of chemical evolution or Oparin–Haldane theory: This theory states that life originated from pre-existing non-living organic molecules (e.g., RNA, protein, etc.). S.L. miller conducted an experiment where he created conditions similar to primitive atmosphere in a flask like high temperature, reducing atmosphere consisting of HCl, NH3, etc. When an electric discharge was created at 800°C, after a week, presence of amino acids and complex molecules like sugars, nitrogen bases, pigments, fats were observed in the flask. (b) Chromosome 1 has most genes (2968) and the Y chromosome has fewest genes (231). (c) This information promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.

15. How did Darwin explain adaptive radiation? Give another example exhibiting adaptive radiation. (b) Name the scientist who influenced Darwin and how?
Ans. (a) During his journey Darwin went to Galapagos Islands. There he observed an amazing diversity of creatures. Of particular interest were small black birds, later called Darwin's Finches which amazed him. He realised that there were many varieties of finches in the same island. All the varieties, he conjectured, evolved on the island itself. From the original seed-eating features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches. This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Darwin's finches represent one of the best examples of this phenomenon. Another example is Australian marsupials. (b) Thomas Malthus influenced Darwin. According to Malthus, population size grows exponentially (due to maximum reproduction). However, the population size remains limited due to limited natural resources which leads to competition.

16. Explain Darwinian theory of evolution with the help of one suitable example. State the two key concepts of the theory. (b) Mention any three characteristics of Neanderthal man that lived in near east and central Asia.
Ans. (a) According to Darwin, evolution took place by selection. The rate of appearance of new forms is linked to the life cycle at the life span. Some organisms are better adapted to survive in an otherwise hostile environment (Survival of the fittest). For example, antibiotic resistance in bacteria. When a bacterial population was grown on an agar plate containing antibiotic penicillin, the colonies sensitive to penicillin died, whereas the ones resistant to penicillin survived due to adaptation. Key concepts of the theory are (i) Branching descent (ii) Natural selection (b) Characteristics of Neanderthal man: (i) Their brain size was 1400 cc. (ii) They used hides to protect their bodies. (iii) They buried their dead.

17. Name the primates that lived about 15 million years ago. List their characteristic features. (b) (i) Where was the first man-like animal found? (ii) Write the order in which Neanderthals, Homo habilis and Homo erectus appeared on earth. State the brain capacity of each one of them. (iii) When did modern Homo sapiens appear on this planet?

Ans. (a) Primates called Dryopithecus and Ramapithecus lived 15 million years ago. Their characteristic features are: (i) They were hairy and walked like gorillas and chimpanzees. (ii) Ramapithecus was more man-like. (iii) Dryopithecus was more ape-like. (b) (i) First man-like animal was found in Ethiopia and Tanzania. (ii) The order of appearance from the earliest to the latest is: Homo habilis, Homo erectus, Neanderthals. The brain capacity of Homo habilis is 650–800 cc, of Homo erectus is 900 cc and of Neanderthals is 1400 cc. (iii) Modern Homo sapiens appeared between 75,000–10,000 years ago.

****